

This interview with Veronica Burrows, Associate Professor of Chemical and Materials Engineering at Arizona State University, took place on the campus of Arizona State University on Wednesday, March 28, 2001.

Susan Ledlow: How long have you been using cooperative learning?

Veronica Burrows: I've been using cooperative learning for about six, seven years now, but it seems like most of my career now.

Ledlow: Why did you start?

Burrows: Greg Raupp, in our department, was working with a new set of course materials that was developed for a course that was taught at Texas A&M. What I didn't realize at the time was that Greg was instituting some new pedagogy, some new approaches to the teaching. I had gone into the class only to view the class, to see what Greg was doing, because I was going to teach it the following semester. I saw him do an interactive exercise and I was astounded at how well it worked, and I decided I had to do something like that.

Ledlow: After this initial encounter, how did you learn how to do cooperative learning? What kind of training or reading or discussions with colleagues did you have?

Burrows: I used every possible path that I could find to cooperative learning; [through] a campus workshop taught by you [Susan Ledlow; through Lynn Bellamy and Barry McNeill, colleagues who had some familiarity with cooperative learning and who recommended specific approaches and readings; through involvement in ECE 100, where an enormous amount of that had already been incorporated into the class materials and the class organization; through books that I found on my own; and through just informal discussions with people—reading, hearing, trying.

Ledlow: Could you compare your experience using cooperative learning versus traditional learning strategies, such as lecture?

Burrows: I always thought of myself as a good lecturer. I wasn't necessarily dissatisfied with lecture until I had seen cooperative learning in action. . . . After doing cooperative learning, I began to realize that lecture hadn't been as effective as I had thought. When I gave an examination and the results were not that good, I thought, "These people knew this; they were responding to my questions in class; they were nodding their heads at me as they were taking notes." When I started doing cooperative learning, I stopped being surprised at what they understood and the level at which they understood it, because I was working with them and taking a measure of what the students did know in every class, because they were required to report out . . . afterwards. Active learning gives me more information about what they're learning. There are some hard things with cooperative learning, too, like not being able to figure out how to get students to "get" it, and, in general, just having student feedback. I liked

using cooperative learning, since it much better matched the kinds of things that I wanted to do, achieved the kind of goals that I wanted to achieve.

Ledlow: Let's move in to talking about setting the climate. First of all, do you explain why you use cooperative learning to your students?

Burrows: In the freshman engineering class at ASU, there is extensive work on explaining why people use cooperative learning—why it's effective; how it's effective; how to do it; the fundamentals; and some exercises, including a Jigsaw, to introduce students to that idea. As a result, I pretty much expect that students will come in to my upper-division-level classes having had that experience, and as a result, I need to refresh them with it but not introduce them to it.

Ledlow: When you're setting up your teams, what criteria do you use?

Burrows: In larger classes, it's a lot easier because you have a lot more variety, but, in general, I follow a procedure that's used in the ECE 100 class: using demographic factors. We survey them on their location in the valley; their self-identified skills with computers, communication, interpersonal relations; gender; ethnicity; and how many hours a week they're working outside of the university. The number of hours they work turns out to be extremely important. I try to make sure there's no more than one person on a team who works full time. I try to make sure that I follow [Richard] Felder's work, making sure there're at least two women on a team, especially at the freshman level; upper division—it's less important. Fundamentally, the most important factors for success—especially if they're going to work outside of class on cooperative projects—has to be hours a week worked and geographical location, so that they're roughly located in the same part of the valley.

Ledlow: Do you use teambuilding activities or any sorts of skills-building activities in your class once you set up your teams?

Burrows: Teambuilding activities are normally incorporated with the technical content of the course. For instance, in the freshman engineering class there's an activity called "the professions of engineering and construction," where students are required to go research their curriculum, the field of study that they're going to be studying in, what it's like to have a job in that field. Then they are put into teams and present that to each other.

Ledlow: Do you ever explicitly teach any communication skills like active listening or constructive criticism? Or if you don't teach them, do you point them out when they're needed in particular lessons?

Burrows: In the freshman engineering classes, there is a unit on communication where they work as a team on skills, following [Bloom's taxonomy, mostly at a comprehension level. We also do an enormous amount of work with them on face-to-face communication. And all of their written work they submit is required to be with a

significant amount of text accompanying it, including setting the context and discussing the outcomes, not merely just providing the answer. We also ask them in projects to comment pretty extensively, not just on product, but on process. Reflecting constantly on the process is really important if you want to have good quality teaming.

Ledlow: What sort of skills do you feel are important to developing students' ability to work in a team? When they graduate and go out and they're in actual teams of engineers, what are the skills that you hope that this experience has provided them with that they might not have had otherwise?

Burrows: They gain a lot with teaming, including specific teaming skills. In teams, for example, conflict is inevitable. Sometimes the more conflict there is, the more they learn. It's also more work they have to put [in] to resolve the conflict. The biggest successes that I've seen in teams learning these communication and conflict skills is where there was a significant amount of conflict and dissension. They certainly learn to communicate—not just product but process, not just to each other but also in writing their materials up. Everyone knows how to talk; everyone knows the fundamentals of polite behavior.

Ledlow: When and under what circumstances do you choose to use cooperative learning, rather than some other teaching strategy?

Burrows: I use cooperative learning in every class, basically. One of the disadvantages of a cooperative learning class is students get so used to it that they lose the ability sometimes to sit through long lectures. And I lose the ability to lecture for long periods of time coherently. Every day there's got to be some kind of activity where students are interacting with the content. If they're not interacting with the content, they're basically not learning it.

Ledlow: Is preparing for cooperative learning different for you than preparing for a lecture, and, if so, how?

Burrows: Preparing for cooperative learning is extremely different than preparing for a lecture. For a lecture, it's the easiest thing in the world to go to a textbook and pull out different quotes and pull out the important ideas and elaborate a bit on them while you're talking in class and think that you're doing elegant or wonderful pedagogy. On the other hand, you can do cooperative learning on a chalkboard rather easily. In preparing cooperative learning, you have to build in flexibility and build in a very tight structure at the same time. You have to know what you want to have happen by the end of the class. You don't have to do that for a lecture. In a lecture the goal is to cover this material. With cooperative learning, you shouldn't really start it unless you know what you want the students to be able to do by the end. If you can write your learning objectives in that kind of a format, then there are many approaches—learning experiences—that will get them there, including traditional cooperative learning exercises or things that you invent on the spot.

Ledlow: That's a good segue. Have you used any of those pre-designed cooperative learning strategies or structures, like Think-Pair-Share or Academic Controversy?

Burrows: Jigsaw is really common, and I think the more abstract the material, the better a Jigsaw works, even though the more abstract the material, the more nervous the students are about it working. They have much less confidence in the Jigsaw working when it's abstract, but afterwards, they are more satisfied with it as a learning experience. Jigsaws are the best way I know—especially early in a semester—to ensure that students take responsibility for class preparation, which they have to do for cooperative learning. They don't have to for lecture.

I use Think-Pair-Share occasionally. I just don't find that as useful for myself. There are also plenty of highly structured, individualized activities that I do. There's a class I do, two-thirds of the way through the materials engineering class, where I bring in a large box of items. Let's see, cups, rubber bands—just common household items—and bungee cords. And the students are instructed to test whether or not Young's or Hook's Law is a good model for developing Young's Modulus, for the bungee cord material. And all they're given is a rough agenda: two minutes to look over the problem, five minutes to get into team roles, five minutes to set it up, ten minutes to do their experiments, and then both teams report out. I'll divide a class in half to do that. A team can do that in an hour's class, if they've been doing cooperative learning all semester. So that's not a named structure, but it's very effective and aimed particularly at that content, so I'll do two of those: one on Young's Modulus and one on Poisson's Ratio—both topical content in the materials engineering class.

Ledlow: If you're not using a pre-designed or named structure, like Jigsaw, how do you go about planning a cooperative learning activity to make sure that it goes smoothly? What are some tips? Like, are you assigning homework or readings? Are you assigning roles? What sort of things do you do to carefully craft that activity?

Burrows: There are planning items and execution items. In planning, you start with the learning goals. Once you have the learning goals and the level of learning that you want them to achieve, you design the activity to be suitable for that level of learning. If I want them to achieve application level, then I have to force them to choose the appropriate approach, because that's really what application level would mean. If I want them to achieve comprehension level, I'll instruct them to use this technique or that technique, because that would be at the comprehension level. You need to put very tight time constraints on them. Most cooperative learning exercises are successful, despite the fact that the students will almost never complete them—to the students' satisfaction—in the time allotted. Giving them a tight time schedule forces them to stay on topic; it forces someone to play the role—either that you designate them in the role or they choose that role—of timekeeper and resource manager. When you don't have that time pressure, they seem not to perform so well. You have to build in a reporting-out feature. If it's a long exercise, there has to be reporting out at various points in the process. Sometimes, if it's a small enough room, and you're going to have a chance to make personal contact with each team or each group of students, then you

can do it informally by just walking, talking to find out where they're at, what difficulties they are encountering. If it's a very large class, then it's very important to have those intermediate reporting-out parts so that questions are shared among the class, so that general direction keeps everyone on track. Reporting out is not just on product but reporting out on process. There's always process reporting included in all my exercises.

In one activity I do, the class talks about listening skills and constructive feedback, and they do a whole variety of activities. They fill out a worksheet as they go along, but at the very top of the worksheet, there's, "who's doing what role?" Then they pursue the various activities that they have to do, including some role-playing. We tried doing constructive feedback with an item that might be a little touchy with the teams, since the teams had been working together at that point for awhile, and they've just turned in a team assignment, and they've probably had some conflict. So we tried to have them work on whatever conflicts they had. It was an unmitigated disaster. It was too close to them; they were too touchy. So now we have them pick varieties of poor communication that bother them the most and have them role-play them, and then we have them role-play the constructive feedback, for instance.

Ledlow: We're getting into classroom implementation, and I want to follow up with some things that you just mentioned about planning. Now, first is—what are you doing while your students are working in their teams in your classroom? What's your role at that point?

Burrows: I, normally, am sitting down with one or more teams and asking questions, challenging them, providing what I call "enrichment context," discussing informally some side thread to pique their interest in the material, rather than interfering with or pushing really hard for them to achieve a certain goal at a certain point in time. If they are supposed to answer a given set of questions, I'm not likely to sit there and say, "Okay, so what do you think the answer is?" I'm much more likely to come in and provide some context to the questions. [I'll say something like], "I was just reading about this the other day in this resource about what this person had to say about this topic," just to generate some discussion. I'm also paying attention to who's doing what; I'm trying to see who's playing roles, who's not playing roles that they had assigned.

Recently, someone who has not had good experience with cooperative learning said that she couldn't get anyone to do the roles that they were assigned or even that they chose. So, occasionally, if you have to enforce that, I had recommended to her that she keep a deck of index cards with student names on it, [and] that there be some very small point value assigned to playing the proper role that you're supposed to play. . . . If she'd just carry that deck of cards around and come into a team and sit down and find out that the people are not [playing their roles]—or if they are—that she'd mark it on her index card, that that would keep the students a bit more responsible.

Ledlow: If you see people are either off task, or maybe they're on task and going in the wrong direction, or what you might perceive is not a very fruitful direction for problem solving, do you directly intervene?

Burrows: I intervene pretty strongly if they're shouting at each other, although that's happened pretty rarely. Once or twice, I've had to intervene when it was getting loud. It depends kind of on the exercise and if the learning goal is vital. Then I'm likely to intervene and push them toward achievement of whatever they're to achieve. If it's something they're likely to work on again in a later class or in an assignment, I'll let them follow completely any direction they want to follow; it's up to them. They can completely waste their time. They find out pretty early that that's not a good idea to do. I wouldn't do this with freshmen, but I'll do it with sophomores and juniors. Freshmen need to be directed pretty strongly. Also, it's feedback for me. If they're off topic, there's a reason for it. . . . Either I've given them too much time or no "sponge activities" or no good direction or I haven't given them enough context for them to value the work. . . . That's feedback for me, so I might try to reinvent or revise the activity.

Ledlow: You just used the term "sponge activity", and I'll bet a lot of people who aren't familiar with cooperative learning don't know what that is. Could you define that for us?

Burrows: I had mentioned earlier you want to make sure that you have more for them to do than they can possibly accomplish. Certainly you want to give them some minimum accomplishment level. You [also] want to have activities to use up the time of people who get way ahead, who accomplish it quickly. . . . You can either directly, or in the handout or instructions for the activity, give them further [sponge] activities. . . . Class time is for class work.

Ledlow: When [they've] finished or, as you've said, they probably haven't finished, but time is up for that group activity, what do you do to debrief or pull it all together?

Burrows: Everything from random selection of teams or individuals to "Who's got the nearest birthday?" I occasionally use selected teams if I'm trying to make sure that each team has had a chance to report out. Occasionally they'll have to come up to the front of the room and present on what they've been working on. In some exercises, the reporting out, or the debriefing, is a work product, a document of some kind that I've structured for them or told them what has to be in it. And that will often be for some small assessment that will count toward their course grade. Usually, there will be reporting on results and reporting on process, but, occasionally, they'll have to post something on a web site.

Ledlow: Do you have any tips for managing the teams? What are your suggestions for just keeping a handle on all the bureaucracy of cooperative learning?

Burrows: The most important [device] for time saving is team folders. It seems like a pretty obvious, or not very elegant or exciting little thing, but they work incredibly well, in that team folders are placed in the front of the room before class starts, the students

pick up the folders, they sign in. That's how I keep attendance. I don't call attendance in class; they sign in every class. They take out anything I'm returning to them, and put in anything that's being submitted, so that takes up a whole lot of overhead out of the class. Occasionally, if there is content or material that they will use in the class, but I don't want them to have it in front of them because it would be distracting, I'll supplement that with envelopes inside the team folders. . . . The envelopes contain materials that they're not to access until a certain point in the class. . . . [The team folders are] for just managing the work products that go back and forth and the auxiliary class materials.

Certainly in a technology-enhanced classroom, you have to have control over the students' computers; you have to be able to shut them down, so that their hands will not go creeping up to the keyboard and go surfing away.

In terms of managing materials going back and forth, the best management tool is a detailed agenda for the entire semester, class by class, if you give [it to] them at the start of the semester when the assignments are due. At least two weeks ahead, make sure those assignments are available to them. That's the best thing you can do, because then it allows them to plan. I can't believe it took me this long to do it, but I just for the first time instituted a Gantt Chart with all their assignments on it. I generated it the day we covered Gantt Charts in class. The content of the course covered scheduling and Gantt Charts, and the students said, "Well, why didn't you do this before?" Well, I didn't think of it before. It's extremely useful because many of their assignments are multi-week assignments, and a Gantt chart is a really useful tool for them to organize that as well.

Ledlow: We've been talking about in-class stuff, but let's move to out-of-class concerns. How often do you expect your students to work together out of class, either on projects or on homework assignments?

Burrows: Homework assignments are not team assignments for me. Out-of-class assignments are always project assignments. Students live very far away, and it's just unreasonable to expect them to get together for extensive out-of-class work. When I give them a project, there's probably a lot more flexibility in terms of time and tasking, and I provide them technological tools for enhancing their ability to work together. I'm using Blackboard CourseInfo; I've been using it since it's been available. Blackboard has the facility for setting up team pages or teamwork areas on the course page, where there's e-mail and the ability to post files. About half my teams use that and find it really useful to have access to it. All of my course materials are always available for the students to download from the PowerPoint presentations for every class. I also give them a blank grade book so they can make sure that I'm calculating their grades correctly.

I tried doing out-of-class, team-based homework where they'd get a team grade. The students just divvied it up. One person did A, one person did B, one person did C; and they were not learning what they needed to learn. I do encourage them to discuss

algorithms—but [now] the words, the keystrokes, the figures, any touching of pencil to paper has to be uniquely theirs.

Ledlow: When you do design projects for out-of-class work, what are some of the ways that you structure for individual accountability so you don't get that complaint of, "one student did all the work and another person slacked"? What do you do to build in individual accountability when you can't monitor, when you're not right there?

Burrows: There's in-project monitoring, and then there's external monitoring. In internal monitoring, I require them to describe project history and keep team minutes of their meetings, and minutes of their meetings include who did what. They know they have to have agendas and action items with names on them when they provide their Gantt Charts. If they are dividing their work, it is required that they indicate who has responsibility either for supervising or for completing that portion of the work. And then the kind of external accountability is two team-process checks—one during each of the projects. In one class we use an instrument for them to report on how they think the team is working, and then they have to develop a consensus version of it. The team, while each team member is there, has to come up with an instrument to have the team give feedback to each individual member of the team. And that's a graded assignment in the class, auxiliary to each project. It's not a lot of credit, but it's a significant part, and they work on it, they sweat over it. They usually comment, "We decided we had to change this," or "This team member made the following commitment to improve." I'm less likely to modify grades [based on student feedback] because the grading scheme I use is not amenable to that kind of adjustment. I don't use point-based grading, so it's difficult to do it directly through grading. Certainly, I would, if it was clear that someone was not participating—and I was getting that information from all the team members—after going through a variety of interventions. If that were still the case, then it would have an impact on their grade.

Ledlow: Let's talk about that intervention. Say someone shows up in your office and says, "I hate my team; we're having problems." What do you see as your role, when it comes to your attention that the team is really not functioning well?

Burrows: Someone telling me that they hate their team is not necessarily evidence that their team is not functioning well. The first thing I always do is listen. And the second thing [is] I ask them what they think the other people are feeling or thinking. And I ask them what the other person is doing that leads them to believe this, and then what would they like to have happen. After all that, then I say, "I'm not talking any further about this with any of you until all of you come in" I won't require everyone to come in to see me, so I offer advice for approaches that the person can take. Usually, they figure out pretty quickly that they probably don't want me to go to the rest of the team and say, "So-and-so says you're having trouble," because that will really destroy the relationship with the team. So I make sure that the intervention involves everybody on the team and that the person who requested the intervention, can, if they want, back away from that request and then try to do it with the team, rather than coming to me on their own. If I see intervention needs to occur within the class, then I do that in the class, everything

from providing them with a new tool—when students are not listening to each other or shouting, it's the “talking pen”; no one can talk who's not holding the “talking pen.” I've never seen it progress to the point where they're fighting over the talking pen, but they do take turns with a talking pen.

Ledlow: You've talked a little bit about grades. Could you talk more explicitly about ratios of group grades to individual grades . . . and how those are divvied up?

Burrows: In the freshman engineering class, teaming is one of the learning goals of the class, one of the learning objectives. As a result, about half of the course grade derives from work that is specifically team based. The work is assessed as a team, and everyone on the team is assessed with the same assessment. In other classes, I usually keep it to about twenty-five percent of the grade, derived from work that was done as a team, where every member of the team gets the same grade. Rather than modify the grade on a project, I would tend to have a team assessment exercise and use the team to bring them into a better, a more equitable distribution of who does what.

I did an interesting survey a number of years ago in a class, asking about different things that I did in the classroom. The wording was something like this, “Students occasionally are concerned that teamwork is done by one member and that other people are going along for the ride. What could I better do to assure that people are not taken advantage of by slacker team members?” And, almost without fail, people wrote, “Nothing,” which could be interpreted in a number of ways. Or, “It's our own fault if we get taken advantage of. You shouldn't be monitoring it any more than you are.” At the end of the semester, you're likely to get that kind of response, which is different from the response you're likely to get in the midst of it, when people can't even clearly see how hard someone else is working. I try to turn the question around, “What do you want to have happen? How can you make it happen?” rather than, “Okay, we have to make you happy because you're unhappy now.” What do you want to have happen, and how can I assist you to meet your goals? Otherwise I'm the intervening parent, and that's not what I want to be in a classroom.

Ledlow: How do you get feedback after you've designed a lesson or activity? Are you getting feedback from students? From colleagues? What makes you know that this is a keeper?

Burrows: In the Introduction to Materials class that I collaborated [on] for many years with Greg Raupp, we just verbally shared experiences, so that's kind of direct feedback from the last person to use it. The person who is teaching it right now gives me feedback on how well a particular activity, he thinks, is working, and what adjustments he would make to it. In terms of student feedback, sometimes we've implemented a “prioritization matrix,” where you give a list of goals on one axis and the activities along the other axis and ask the students to rate the usefulness of the activities in helping the students to achieve that goal. And that can be really instructive in getting feedback from the students about what was useful in achieving that goal. You have to train the

students over a long period of time to give assessments based on learning and not on liking. And at the end of a semester, at the end of a curriculum, students do appreciate that you're asking for feedback.

Ledlow: How large are the classes that you teach?

Burrows: Anywhere from five to 120.

Ledlow: And do you vary the types of cooperative learning activities that you're doing with the size of the class that you're teaching?

Burrows: Cooperative learning, in terms of formal techniques, is really hard to do in a classroom of five. It's almost a requirement that it be a kind of cooperative classroom when it's that small. But when you get to a larger scale, when you have at least three teams—say fourteen or so, up to 120—I'd have to say most of the good techniques work well. You may have to be a little more active in running around and making sure people are staying on it, but I don't see that there's a big difference in what I do, either by class size or by class level. It's more based on experience. What experience level they have with cooperative learning determines that, more than the size of the class.

Ledlow: So as students get more skilled, you can do more complex things.

Burrows: Oh, yes, absolutely. Longer and more complex.

Ledlow: As you've gotten more skilled . . . what are you doing now that you didn't do at first? How have you evolved? Has your developing more expertise changed your teaching, just as the students developing more expertise has changed what they do?

Burrows: I'm more likely to amend an exercise on the fly. I was very cautious about doing that before. If a portion of an exercise is not going well, sometimes I'll abort it early. I'll sometimes add activities. But once you find a good activity and you know that it's good, you tend to stick with it. I was depending on other people's activities for awhile, especially in the freshman engineering class. Now I invent my own. I consult often with people who developed that freshman engineering class, and we trade things back and forth.

Ledlow: If another engineering faculty member came to you and said they were considering using cooperative learning, hadn't quite made up their minds yet, or were leaning toward it, what advice would you give them about getting started?

Burrows: The single most important thing—and it's not directly [related to] cooperative learning—is to have a good, well-developed set of learning goals. That has been the most generative, activating, exciting thing that happened to me, six or seven years into my education career. It's the whole idea [that]—based on Bloom's Taxonomy—having a good set of learning objectives makes everything easier. It makes lecturing easier, but it certainly makes cooperative learning activities or choosing cooperative learning

activities much more sensible. You know what you want them to be able to do, and you design activities so that they can get experience doing it. It seems obvious, but there's a lot of resistance. I've heard a lot of resistance from faculty to the idea of constraining themselves by writing learning objectives. And I've never understood why that was a constraint myself.

After that, start small. Do it with a few little things. Build in attention to process as well as product. Make sure the students pay attention and are responsible for and are assessed on their process, not just their product, because if they're not assessed on and responsible for process, then they'll use whatever process is comfortable, not what you want them to do. Tell the students at the start of the semester [that] they're going to be assessed three or four times during the semester, at random, to assess whether or not they are playing the role that they are supposed to be playing. If there's a formal team role, carry that deck of index cards around with you; and when they see you coming, if they're not actually doing it, they'll start right away, as soon as you sit down; they'll get used to it, and then they'll do it.

Ledlow: A lot of faculty aren't familiar with Bloom's Taxonomy. Can you give me an example now of how it is that you use it to help you define learning objectives for your students?

Burrows: The most important thing about Bloom's Taxonomy is that it prescribes that you use measurable verbs [in creating objectives], verbs that are easy to assess and that most people would agree that someone has achieved it or not. Instead of "understanding," or "appreciating," or "knowing," you use words like "describe," "compare," "contrast," "select." Those verbs are useful verbs because if you want someone to know about oxygen, they can know that it's O₂ or they could know how much oxygen you'd need to run a particular process at a particular chemical plant.

I think about Bloom's Taxonomy as [for example] describing a toolbox—such that knowledge level is the ability to say, "Yes, that's a hammer in the tool box; it's shaped like this; you use it for this kind of activity." At the comprehension level the students might have the ability—when I tell them to pick up a hammer and drive a nail—to pick up a hammer and drive a nail. And they can do it correctly. And they could recognize that it's a hammer. At the application level I would expect students to be able—using the same toolbox analogy—to look at an entire toolbox full of tools, and, when told, "Pick a tool that you would use to drive nails," that they would pick the proper tools out of the toolbox and apply them properly. At the analysis level I'd expect them to be able to talk about why one tool would be better than another tool, what makes that tool a better tool, and compare how the tools work in this environment. And then, of course, at the synthesis level you'd say, build a doghouse or a birdhouse. And they would do different aspects of all of those. I'm not sure how to integrate evaluation into the toolbox analogy.

Ledlow: My final question is to ask you to share some of your best experiences with cooperative learning. What are the best things about teaching in this new way?

Burrows: The best thing is that students are really thinking well, and you find out in ways that you could never find out in a lecture. We do a team dynamics jigsaw in ECE 100 about the PIGSFACE acronym [Positive interdependence, Individual accountability, Group processing, Social and team skills, and FACE-to-face interaction]. Without any push, without any hint at all, a very large fraction of students will say, “Oh yeah, we were using cooperative learning to find out about cooperative learning. Here’s how we were positively interdependent with this exercise.” They’ll do this on their own. They’ll be able to recognize that. They ask questions, especially if you allow the team a little bit of time to discuss what they’re uncertain about. They’ll ask questions—and asking questions is so vital for them to learn—and they’ll do that much more often than in a lecture type class.

Besides asking questions, they will challenge me more. They’ll explore the information that I give them. If I give them constraints on what they have to do, they’ll push the constraints a little. They’ll take risks because they’re supported by a group of people. Whether it’s asking questions, whether it’s pushing boundaries, pushing limits, pushing constraints. . . . They’ll do that because they realize they’re not alone. In the struggle for learning, they’re not alone in what they have to do, and they feel like they’re part of a community, even if the small community is a team. I’m right now working on how to make that sense of community extend more to a classroom as a whole, because you can’t say that in a lecture classroom the students feel like a community of students, but certainly, in a class as a whole, they don’t feel the same kind of community as they do in a team. Certainly those relationships that they form in teams are usually good, sometimes not so good. I’ll see them years later still hanging out with the same people, even if they’re not in their major, so it’s just a richer experience for them, and it’s a richer experience for me. I learn a whole lot more from them [than I did] when I stood in front of them talking.

I was at a workshop a couple of weeks ago, and one of the workshop leaders asked people in the room to talk about bad experiences that they’d had. I couldn’t think of one off the top of my head. The other people in my group couldn’t think of a good experience, so it was very strange to me. I think I had some really good training from some other people and was able to build really successfully on what they had done, so I’m really grateful for that.

Ledlow: That reminds me; you’ve done some team-teaching with folks. It seems to me that people who are interested in doing cooperative learning with their students are more likely to be team-teachers as well. What’s valuable to you in the team-teaching experience?

Burrows: . . . Whether it’s simultaneous team-teaching or kind of sequential team-teaching, you have someone to make you more accountable and someone to appreciate the things that you might be doing well that you might not be aware of, and to point out the things that you’re not doing well that you’re not aware of. That’s important. If you’re always by yourself—we wouldn’t dream of doing that in the

scientific community. I go to seminars and listen to technical presentations by my colleagues. We wouldn't dream of isolating ourselves so much from what other people do. It's a crime that we do that in education. Cooperative learning [and team teaching] is just fun. You learn a lot more when you have other people to share your ideas with and to challenge you about the ideas that you do have.

Ledlow: Are there any additional comments about cooperative learning that you wanted to mention?

Burrows: Just one comment. And that is, along with the cooperative learning activities, [some of my colleagues and I] have thought a lot about how grading is done, and we're making pretty significant changes in how we do grading... I mean, I can imagine doing cooperative learning with a point-based scale. I can imagine, sort of, teaching a lecture class with this newer [grading] approach that we've been using. . . . But certainly, I think it was the whole experience of cooperative learning that allowed us to envision completely different approaches to grading, to recognize some of the failures of traditional grade schemes in encouraging and recognizing what we wanted to encourage and recognize. So the experience with cooperative learning has led to other kinds of newer approaches and innovative approaches in teaching. . . There [are] a lot of interesting areas that I think my experience with cooperative learning has alerted me to, or sensitized me to, if not lead me directly to.

Ledlow: Thanks very much!