

Cooperative Learning for New College Teachers¹

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When Karl Smith started teaching engineering courses, he knew only one model to follow: stand up and lecture. He was the one with the knowledge, the students needed it; his job was to deliver the information to them. It didn't work very well. His students weren't getting it. He was very frustrated; jobs in industry began to look very attractive. But in seeking different ways to teach he took a course from one of David Johnson's students, where he was encouraged to work cooperatively with other students to learn the material. Cooperative learning brought back memories of work as an engineer, where teams of engineers (and others) divide complex problems into manageable parts for solutions, with everyone taking responsibility both for his/her own part and for the quality of the whole. Intrigued, he participated in Johnson Brother's cooperative learning workshops. Since then he has been practicing cooperative learning techniques in all of his courses. He currently serves as Associate Professor of Civil Engineering at the University of Minnesota and gives numerous workshops around the country on problem-based, cooperative learning, and creating supportive learning environments for all students. His email address is <ksmith@maroon.tc.umn.edu>.

Alisha Waller hated working in groups as an undergraduate. Instructors would assign group projects to be completed out of class. A perfectionist, Alisha would assume that no one else could do as well as she, so she would do all the work and share the credit. But she

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gradually realized that she works well with others—explaining herself to them, hearing their approaches, and working together to understand. Working with former colleague Karl Smith showed her that the group assignments she hated were fatally flawed: not enough structure, no training for participants, not enough accountability, not very cooperative. Since that realization, she has incorporated cooperative learning into her classes and has experienced tremendous increases in students' learning and in their positive feelings about working together. And she's having more fun. Today, Alisha is an Instructor in Mathematics and Computer Science at Macalester College, St. Paul, MN. Her email address is <WALLER@macalester.edu>.

Why bother actively engaging students? Because it's easier for the teacher? Because it's the fad? Engaging students with the academic material and with other students is important for learning. Actively engaged students learn more! Cooperative learning is one very effective way of getting students involved.

We have been using cooperative learning for many years and offer our guidance on getting started. We also clarify the differences between cooperative learning and simply putting students in groups; provide background and rationale for cooperative learning; summarize specific cooperative learning strategies to start with; discuss the types of cooperative learning groups; suggest procedures for developing skills and confidence for implementing cooperative learning; and open up the bigger picture of active and cooperative learning in the college classroom.

Support for Cooperative Learning

How do you learn best? What conditions, environment, circumstances, etc. make is easiest for you to learn? Please reflect for a moment. We have asked this question of thousands of faculty around the world. Usually we ask it in an informal cooperative learning format: *Formulate* an answer individually, *Share* your answer with a partner, *Listen* carefully to your partner's answer, and *Create* a new answer through discussion (or, alternatively, *Learn* your partner's response well enough to present it if you're called on). Typical responses include: "I learn best when it's something I'm interested in," "When I'm motivated to learn either through interest or need," "Through reading on my own and making notes," "Through expressing it in my own words, such as by writing a summary," "Through explaining it to someone else," "Through preparing to teach," "By doing it." Our surveys indicate that faculty prefer to learn in a variety of ways, most of them active. Very few faculty have said, "I learn best by listening to a lecture."

Who learns the most in the typical college classroom? Who is organizing, summarizing, and presenting? Who is elaborating, and providing rationale and justification? In other words, Who is actively involved? Who is having the most fun in the typical college classroom? Perhaps no one. Most likely, however, the professor is learning the most and having the most fun!

During the past 90 years nearly 600 experimental and over 100 correlational studies have been conducted 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 age subjects, in different subject areas, and in different settings. More is known about the efficacy of cooperative learning than about lecturing, departmentalization, the use of instructional technology, or almost any other aspect of education. The research reveals 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 (1991). A comprehensive review of all studies and meta-analyses of their results is available in Johnson & Johnson (1989).

McKeachie (1988) concludes that at least three elements of teaching make a difference in students' gains in thinking skills: (1) student discussion, (2) explicit emphasis on problem-solving procedures and methods using varied examples, and (3) verbalization of methods and strategies to encourage development of metacognition. He states, "Student participation, teacher encouragement, and student-to-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, especially in small classes, are superior to lectures in improving thinking and problem solving." (p. 81)

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).

Alexander Astin (1993) recently addressed the question, "What environmental factors make the biggest difference in college students' academic development, personal development, and satisfaction"? A longitudinal study was conducted of 27,064 students at 309 baccalaureate-granting institutions. This work represents the first attempt to study the impact of different approaches to general education on student development using a large national sample of undergraduate institutions and a wide range of student outcomes. He was primarily interested in the *outcomes* and in particular how they are affected by *environments*. One hundred ninety two environmental factors were investigated to determine which factors influenced students' academic achievement, personal development, and satisfaction with college.

Astin found that the particular manner in which the general education curriculum is structured makes very little difference for most of the 82 outcomes. Instead, Astin found that two environmental factors were, by far, most predictive of positive change. These two factors—interaction among students and interaction between faculty and students—carried by far the largest weights and affected more general education outcomes than any other environmental variables studied, including the curriculum content factors. Student-student interaction produced significant effects on 18 of the top 22 outcomes and student-faculty interaction produced significant effects on 17 outcomes.

In short, Astin says it appears that how students *approach* their general education and how the faculty actually *deliver* the curriculum is far more important than the formal curricular structure. More specifically, the findings strongly support a growing body of research suggesting

that one of the crucial factors in the educational development of the undergraduate is the degree to which the student is actively engaged or involved in the undergraduate experience. His research findings suggest that curricular planning efforts will reap much greater payoffs in terms of students' outcomes if we focus less on formal structure and content and put much more emphasis on pedagogy and other features of the *delivery system*, as well as on the broader interpersonal and institutional context in which learning takes place.

Intensive interviews with a randomly selected sample of Harvard undergraduates resulted in conclusions similar to Astin's. Richard Light (1992) wrote in the preface to the *Harvard Assessment Seminars: Second Report* (p. 6):

The biggest challenge for me is to ask what the details all add up to. Do the many suggestions that interviewers get from their long conversations with undergraduates drive toward any broad, overarching principle? Is there any common theme that faculty members can use to help students, and indeed that students can use to help themselves? *The answer is a strong yes. All the specific findings point to, and illustrate, one main idea. It is that students who get the most out of college, who grow the most academically, and who are the happiest, organize their time to include interpersonal activities with faculty members, or with fellow students, built around substantive, academic work.*

Experience is another important source of support for cooperative learning. For example, Harry Pence (of SUNY Oneonta) recently posted the following note to a teaching forum on the Internet:

I've used cooperative learning for five years in a variety of classes ranging in size from a dozen to a hundred. The vast majority of students have been extremely enthusiastic, including the best students I've had in each of those classes. . . Judging from my experience, a major barrier to using cooperative methods is the instructor. I've spent most of my career in higher education with the assumption that I was getting paid to organize and present information to students. Unfortunately, I realized rather late in the game that the real goal is not for me to learn how to organize information better, but for my students to learn that skill. As long as I do most of the work, and they only have to memorize what I have already processed, they are missing the most important skill to be gained from higher education, learning how to learn. I use a mixture of lecture, multimedia, and cooperative learning, so I still do some of the organization, but I have succeeded in transferring much more responsibility to the students.

After teaching a senior level engineering class using cooperative learning, Alisha asked her class to write for two to three minutes how they felt about cooperative learning. A few of their thoughts:

Learning to interact and work with other people in class was a good experience for working in the “real” world.

Cooperative learning is a valuable tool in pursuing higher levels of learning and performance. It is a must when maximum efficiency is truly desired.

It's too bad cooperative learning is not used earlier in educational systems. It really gives the students a chance to develop their strengths and fix their weaknesses. Students know what they do and don't know, and this gives them a chance to really take a controlling aspect of their education.

Implementing Cooperative Learning

"I've got so much to do! How can I write proposals to get my research program going, keep up with professional meetings, prepare my lectures, meet with students, *and* find time to learn how to do cooperative learning?" Concerns such as this are expressed by almost all beginning college faculty. You are not alone in feeling stressed. In the rest of this chapter, we will share some strategies for learning about and implementing cooperative learning in a series of small steps. The first step is to explore the meaning of cooperative learning a little further.

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. Cooperative learning in college classes involves small groups of students working together to achieve the common goal of maximizing their own and each others' learning. Cooperative learning shares many features with

collaborative learning (Bruffee, 1993) and team learning (Michaelson, Jones, Firestone, & Watson, 1993). Cooperative learning involves structured interaction among students within the college environment, especially within the classroom.

Many college faculty members have not had an opportunity to work as a member of a team either in the classroom or on the job. 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* (Katzenbach and Smith, 1993).

When they first hear about cooperative learning, many faculty tell us they already do that—they have students complete term projects together. Further exploration, however, reveals that although they do have students working in groups, the work is not cooperative learning. The table below summarizes some of the major differences between traditional learning groups and cooperative learning groups.

Traditional Learning Groups	Cooperative Learning Groups
Low interdependence. Members take responsibility only for themselves. Focus is on individual performance only.	High positive interdependence. Members are responsible for their own and each other's learning. Focus is on joint performance.
Individual accountability only.	Both group and individual accountability. Members hold themselves and others accountable for high quality work.
Little or no attention to group formation (students often select members). Groups typically large (5-10 members).	Deliberately formed groups (random, distribute knowledge/experience, interest). Groups are small (2-4 members).
Assignments are discussed with little commitment to each other's learning.	Members promote each other's success, doing real work together, helping and supporting each other's efforts to learn.

Traditional Learning Groups	Cooperative Learning Groups
Teamwork skills are ignored. Leader is appointed to direct members' participation.	Teamwork skills are emphasized. Members are taught and expected to use collaborative skills. Leadership shared by all members.
No group processing of the quality of its work. Individual accomplishments are rewarded.	Group processes quality of work and how effectively members are working together. Continuous improvement is emphasized.

No doubt you're saying "Cooperative learning involves a lot of structure!" Working effectively as a member of a team is quite complex and there is a lot that faculty can do to help students succeed. Providing a supportive structure is one of the most important things we can do. Many students have had bad experiences with groups. For example, they've been told to go off and work on a joint project without any class time to help them get organized or even to meet the other members of their group. As students' skills and competencies grow with repeated group experiences, faculty can turn more of the responsibility over to the student. Initially, however, many students appreciate the guidance provided by a carefully structured cooperative learning group.

Key Concepts in Structuring Cooperative Learning Groups

Students working together to get a job done in a classroom where students are concerned about each other's learning in addition to their own is the heart of cooperative learning. The conceptual approach to cooperative learning is characterized by five basic elements:

Positive Interdependence exists when students 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 a problem-solving session, positive interdependence is structured by group members (1) agreeing on the answer and solution strategies for each problem (goal interdependence) and (2) fulfilling assigned role responsibilities (role interdependence). Other ways of structuring positive interdependence include having common rewards, being dependent on each other's resources, or dividing labor.

Face-to-Face Promotive Interaction exists among students when students orally explain 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, and explain to each other the connections between present and past learning. This face-to-face interaction is promotive in the sense that students help, assist, encourage, and support each other's efforts to learn.

Accountability/Personal Responsibility requires the teacher to ensure that the performance of each individual student is assessed and the results are given back to the group and the individual. 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.

Teamwork Skills are necessary for effective group functioning. 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.

Group Processing involves a group discussion of how well they are achieving their goals and how well they are maintaining effective working relationships among members. At the end of their working period the groups process their functioning by answering two questions: (1) What is something each member did that was helpful for the group and (2) What is something each member could do to make the group even better tomorrow? Such processing enables learning groups to focus on group maintenance, facilitates the learning of collaborative skills, ensures that members receive feedback on their participation, and reminds students to practice collaborative skills consistently.

Many educators 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 part of a genuine cooperative learning group, members must be committed to a common goal, must promote each other's learning and success face-to-face, hold each other

personally and individually accountable to do a fair share of the work, 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.

Types of Cooperative Learning Groups

There are many ways to implement cooperative learning in college classrooms: informal cooperative learning groups that involve very little structure (typically small, short term, *ad hoc* groups); informal cooperative learning groups that contain more structure (such as the ‘bookends on a lecture’ format); formal cooperative learning groups that are highly structured and task oriented; and cooperative base groups that are long term formal groups created for student support and encouragement. 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 groups are commonly used in predominately lecture classes. 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

Informal groups are temporary, *ad hoc* groups that last for only one discussion or one class period. Their purposes are to focus student 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 an instructional session. For example, you may begin class by asking the students to take two minutes to review their notes from the last class and then pair up with someone sitting nearby. Together the students should come up with a question about the material. Often, this is much more effective in focusing students' attention and identifying confusion than the typical "Does anyone have any questions from last time? No? Then let's begin today's class. . ."

Informal cooperative learning groups may be used at any time, but are especially useful during a lecture or direct teaching before the students' eyes begin to glaze over. Some estimates of the length of time that people can attend to a lecture is around 12 to 15 minutes; students then need to process what they are learning or their minds drift away. During lecture, the instructional challenge for the teacher is to ensure that students do the intellectual work of organizing material, explaining it, summarizing it, and integrating it into existing conceptual networks. For example, Eric Mazur, a physics professor at Harvard, uses multiple choice, conceptual questions after each lecture segment which require the students to apply the new concepts or theories to real world hypothetical situation (*Thinking Together*, 1991). Breaking up lectures with short cooperative processing times will give you slightly less lecture time, but will enhance what is learned and build relationships among the students in your class. It will 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."

Here is a specific example of how one would incorporate an informal cooperative learning activity. When Alisha teaches *Introduction to Operations Research* in engineering (a mathematical modeling course), one of the biggest challenges is to help students understand the assumptions underlying the models. For each model category, she gives a mini-lecture on the assumptions and data requirements inherent in the model. The students pair up and develop a list of “real world” applications that fit the model requirements and a list of ones that *do not* fit the model. She then randomly calls on students (by drawing from a stack of index cards with their names) to share the lists they developed. This five minute activity helps the students develop a conceptual framework that is based on a comparative and network approach of a series of independent units of information.

When planning an informal cooperative learning exercise, answering the following questions will help you clarify your goals and structure.

- Who is interacting? Will students pair up with someone beside them? Or perhaps someone sitting behind/in front of them? Should they pair up with someone from a different background? Someone they don't yet know?
- When does the activity occur during the class? Beginning? Middle? End? How much time are you willing to spend on it?
- Will they write down their answers/ideas/questions? If they are asked to turn them in, should they put their names on them?
- Will you give individuals a minute or so to reflect on the answer before discussing it or will they just jump right into a discussion?
- Will you grade their responses or not?

- How will they share the paired work with the whole class?
- How will you share the feedback and insight you gain from their responses?
- If they are responding to a question you pose, how are you going to ensure that they leave with confidence in their understanding? (Often, if the various student answers are discussed without the instructor explicitly indicating which ones are right, students become frustrated. Even with a question that has no absolute right answer, students want to know the professor's stand on the question.)
- What preparation do you need to use the activity? What preparation do the students need in order to participate fully?

There are a variety of informal cooperative learning techniques professors can employ.

We use these four regularly.

Book ends on a lecture. The book ends procedure begins with a question or task that students work on individually and then in pairs. The purpose of this initial task is to focus students' attention and to try to spark their curiosity and engage them in dialogue. A brief lecture that addresses the question follows. After lecturing 10 to 12 minutes, give each student a chance to process the lecture intellectually with another student. You might ask each pair to construct relationships, make predictions, or create explanations. Continue the lecture, if appropriate, or engage the class in a discussion. Close the class period with a focused concluding discussion wherein the students are asked to create a summary of the main points. This procedure will help you plan a lecture that keeps students actively engaged intellectually.

Focused Organizing Discussion. Plan your lecture around a series of questions that the lecture answers. Prepare the questions on an overhead transparency or write them on the board

so that students can see them. Have students discuss the questions in pairs. The discussion task is aimed at promoting *advance organizing* of what the students know about the topic to be presented and *set expectations* about what the lecture will cover. For example, before the opening lecture on Shakespeare's Hamlet, ask students the following questions to be discussed in pairs. What does it do to your understanding of the play to read it through Ophelia's eyes? Do you agree with Hamlet's view of his mother's remarriage? Why or why not? How old does Hamlet seem to you as you read the play?

Turn-To-Your-Partner Discussions. Divide the lecture into 10 to 15 minute segments. This is about the length of time an adult can typically concentrate on a lecture. Plan a short discussion task to be given to pairs of students after each segment. The task needs to be short enough that students can complete it within three or four minutes. Its purpose is to ensure that students are actively thinking about the material being presented. The discussion task may be to:

- Summarize the answer to the question being discussed. Example: In kinesiology, what is the role of a heart rate monitor in determining training schedules?
- Solve a problem. Example: Integrate an equation by parts.
- Give a reaction to the theory, concepts, or information being presented. Example: In a lecture on Toni Morrison's novel *Beloved*, ask students to share how each feels when reading the climactic scene in which the central female character tries to kill her children to prevent their being retaken into slavery.
- Elaborate on the material being presented or relate material to past learning so that it is integrated into existing conceptual frameworks. Example: In an early lecture on

feminism in the 20th century ask these questions: How does the 20th century or second wave of feminist activity differ from the 19th century suffrage efforts? What are the chief issues around which feminist activism has organized itself? Who are the four leaders in the 20th century women's movement? To what extent has this movement been dominated by white, middle-class, heterosexual women and their issues? How can the 21st century effort be more inclusive?

- Predict or explain. Example: Conceptual questions in physics, such as “think about a ball that is spinning at the end of a string. If you release the string, what path does the ball follow? (a) curves in the direction it was spinning, (b) straight line, (c) curves in the opposite direction to the one it was spinning.” (See Hestenes, *et. al.*, 1992, for more details).
- Attempt to resolve the conceptual conflict the presentation has aroused. Example: In the Pacific Northwest, should the government preserve the forests for endangered species or should they permit timber harvesting?
- Hypothesize answers to the question being posed. Example: In an economics class discussing price elasticity, ask students to predict the changes in demand for Coca-Cola products in a region where Pepsi products are introduced.

Each discussion task should have four components: *formulate* an answer to the question being asked, *share* your answer with your partner, *listen* carefully to his or her answer, and *create* a new answer that is superior to each member's initial formulation through the process of association, building on each other's thoughts, and synthesizing. Students will need to gain some experience with this procedure to become skilled in doing it within a short period of time. *It is*

important to call on students to share their answers after each discussion task. Such individual accountability ensures that the pairs take the tasks seriously and check each other to ensure that both are prepared to answer.

Focused Concluding Discussion. Prepare an ending discussion task to summarize what students have learned from the lecture. The discussion should result in students integrating what they have just learned into existing conceptual frameworks. The task may also point students toward what the homework will cover or what will be presented in the next class session. This provides closure to the lecture.

Formal Cooperative Learning Groups

Once you have some experience with informal cooperative learning groups, you may want to extend the use of cooperative learning in your classes. Formal cooperative learning groups allow your students to gain the benefits of cooperative learning throughout the course. Formal groups can be very successful in helping students master complex course material, solve problems and reach consensual decisions, and support each other through difficult learning experiences. (For more detail about establishing formal cooperative learning groups, see Johnson, Johnson, & Smith, 1991.)

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 your class is probably ready for formal cooperative learning groups.

Formal cooperative learning groups may last from one class period to several weeks to complete specific tasks and assignments—e.g. learning new conceptual material, solving a specific problem or coming to a decision, 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:

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.

Make instructional decisions before the lesson commences. The professor should 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. First, keep groups small, especially at the beginning. Groups of two or three maximize members' involvement and help create a sense of interdependence and accountability. Second, choose the groups yourself. Random assignment works very well for many faculty. 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, perhaps even longer. But not forever; 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.

Explain the task and the learning strategies the group will employ. The professor should clearly define the assignment, teach the required concepts and strategies, specify the methods for positive interdependence and individual accountability, give the criteria for success, and explain the teamwork skill groups should employ.

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. Courses 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 student's grade is based on group work. Some faculty use the 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.

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 working together and completing the task 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 in working in the group. Typical things to look for are on-task interactions (what happens when someone says something?), involvement of group members, the strategy the group is using, how the groups deal with task or group functioning difficulties, etc.

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. Individual student's learning is typically evaluated by written exams, quizzes, and papers. 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.

Cooperative Jigsaw Strategy

The cooperative jigsaw strategy was described by Elliot Aronson in 1978. It is a strategy that highly effective student study groups in content-dense disciplines such as medicine and law have used on an *ad hoc* basis for many years. The professor's role in a jigsaw involves carefully choosing the material to be jigsawed; structuring the groups and providing a clear, cooperative context for the groups; monitoring the groups' work to ensure high quality learning and group functioning; and helping students summarize, synthesize, and integrate the conceptual material. The conceptual material you choose for the students to learn *via* a jigsaw strategy should be at a difficulty level that makes the materials accessible to the students, it should be easily divisible into sub-parts, and it should have some common overriding theme that can be used to integrate the sub-parts. Students need substantial guidance in working in a jigsaw format.

Suppose you are about to give a reading assignment. Divide the assignment into parts. Ask each member of each group to read a single part. Two readers of each part should meet to discuss the part they read to agree on its major points and plan how to teach them to other members of the group. Next, two readers of different parts should meet to practice teaching the major points of their respective readings to each other. Then the original groups meet and members teach each other the major points of all parts of the reading. Finally, the professor assesses the students' mastery of the material, through one or more means: reports by randomly

selected groups, individual reports, quizzes, etc. Once again, preset criteria of mastery should be used rather than a curve.

Cooperative Base Groups

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.

Base groups can significantly affect student retention. Academic factors in retention are (1) students see the work as worthwhile, and (2) students experience success. Base groups contribute to both of these factors. Personal, peer support is essential in student retention as found in the Berkeley Mathematics Workshop Program (Fullilove & Treisman, 1990; Tresiman, 1992).

Getting Started with Cooperative Learning

Often faculty find it difficult to stop talking and give students an opportunity to talk with one another. Since many faculty have not experienced a cooperative classroom, you may lack an

experiential model of how a cooperative classroom operates. Therefore, the most important advice we can give is to *start small and be brief*. Choose one simple informal cooperative learning structure that only takes a few minutes, use it and modify it until you and your students are confident and experienced. Remember that just as you are not accustomed to teaching this way, many students are not accustomed to learning this way. It may take a few weeks for the process to become smooth. Some additional keys to successful implementation of cooperative learning include:

- Develop a plan for a cooperative learning activity, try it out, collect feedback, then modify and try it again.
- Learn strategies for formulating questions, encouraging conversation among students, making smooth transitions between small group and whole class discussions, and working with students' contributions to the whole class discussions.
- Start from the first day of class. For example, have students pair up and write responses to questions about the course, such as their expectations or reasons for taking the course. Always try the question or task yourself before you assign it to your students. Whenever possible, try it on a colleague as well.
- Be explicit with students about why you are doing this and what you know about the learning process. Or ask students what helps them learn. Spending a few minutes at the beginning of the term discussing ways of learning in your discipline can be very beneficial to students.

- Use obvious means of timing, e.g. hourglass, class clock, etc., if students are reluctant to stop talking. Negotiate a transition signal, such as raising your hand or ringing a bell (preferably one with a pleasant tone).
- Learn students' names (and help them learn each other's names) to personalize classroom environment and to increase accountability. Walk among students as they work to increase accountability.
- Randomly call on pairs to share. To keep choices random, have each student write their names on cards, then shuffle the deck and pull out a card. Occasionally have the students turn in their questions or responses. Compile their questions/responses and work with them during the next class period.
- We recommend that you take a time-tested engineering approach to change as you implement cooperative learning: make many small changes, rather than one huge change. Start early in the term with short-term informal cooperative learning strategies; modify, drop, and add strategies as you find out what works for you in your setting; progressively refine what is working. Find a colleagues or two to plan (and perhaps teach) with while you're implementing cooperative learning. Two faculty working together progress more than twice as fast as one person working alone. Also, it's often a lot of fun working together.

When using cooperative learning, it is imperative that a criteria-referenced evaluation is used. Competitive grading, such as grading on a curve where only a fixed percentage of the student will earn an “A”, is not compatible with cooperative learning. A student will not be able to wholeheartedly contribute to a classmate’s learning if, on the exams, the classmate’s improved

performance lowers his or her own grade. This does not mean that students are graded on effort alone, because typically performance standards are set very high in cooperative learning classes. Instead, it simply means that the grading system is such that if I help you to learn more, my grade will not be reduced as a result of your improved performance.

Conclusion

We know that it's very easy to slip into the traditional mode of lecture, but in our classes we try to follow Wilbert McKeachie's advice on lecturing: "I lecture only when I'm convinced it will do more good than harm." While conducting a workshop on cooperative learning for a combined group of faculty and students at the Norwegian Institute of Technology, one of us (Karl) was convinced that a short lecture on the latest research on learning would be very useful and effective. He asked a focus question at the start, lectured for about 12 minutes, and asked the participants to prepare a summary of the main points and to formulate at least one question. When he finished the short lecture, and asked for a summary, people didn't know what to write. One student jokingly asked, "Karl, what did you say between 'Here's the research' and 'your task is to create a summary?'"

It got a big laugh, but after the lecture several of the faculty came to him and said, "I didn't know what you were talking about. The concepts were somewhat new to me, you were enthusiastic and spoke slowly and clearly, but I really didn't understand what you were talking about." Karl apologized to the group for wasting their time. It was painful for him since he thought he had given an excellent lecture. A couple of faculty came to his defense. They said,

"Well, you know, it was a pretty good lecture. It was just kind of new to us." But then a student in the back said, "I understood a little at the beginning, but a lot of lectures are like this for me." And a student in the front said (with emphasis), "This is what it's like for me every day."

The look on the faces of those faculty! Karl wished he would have taken a photograph. For the first time in a long time, it appeared they understood what it's like to be a student trying to make sense out of these lectures, not understanding, and being frustrated with not understanding.

This is what it's like for many students in college.

Cooperative learning can help you break the pattern. In order to maximize their achievement, especially when studying conceptually complex and content-dense materials, students should not be allowed to be passive while they are learning. One way to get students more actively involved in this process is to structure cooperative interaction into classes so that students have to explain what they are learning to each other, learn each other's point of view, give and receive support from classmates, and help each other dig below the superficial level of understanding of the material they are learning. It is vital for students to have peer support and to be active learners, not only so that more students learn the material, but so that they get to know other students in class and build a sense of community that centers on the academic side of the school.

It is equally important that when seniors graduate they have developed skills in talking through material with peers, listening with real skill, knowing how to build trust in a working relationship, and providing leadership to group efforts. Without developing and practicing the social skills required to work cooperatively with others, how can faculty honestly claim that they

have prepared students for a world where they will need to coordinate their efforts with others on the job, skillfully balance personal relationships, and be a contributing member of a community and society?

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