This interview with Don Evans, Director of the Center for Research on Education in Science, Math, Engineering, and Technology at Arizona State University, took place on the campus of Arizona State University on May 14, 2001.

Susan Ledlow: . . . I'm here today with Don Evans, who is the director of the Center for Research on Education, Science, Math, Engineering and Technology and the Director of the Foundation Coalition Engineering Project here at ASU. Don, I'd like to start by asking you a little bit about your background in engineering.

Don Evans: Well, I've been in engineering for a long time—about thirty-five years. When I entered into undergraduate school, I thought I wanted to go into industry and sometime own my own business. When I got my bachelor's degree, I decided I didn't know enough about anything in-depth. I knew a lot of things about many fields, but not much in-depth. I went to graduate school, and that is when I became interested in teaching. I did work for General Motors when I was in the undergraduate program, and then I came straight . . . to ASU. That was a long time ago, and I've been in engineering since that time. I've been a department chair or interim department chair and now the director of a Center.

Ledlow: How did you get interested in engineering education or science, math and technology education?

Evans: . . . It's a long story that I can't tell totally here. But, briefly, about the mid-eighties, [university staff] came to me and said . . . "You're using [computers] more than anyone else on the faculty. We need to revise the freshman program to keep it modern. We want to get some computer centers. Would you do that?" I said, "Absolutely not!" I was not interested in teaching freshman. They worked on me for about six months or so . . . and finally I decided to give it a try, . . . and I've been doing it ever since. That is in the education side. Ever since, my interest has deepened. When I participated in things like the ASEE and the FIE, I realized there were a lot of things that we really did not know about how people learned (that we were using anyway) and started doing some research and investigations into how that might be done.

Ledlow: The Foundation Coalition stresses active or cooperative learning as an important part of its curriculum. What are some of the driving forces that are making you promote cooperative and active learning in engineering education?

Evans: Before the coalition started we had done several classes using cooperative learning. When the schools that ultimately became the Foundation Coalition got together, we decided there were certain student attributes we wanted to address. To do that . . . there were really three main approaches. One was to address the interfaces between students and between students and faculty. That's where the cooperative, the active learning strategies, and the teaming come in. The next was [the] use of technology. At that time, we were thinking about power tools: MAT Lab and MAYPOL—things of that sort. The third was integration of materials. . . integration of topics and subjects so there was a uniform approach to the materials in engineering—so that

subjects didn't seem to stand alone, disconnected from anything else. So, these were the three main thrusts . . . that we thought would generate the student attributes we wanted to see.

There was also an assessment component . . . to check and see if we were doing any good or not. Because we had experience with active and cooperative learning, we became the initial drivers on that part of the coalition. I myself got involved in [cooperative learning] after attending a workshop that Karl Smith ran. I decided there might be something to this, so I tried it in my classes and it seemed to work. I had an opportunity to teach a summer class . . . . I had never done it before, and I had no interest in teaching a summer class at the time. But it needed someone, since the person who was going to teach it couldn't. They asked me and worked on me for another few weeks, so I decided I would try it, . . . and I would use cooperative learning. We did a class in dynamics. . . in five weeks. I think I would rather turn over a dynamics problem to that class than any other class I've had up to that time. They knew more about dynamics [from using active, cooperative learning] than they had with me telling them to do things. That is really what got me started, and I have used [cooperative learning] ever since.

Ledlow: The Foundation Coalition is not the only group of universities looking at [learning in engineering education]. At a national level, what is the push . . . to improve science, math, engineering, and technology education?

Evans: There are several things going on. One: U.S. students are not doing very well compared to other countries. We could argue about how far we are behind everybody else, but it turns out that our students really don't learn the things that we think we are teaching. So, there is a big movement, especially in science and mathematics education, to do what is called inquiry-based learning. This lets the student generate the question, become curious about things . . . [and] lets them deal with some topic before [a teacher] does a lecture on it. Part of that [learning method] is to get the students to work together and talk to one another. The teacher [is] just a monitor of that—not the leader of it—to guide them through that discovery period and make sure that information is stored away in the correct way, so it is usable. That's continuing on up through colleges and universities, I think. It's going slowly, because [teaching] is different for college faculty. We have time problems and limitations . . . . We have a lot of subject matter that has to be covered, [and these] are deterrents to doing [cooperative learning]. But one has to stop and ask, "Do you want [students] to learn the material or just memorize it up to the next exam?" So, I think that is driving the use of active learning strategies to improve the quality of the learning. There is also another reason. If we are successful in converting all of K-12 to this type of learning philosophy, will the students want to come to university, to sit in our classes, and listen to a talking head? This is another big problem we have to face up to. One of these days we will have to change, or we are going to lose those students.

Ledlow: How did the ABET 2000 [Accreditation Board for Engineering and Technology Criteria fit in with this movement towards active, cooperative learning and inquiry-based learning?

Evans: The ABET 2000 Criteria learning came out with about eleven different student outcomes. One of the criteria is that students should be able to work in multi-disciplinary teams. Most of us over the years have just put the students together in teams of three or four, or whatever, and said, "Go at it!"—sometimes with disastrous results. Sometimes it worked, sometimes it didn't. What we found over the years, as we've been in existence as a coalition, [is that] if we give students some training in interpersonal skills and training in . . . how to run the process as a team, the success rate is much higher. It's not one hundred percent. You do still have dysfunctional teams and have to learn how to deal with those, but the success rate over all is much better and the quality of work is much better. So, we are all struggling to meet the criteria imposed by the ABET, the EC [Evaluation Criteria] 2000. Somehow, we are going to have to deal with that problem, or that challenge, of working with multi-disciplinary teams.

Ledlow: Let's talk about some of those challenges a little more specifically. I know individual faculty face challenges when they are trying to change their teaching [methods]. From your perspective as an administrator, what are some of the challenges [that arise] . . . at the department level or at the school level when you are trying to make these changes?

Evans: One of them is . . . that we impose an assessment process on essentially all of our classes. Students fill out instructor evaluation forms. During the times when you are trying to make a transition, you are not always sure what to do. . . . You're going to make some mistakes. If we continue to assess everything that we do, even transitions to new things, we are going to run into problems; because, occasionally, students may not like something that you have tried. That dislike shows up in the ratings, and somebody gets penalized for it. During those transition periods, we have to back down and take a different view about assessment . . . and say this was a transition period. We're finding throughout the Coalition and throughout several other projects that are going on at the Center [Center for Research on Education in Science, Math, Engineering, and Technology that it takes three to five years for that faculty member to make that transition . . . from lecturing as an expert in class to one who can guide the students through their learning—to judge whether [students] are learning or not, listen to their dialogue, and make sure they store this information away in ways that it is useful and correct.

Ledlow: What advice would you give a department or a school if they want to change their curriculum to be more inquiry based?

Evans: Well, I think the big change is to change the evaluation process during those transition periods. Also, [they need] to reward faculty for doing it. . . . The Carnegie Foundation for the Advancement of Teaching makes two distinctions. They talk about

"scholarly teaching" and "the scholarship of teaching." Everyone should be using scholarly teaching. That is, [faculty should be] using the best teaching practices in the classroom, and they should be trying things like cooperative learning. They should be doing things like using teams, perhaps. Not all classes need to use teams, but that is something that should be done in several places in a continuous way throughout the curriculum. And [there is also] the use of technology. All those things should be used to do teaching in a scholarly way, an informed way: "What do we know from the research base and how do we use that?"

The other is the scholarship of teaching, which means that, as an instructor, I'm going to put that material out . . . for critique by others and for use by others . . . like we do in the research side. We do a project in research and we publish those results for whoever wants to use them or for criticism. We don't do that in teaching. I think, if we were to approach teaching the way we do research, we wouldn't have the dilemmas that we are in today. I think we would have a much better learning environment.

Ledlow: . . . Why are you, personally, a proponent of active and cooperative learning?

Evans: I think the big reason is that I have used it in my class, and I have seen a difference in my students. You can see the light bulbs go on in their heads when they get it, after they have discussed it, and as they have tried to explain it to others. I'd . . . very seldom seen that before . . . except for some very bright students who will do this anyway. But the majority of the students really don't quite get it. . . . [Sometimes] they will get it later when they are doing their homework, but you are never sure what process they've gone through in the solution of these problems and challenges you've sent out as out-of-class work. With active strategies, you can see that [process] happening in the classroom. You know if they are thinking correctly about these ideas. You know how they are interpreting them, because they have had to articulate their thoughts on what they are doing. And you have been able to monitor some of that (not all of it) because some of it is going on in the classroom. You can go around to different teams and do spot checks to see that everybody is on track. I think it helps everybody overall.

The first time I used [cooperative learning], I asked a couple of questions and gave them time to work on something. I picked a random person from each team to go to the board and draw a free-bodied diagram on the board. I saw eight free-bodied diagrams, because there were eight teams and each one had a free-bodied diagram. What I had been used to was telling [students] the best way, in my view, to work that problem. Now I see eight diagrams the way [students] thought to work the problem. Now I have a chance of discussing each of those [ways]. I never had that before. So, that's the real reason I've done it. I've seen an improvement in class; Certainly, [I've seen] an increase in interest and the involvement of the students.

Ledlow: Thank you.