

This interview with Greg Raupp, Associate Dean for Research at Arizona State University's Engineering College, took place on the campus of Arizona State University on Wednesday, March 28, 2001.

Susan Ledlow: How long have you used cooperative learning?

Greg Raupp: About nine years.

Ledlow: Why did you start to use cooperative learning techniques?

Raupp: That is an easy question to answer. [It was] summer of '92, and I was scared because I had spent the previous year working to get the faculty to commit to a new curriculum at the sophomore level. This particular curriculum, in my view, was a completely new way of looking at engineering—a new way of structuring it—and I believed it was conceptually more difficult in some ways than the old way of doing things. And, of course, since I had convinced the faculty that we should try this, the faculty says, "Well, who is going to teach it?" and the obvious person to teach it is the main advocate. So I jumped in, along with another faculty [member], to agree to teach the first set of courses in the fall of '92. As we looked more and more at this curriculum, the more and more scared we got, because it looked so tough. And having taught at that point for about seven or eight years, I realized the weaknesses of all we had done [in the past]—that despite my best efforts and the students' best efforts, if we do this the same old way, we don't have a hope of having this be a successful curriculum. People will look at this as a failure. So we looked for everything. My colleague had seen active, collaborative learning practiced at a couple of other institutions and at some workshops, [and he] suggested that. I got interested in it, and we went to a workshop that summer, a three-day workshop, which I guess was my boot camp. Basically, we launched the curriculum that fall with that kind of teaching style that fall. It was very much a love/hate kind of thing. Some days it just worked wonderfully; other days it didn't. Most times it didn't work—it happened there because we just weren't experienced enough, but basically that was the start.

Ledlow: How did you learn how to do cooperative learning—formal training, a workshop or seminar here or there, books, discussions with colleagues, observations?

Raupp: From that point on, I think it was very much a trial and error process. Within those three days, this was a very active boot camp; it was not, "We are going to talk at you and you are going to figure it out on your own." It was, we walked in, and the first thing was, "Introduce yourself to your neighbor." They gave us basically an active, collaborative learning exercise to start that particular workshop. The whole workshop, the whole three days, we were basically in the middle of doing it—mostly from the side of what the student experiences—but we were seeing it modeled the whole time. It wasn't at all that kind of workshop where they try to sell us on the technique, giving us lots of statistics, giving us lots of presentations. Instead, it was three days of actually doing it. And so, it was a good boot camp from that point of view. Most of what

happened after that was a trial and error process, where we took many of the structures . . . we saw at the workshop, and tried to form them in different cases and then see what worked. Then we adopted those things that worked well, and those things that didn't work well, we tried to change, and gradually became more and more comfortable with the process as a whole as we went. Other than that three-day workshop . . . we did some reading, and, yes, we did some talking to people—but trial and error seemed what worked.

Ledlow: Could you compare your experience using cooperative learning versus traditional learning strategies, such as lecture? How have your students responded to cooperative learning? Do students seem to learn more and have better grades when cooperative learning techniques are used? Do they learn different things than they did when using a more traditional approach?

Raupp: There are many ways that it is different. That's why I am pausing; I almost don't know how to answer the question, because it's very much a night and day kind of comparison. Some things that are different that come right to mind are: the preparation that you go through is very different. The preparation for a lecture becomes very much an organizational preparation and trying to think, "exactly what I am going to say at this particular time" kind of preparation; whereas the preparation for cooperative, active learning exercises is more strategic. It's more "what if," since there's a big unknown as to how the students are going to respond to that particular exercise—both from the point of view of the exercise itself and the structure itself of the cooperative learning exercise—and also from the content, whatever learning content you are trying to get them to pick up. Are they going to revolt because this particular kind of mechanism, structured mechanism, is something they are not familiar with? It is not going to work because I haven't given them good enough instructions? It is not going to work because of some unknown social reason that they are just not going to accept? And then independent of that, what is it that I am trying to get students to learn out of this exercise? Are they going to get that? And then what am I going to do as an instructor when things don't go well? Because the first thing you learn, especially as a novice, is: it's not going to go well every time. It's not going to be the perfect exercise every time; you have to be willing to adjust on the fly to something that's not going well. You have to be able to redirect the students and be willing to stop and say, "I see I didn't give you good enough directions or that you didn't really comprehend the directions." Stop, start over, those kinds of things. You have to be prepared to realize that you may not get through everything you want to get through that day. What are you going to do in that case to make up for what you didn't cover, and so on, and so on. So there's a whole lot of things, different things, from the point of preparation. And then in class it's very different. In class it's very much a one-way street if you're a lecturer, if you are doing it in the conventional way. You, of course, hope for questions as evidence that the students are paying attention and are getting something. I often say to my students when I am in a lecture mode, "Okay, you are looking confused. Don't feel bad. In fact, if you're not confused right now, you are probably not paying attention." So you want those questions. But the students tend, of course, not to ask questions, because they won't admit that they're not getting it. So in general, the biggest waste of breath I find in

a lecture is, “Are there any questions?” The answer is, of course, “Yes.” The odds of getting those questions heard are almost negligible in a typical classroom format, no matter how personable you are and no matter how open you are. It’s pretty tough to do that. You’re in control all the time because you’re doing all the talking. Then with the active format, ideally you are doing very little of the talking—they are doing most of the talking, including at the report-out stage—so you have to turn over your class to the students. Yes, you are in control of the overall structure, you are in control of the overall objectives; but in terms of what actually is happening, those students are in control. So you have to be the kind of person who can (a) give up control and (b) be willing to move on your feet to understand when things are not working well—to redirect and all those kinds of things. You need to be able to anticipate the unexpected, to deal with the unexpected. And having said that, by the way, the unexpected is not always bad; and, in fact, more times than not, it’s good. I don’t want to give the wrong impression. What’s most exciting to me, since I’ve been in this kind of format, is what the students can actually do when given room to think on their own—what students can actually construct in their own minds without reading it from a textbook, without me telling them. That’s a very exciting thing. I have had students come up with analogies in class that I said, “Wow. If I was lecturing, and I had come up with that analogy, I would be so proud of myself, because that was so clever.” It’s something you would never find out otherwise. There are probably more things than that, but those are the things that come to mind.

Ledlow: How have your students responded? Are they learning more, learning different things, liking it more? What are they experiencing?

Raupp: Let me answer the question you didn’t quite ask first, and then I’ll answer the question you did ask. . . . I was one of the pioneers here in the engineering college, me and my colleague Lynn Bellamy . . . in 1992. Back then . . . you have to understand that this was the first time they had ever seen anything like this. We had to do a “sell job” on these students. Nowadays we don’t have to do that. What we found is that just dozens of faculty are using these techniques. By the time you get them as a junior, they would probably have had at least three or four courses in this mode. ECE 100—all the students go through that. They have all been through basically most of the structures. They have seen it all before. So now it’s very simple. I don’t do anything in class except just start with it. I don’t even say I’m going to do it—just start with it, kind of like the boot camp. Back then there was a different story. We had to sell the students on the whole idea, because it was completely different from anything they had experienced. The way we sold it was basically we were saying that this was an experiment: “We believe that what we’ve done in the past hasn’t worked well. Ask yourself how much you get out of the conventional mode and is that what you think you ought to be able to get for your money, for your hour in class? And are you willing to try something else?” We basically got the students to agree to try it as an experiment. Now early on we weren’t experienced; we did a lot of things poorly. The biggest mistake we made, over and over again, was we didn’t give precise directions on what we wanted them to do when we gave them an active exercise, a collaborative exercise, and so on. So there was a mini-revolt, about a third of the way through the course,

where there was a bunch of us who said, let's go back to the old way. And we basically dedicated an entire class session to hashing out that issue, which we ended up doing in a collaborative format—asking each group to discuss the pros and cons, the barriers, the promoters, and what we should do about it. And basically that got us through that crisis and moved us on to the point where we did better as instructors, they did better as students, and so on. Nonetheless, there were difficulties, as always. Most people are aware of most of these difficulties, the biggest one being probably the so-called “slacker” problem. Those problems continue today and haven't gone away. Other problems are just more of an interpersonal, social interaction problem; sometimes you run into personality conflicts, and so on. But the good news is that we've seen enough of it now that we know how to deal with it. So, now for the most part, the students expect it, they accept it, many prefer it. I wouldn't say everyone prefers it, but I would say that a very large chunk of students actually prefer it; and many just say, “This is the standard, this is really the way to go.”

Then you asked the question—now let me try answer the one you actually asked—which was do they learn more. . . . I think what they learn is . . . something which is quite different. Most people who develop these structures in collaborative learning realize early on that, “I am not going to be able to cover the old syllabus I used to cover. I am going to have to try and cover the content that is different than the content I used to cover in the usual lecture course. Yes, I can wiz through a lecture and get everything up on the board. Does that mean you caught it all?” So, what it forces you to do as a collaborative learning practitioner is to be more strategic. What is it I really want the students to know? What is it I really want the students to learn? It was that kind of thinking that turned all my courses around to the point where I thought very carefully about learning objectives—overall for the course and for the specific session that we would have. I called those enabling objectives for this session, to get to the big global objective. Think about those very strategically. . . . In lecture, you commonly say, “I'm going to cover this example today, because it was what was covered when I was a student, it's what's covered in all the textbooks, it's the classical problem.” Never do you ask yourself, “Why am I covering this classical problem?” You just do it because everyone always does it; it's in the book. What active, collaborative learning causes you to do is to say, “What is it I want the students to get out of this classical example?” and focus it that way. So what the students learn is not just “I can repeat this example if I see it again.” What the students learn is the basic, underlying, driving concepts that are important to that particular example. Then potentially, hopefully, they can apply it elsewhere. I have found examples where students, there is no doubt in my mind, get a deeper level of understanding because of this approach than they would get if I just talked this example through. No matter what I say, no matter how clever I am, they are going to get more by focusing on what is it I want them to get out of it, and then [I focus on] designing the exercise in that way.

Ledlow: What methods or criteria do you use to set up teams in your classroom?

Raupp: I have several kinds of teams. One I have many people use: base teams—basically the same team is together throughout the semester. For those I look for two

features. Basically, I look for heterogeneity and things like sex and race. I try to make it so it's not an all-female group or all-male group, for example. If there are minorities, try to sprinkle them throughout, don't just have a minority group, and so on. Then I also look for diversity in terms of, and unfortunately it's the only metric we have, but GPA. It's a measure of ability. I don't know how good a measure that is, but I tend to use that also, so that I don't have all the "4.0's" together and all the "2.2's" together. We try to mix those together. Then . . . those groups are set throughout the semester. They do much of their work in their base groups, but for mixing it up, because people get comfortable with their base groups, we often do informal groups during the semester that largely are picked at random. Our students come in and we, say, pick a card out of a hat and go to that table. It might be the Blue Team, or it might have names that correspond to NHL teams. Today you're the Coyote team; today you're the Penguins . . . and so on. So occasionally mix it up that way, so that it's random.

Ledlow: Have you incorporated any sort of teambuilding activities into your teaching?

Raupp: We did it early on. We did those first couple of years when this was very unfamiliar to the students, as well as to the practitioners, or trial practitioners. We tried to build it in a couple of ways. We did some, what you would call bona fide teambuilding activity, that had nothing to do with the contents of the course. So, you may be familiar with the desert survival exercise, for example. We did those kinds of things, which was a selling thing partly too, trying to convince the students that working in a team you can come up with a better solution than working on your own—those kinds of things. And also the secondary motivation was to get some teambuilding in. But largely now, again, I find that the students are so comfortable with the entire idea of working in teams that I don't do a whole lot of that anymore. It's just built into the course itself. I don't have to even do things like explain team roles to the students. I will review very quickly what team roles I want them to take on. Early on in the semester I will assign them team roles during, or at the beginning of, each session, and then two or three weeks in, I will say, "From now on it's your responsibility as you come in to assign individual team roles for each of today's activities; and it's your responsibility to rotate them," and so on.

Ledlow: What are some of the roles that you use?

Raupp: "Leader," "group leader," "gatekeeper"—that person is to track the resources including time. "Checker"—that person makes sure that every person in the group knows the solution, understands the solution, understands the approach to the problem, and so on. "Group member"—that person's job is just to do the task, and "recorder." I generally do not assign "reporter" as a job because I don't want people to know in advance that they are going to be the ones that have to report out. Because if you do that, now all of a sudden, people don't see the need for the checker. Because the only person that needs to know is the reporter.

Ledlow: Do you ever explicitly teach communication skills like active listening, or constructive criticism, or checking for consensus?

Raupp: Just the checking for consensus. I really haven't done the others.

Ledlow: What do you tell students about consensus?

Raupp: Gosh, it's been so long since I've done it, I don't remember. That's the one area we focused on. We do have them understand the difference between consensus and just majority vote, minority vote, those kinds of things. We talk about ways to achieve consensus, ways to interact with one another that are conducive to achieving consensus—things like criticize the idea, not the person—all those kinds of interpersonal kind of ideas.

Ledlow: Under what circumstances, or for what kinds of tasks, would you choose to do cooperative learning instead of using some other teaching strategy?

Raupp: . . . There is no topic that cannot be or is not appropriate for this kind of learning approach. Some folks who would say, "I can't do that. My topic is too complex. The concepts are too difficult"—I couldn't disagree with that more. I think the more complex, the more difficult the topic, the more important it is that you get to see them actually working together on it, actually working on the real problem—not just listening to me talk about how difficult the concepts are. They need to talk through the concepts. They aren't really truly going to understand or believe it, until the words actually come out of their mouths on a particular theory, a particular idea, or particular model. Until they are at the point where they have to defend it to the others folks in the group, they aren't going to see its value. I can tell them how great it is, I can tell them all these things, but they need to actually experience it. So there's really nothing that can't or shouldn't be used in this format.

Ledlow: Is it necessarily more difficult to prepare for cooperative learning than a lecture?

Raupp: I think it's less time consuming once you get experienced with it, once you've seen all the pitfalls. Early on I spent a lot of time preparing, but it was due to lack of experience. Now I can kind of look at a problem, decide what it is strategically we want the students to learn: what is the learning objective, what are the possible things we can do. I have a repertoire of things we could do; the students are familiar with them. It takes, in fact, much less time now to prepare now than it would for a conventional lecture. A typical lecture, if I want to just scribble notes on a board, [I] figure about a three to one ratio. If I want fifty minutes, I had better have a hundred and fifty minutes for prep time, minimum. If I want to do something a little more polished, for example for a TV course, now the prep time is more like twenty to one. For every hour in the TV studio, I am probably prepping twenty hours. For a fifty-minute active learning session, now that I know what I am doing, probably less than an hour.

Ledlow: Have you used any pre-designed cooperative learning strategies?

Raupp: Almost exclusively. In fact, we use well-defined strategies and structures I would call them, that other people developed. Generally, they can be modified slightly to meet our needs, but generally you find that the better structured you have the exercise, the better the instructions you can give the students. And the more familiar they are with the structure, the better off you're going to be. There's less focus on, "What is it I am supposed to be doing structure-wise?" so they can focus more on the learning. . . . Things like a Jigsaw I tend to use for what I would call lower-level learning objectives—knowledge content, a little bit of understanding content—that can be done very well with a Jigsaw. Rather than having everyone go out the night before and learn 100 percent of the material for that day, you assign each person twenty-five percent. They come back and teach each other. It works very, very well. The students like it, because really they're only essentially doing only twenty-five percent of the work outside of class they would be do otherwise. Almost all of the session is interactive in that case. We do some things with the Jigsaw where we put expert groups together and then separate them and have them go back out after they have worked together, so there's that kind of tailoring of the process. Think-Pair-Share, all those things we use, and they all work very well. The better the students know them, the more you can focus on the real content.

Ledlow: Is there anything you do to prepare students for cooperative learning besides assigning roles?

Raupp: The key, two keys I think, and I brought both of them up before, but I'll summarize, is that good strategic planning on my part is key. . . . It doesn't matter how good the structure is and how much the students are trying, if what I've designed is somehow flawed. So I need to think very carefully about what it is I am after, and how am I going to get the students to that point. So that has to be done well, and I have to have the right structure for it. The Jigsaw probably isn't going to work if what I want them to do is dealing with one of those very complex issues. And I think Jigsaw is great for the lower-level learning. It's not going to work unless you just have a bunch of very brilliant folks out there in your class; it's not going to work very well for the real higher-level learning. [For] those you just need to get folks working together, talking together in some kind of format. The other thing that is crucial is very precise instructions to the students, both in terms of letting them know what we expect [and] what is it we are trying to accomplish out of this. So the learning objective needs to be clear, and in terms of precisely what are the mechanisms, what are the steps they have to go through to get there: "I want you to do X, Y, and Z, and I want them in that order, and I want you to do A." And they need to understand what they need to do basically, and they need to know what's expected of them.

Ledlow: In the classroom, what are you doing when students are working on these problems collaboratively?

Raupp: Sometimes I go get a drink of water. No, just kidding. I tend to migrate around from group to group. I will do a quick scan of the class, just to make sure it looks like

everyone started on the problem, making sure they are getting off the ground and not spinning their wheels. So, that's a real quick scan; I'll only spend a few minutes, more or less, just looking at each table. I won't jump in; I won't sit down. Once I'm sure that everyone is on the right track, then, typically, it depends on the length of the exercise. If it's a long exercise, I might jump into more than one group. But say it's something they are going to do in ten minutes, then after that two- or three-minute scan of the room, I'll sit down with a group, and I'll play like a group member, and I'll actually participate with them. I try to take on a member role though. What I don't want to do is to take on the leader role, which sometimes is they want you to do, so the leader will say, "Well, should we do this?" And I'll say, "Well, you're the leader. You decide," that kind of thing. And I'll actually participate with them. Then again, if it's a longer exercise, maybe a twenty-minute exercise, I'll might actually see how they're doing, work with them part of the way through, and then jump to another group.

Ledlow: Are you actually intervening if groups are getting off track, either in terms of off task or in terms of solving their problem in a way that you view as not productive?

Raupp: Yes. If they are off task, I will remind them that they are off task. Usually though, however, when I do that, I will do it by going off task with them first. They will be talking about the Coyotes game last night, and I will say "Yeah, I can't believe how bad the power play was." I'll go ahead and talk about the Coyotes game for twenty seconds, but then I will say, "But we're off task," and get them back that way. So, yes, I will intervene if they get off task. And mostly when they get off task, that in my experience, it's the previous day's events they are talking about, or maybe even the last class. So they'll talk about a class, and I'll say, "Yeah, that transport test you had, I'm sure, was tough. That's a tough topic. I always had a tough time with that." And in terms of intervening when they get off track, again, I do that; but I don't just do it by saying they're off track. I do it by trying to ask the right questions, so they see they're off track, by redirecting the thinking so they get towards the right track, rather than saying, "Wait a minute, you're off track. Here's where you ought to be." I try to get them to realize what's going on, get them to redirect, new direction. It's steering for sure, but it's not a real abrupt steer; it's a subtle steer.

Ledlow: And when students are done or your time is up, how do you debrief the teams to pull it all together?

Raupp: Almost exclusively we do what I call the random report out. Roles that are assigned typically will not include a reporter. They do not know which one of them is going to have to report out. Typically, I would randomly call on a group and a member of that group, and the way I do that is by [using] multi-sided dice so that, for example, if I have ten groups, and within each group there are four members of some form or another, I have a four-sided die and a ten-sided die. And we role the dice, and group eight, number three is the gatekeeper; they're going to report out. We go that way. The students hate the dice, by the way. They call them Russian roulette. Why do they call it Russian roulette? I have them roll the dice. So I give the dice to someone in the class; they roll it. Whoever was picked the previous time rolls for the next time. And they

always feel like when the dice are rolling, they say they can hear the revolver clicking, “It’s going to be me.” But you’d be surprised. It’s all just peer pressure, by the way. I never ever grade anything they do in class, and I don’t do that because, I don’t grade in class, because I want them to have the freedom to make mistakes to say “stupid things,” to say things that just aren’t right, to go off track, to explore ideas that might not be right. And I’m afraid that if I grade in class, that they are going to be too risk-adverse to try anything like that, so the only pressure on that—and it’s real pressure, there’s no doubt about that—is from their peers, that they stand right up in front of their peers, and argue the case well, and present the case well.

Ledlow: Do you have any special tips for managing teams effectively, such as folders, classroom management software, etc.?

Raupp: Folders, yes, team folders which really help get things back and forth. There’s no time wasted at the beginning or end of class getting material back and forth. Again, they are responsible for picking up the folder at the beginning of class and turning it in at the end. Everything goes back and forth that way, whether it’s a resource for that day’s activity, or an assignment, a returned assignment, etc. So those work well. For years I’ve used the Web to run discussion boards, asynchronous discussion boards. We must be in our third or fourth incarnation of software. I can’t remember what we started to use way back when, but those work well where we have groups set up. Groups have their own page, or their own folder depending on what software we have, and there’s one for the entire course. And we work things that way also.

Ledlow: How do you assess student performance? What sort of ratio of group to individual grade do you use?

Raupp: Remember those dice? I roll them. No. It depends on the course; it really does depend on the course. Early on, at the sophomore level, I would say typically that only twenty to thirty percent of their final grade would be based on group work. When they get to the senior level, and I’m doing mostly design projects, where they absolutely have to do their design projects in teams, the problems are just too large for even the brightest and hardest-working students to do a decent job on them. There it’s more like fifty to sixty percent is a group assignment. In a group assignment the assignment receives a grade, so all people within the group get that grade, with the exception of when the group agrees that a particular member didn’t contribute. And so how do we know whether or not someone contributed? Each assignment has a cover sheet which includes an accountability statement, which says not just that we all contributed but specifically identifies what each individual contributed to that particular design project, that particular assignment. And everyone signs off on it. Another thing we do, particularly for the big design project, is a peer review; we have each student do a peer review, a written review of the other students’ contributions to the projects. And that helps me understand whether or not . . . there is a slacker. We don’t necessarily need every student to perform at the highest level to get whatever grade was for the group assignment, but we want to make sure we didn’t have someone who totally just blew it off and abused their team members, and the other team members went along with it.

Ledlow: Are grades then adjusted as someone didn't work as hard as others?

Raupp: Right, yes, adjusted down for those people.

Ledlow: Do you have any individual grade component like separate reports?

Raupp: I have not tried that.

Ledlow: How do you get feedback as to whether the project was successful? Is it feedback from colleagues, students?

Raupp: There are a variety of forms. One is, the feedback comes almost instantaneously within the class. If you see the outcome of the students in the report-outs, when what they report out reflects what it is that you want the students to get out of the exercise, that's an immediate feedback that it worked. When what they report out is either (a) completely off base or (b) not necessarily wrong but not what you wanted them to get, you say, "Hmm, I didn't quite design that [well]." Not that they didn't learn something, it just wasn't what I was after. So you get that immediate feedback. We also tend to do, and I don't do this in every class because the students get bored with it, and I find that almost anything you do over and over again, no matter how good it is, the students get bored, that's a Plus/Delta kind of feedback. So, occasionally we'll ask the students to give us feedback on what worked with this particular exercise, what could we change to make it better. There's that kind of thing. Feedback from faculty is again very anecdotal. Some faculty will make comments about, these students just hate [this topic], really know this topic well, or don't know that topic well. But unfortunately that feedback is just like the end-of-course feedback—it's delayed. You don't hear about it until the next semester, maybe two semesters down the road, and so that doesn't really help you a whole lot. Plus, you're not sure from their comments what exactly it was that the problem was, if indeed there was a problem. . . . So I tend to work more off the almost immediate feedback of the outcome of that session and the Plus/Deltas.

Ledlow: How do you handle conflicts within teams?

Raupp: The first thing I do is try to work with that particular team that's having trouble, to see if we can't work out the difficulties. Typically, what will happen is: an individual or subset of the team will come to me and say, "This other person is causing problems," and it could be in fact that they are causing the problems. I just listen. "Okay, let's sit down together as a group, I'll facilitate, and we'll try and identify the source of the problem and see if we can't work out a solution." And so typically, within the next couple days or day or two, we'll actually sit down and talk together. I'll basically just facilitate—try to do it in a neutral way without identifying blame or pointing fingers—and see if we can't identify something that is really the root cause of the problem that can't be somehow or another solved. Typically, it just comes down to those one or two members of the group that aren't following the code of conduct that we all agreed to at the beginning of class. Let's identify what those particular issues are and simply agree

to follow that code. And that can solve the problem in some cases. In other cases where they're more severe, sometimes you just have to change groups. A particular example in which case I feel you just have to change groups, and I've experienced this a couple of times, is between a male and a female where there's basically a sexual harassment issue. You really, in my view, can't keep the female in that situation, or whoever is being harassed in that situation. You gotta' change groups. The other thing I do that tends to short circuit the problem some is that students do have the opportunity, typically in my class it is halfway through the class, to switch base groups. And if they know that escape hatch is coming, sometimes they can live with a less than optimum operating group to that point and then switch out, and we do that too.

Ledlow: How might you respond to a colleague that doesn't want to do cooperative learning?

Raupp: To me, if the faculty member doesn't want to do it, fine; they don't want to do it. I think this is only going to work for people if it's something they have an open mind about and really want to try. The interpersonal problems are there, that's for sure. Most of us are not trained in them. I found myself, I've gotten better at them over the years, not because of training but because of the experience. But if it is, in fact, something that a faculty member doesn't want to experience, I have to be honest, [interpersonal problems] are going to come up if you go this route, and they are going to be something that we'll have to deal with, one way or the other. So if that is absolutely something they don't want to do, then don't go that way.

Ledlow: How large are the classes that you typically have taught?

Raupp: I've done a full range of them in this format. I had one class as small as eight, had two groups of four. Boy, when someone doesn't show up on that day, you really know it. And then the largest class I have had in this format is seventy, and most of the classes, however, were more in the twenty-five to forty range.

Ledlow: Did the methods and strategies differ with class size?

Raupp: I don't think my strategies have changed much; there may be some subtle differences. I've basically used the same kind of techniques. It's the same set of learning objectives, obviously, so then it's the same set of exercises. I think can achieve those objectives whether I have a class of eight or a class of forty. But what happens is the dynamics are very different as class size changes. With two groups of four, you lose a little bit of synergy, because there can be days when neither group is going to quite get what you want them to get. Whereas if you have ten groups, there are going to be at least a few groups in there that are going to get it, and as you get around and do different groups report out, somebody is going to have really what you want them to have. Then, when I had seventy-eight . . . that works out to, twenty groups of four—now you can't really interact with the groups the way you would like to. But obviously [with] two groups, that class of eight, you are probably interacting with them too much. They probably want you to go away for awhile. With those twenty

groups, I'm not going to get to all of them, to spend as much time with them when they are doing their exercises as I would really like to.

Ledlow: Have your strategies changed as your repertoire has expanded and skills have increased?

Raupp: Well, it's done both. It's definitely expanded. I definitely do things now I wouldn't have tried right out of the gate. On the other hand, there are a few things that never worked very well so I just gave up on them. It's kinda' gone both ways.

Ledlow: If a faculty member came to you, what advice would you give them about cooperative learning?

Raupp: One, start slow. Don't try and go 100 percent active learning if you've never done it before. Try a few things at first, and see how they go. As you get more confidence with turning your class over to the students and all the different little tricks of the trade, then try more. The more and more confidence you get, then encourage yourself internally to do more, then just go ahead and do it that way. The other piece of advice I would give is that if at all possible, you could team with a faculty member who is experienced. Either visit that person's class for a few days or actually co-teach a class with someone who does it that way. That would be the absolutely best way. I have some more advice, but it's escaping me at the moment.

Ledlow: Could you share some of your best experiences from cooperative learning?

Raupp: Well, there are a lot of "Aha!" kind of moments. I'm almost afraid to talk about them because I'd almost have to explain which part of thermodynamics there was an "Aha!" in. But as soon as I say thermodynamics, that's going to resonate with some people, because they are going to appreciate that thermodynamics is conceptually one of the toughest topics in engineering. You almost get the same reaction across the board from faculty and students when you say thermo, and the reason why is because that conceptually it is very, very difficult. You are talking about hypotheticals, analyzing the real world with some hypothetical situations that physically just could never be. That's what thermo is all about. So, of course, that makes it very difficult to grasp it. Without going into specifics, I've had a variety of cases where I have had some "Aha's" on the students' part, where they have come up with . . . really deep understandings of thermodynamics that I myself did not get until I had taken four thermodynamics courses—two undergraduate, two graduate classes—had taught the undergraduate class three times, the graduate class two times. It was at that point that I was getting the "Aha's" that some of these students were getting from thermodynamics. That was quite impressive. A more fun kind of story . . . and I still get students four, five, six years later come back and tell me about that particular class session, because they remember it. This is an intro materials class, and in a typical exercise I would . . . show them a demo of some materials behavior and their task was to model it at some molecular level, to understand what is going on down at the atomic level. And in this particular

case, I brought in a scorpion. I called the scorpion Max when I brought the scorpion in, and we put it on the camera pad, projected a six-foot scorpion up on the screen. . . . I then commenced to tell the students facts about scorpions, like you can freeze them in an ice cube and thaw them out a month later and he's fine, or he can sit on the bottom of your swimming pool for a week and you can dish him and he walks away. So they're interested in the scorpions. So we demoed florescence, and as we were demoing the florescence, I noticed that Max was kind of agitated. [Over] . . . the previous couple of weeks, Max had been kind of docile—just sat there in his little container. I [was] not sure why he was so agitated. Well, halfway through the demo, Max started to give birth to twelve little baby scorpions. And Max became Maxine. That's one of the reason they remember it. But one of the key reasons I remember it is for what happens when the students actually try to understand, florescence. It's actually a pretty complicated process; the difference between that and phosphoresce is a very subtle kind of difference. But what I found is that, almost exclusively, the students as groups come up with—there basically are two models to explain this—come up with one model or the other. And these are the models that you'll find in the textbooks. And the students come [up] with them on their own, and because they come up with them on their own, they remember what it is about. They can tell me six, seven years later, “Hey, I know what the difference is.” And so that's a very memorable day for active learning.