

THE WARM WINDS OF CHANGE*

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It might surprise you to learn that some people think I'm a bit pessimistic. Somewhat cynical, a few would add. A perpetually grumpy curmudgeon whose patron saint is Eeyore, one might mutter (but she's only my wife—what does she know?) This image is reinforced by how I spend much of my time these days, writing papers and giving speeches about the woeful state of practically everything involving education in this country.

My dark reputation notwithstanding, I am currently more hopeful than I have ever been about the direction of American higher education in general and engineering education in particular. To lift the spirits of those who share my disposition to gloom—and to prove that Rebecca is all wrong about me—I offer my reasons for this unaccustomed optimism, starting with some that might at first appear negative and depressing. (All right, so maybe Rebecca isn't *completely* wrong.)

Growing Pressures to Upgrade Undergraduate Engineering Education. Engineering schools are going through turbulent times these days. The pool of qualified applicants is shrinking and the dropout rate is higher than ever, leading to losses in tuition revenues and state funding. Significant numbers of entering students need remedial work in mathematics, science, and English, severely stretching campus teaching and advising resources. Industrial recruiters and supervisors complain loudly and publicly that most engineering graduates lack the skills (teamwork, writing, speaking, etc.) they need to succeed in the workplace. Legislators, trustees, faculty members, and students have begun to question—sometimes unfairly, sometimes with good cause—the minimal teaching loads and low status of teaching at most research universities, and chancellors and deans are feeling increasing pressure to respond with more than rhetoric. Traditional sources of research funding are drying up and the Ph.D. job market is anemic, providing still more incentive to upgrade undergraduate education. On the positive side, external financial support for improving teaching and advising has been growing, led by the NSF's impressive investment in engineering education in the past decade through Division of Undergraduate Education grants and the education coalitions.

To be sure, most of these developments are not exactly cause for celebration. The financial crunches at most universities are real and severe, the survival of some academic

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programs and positions may be in jeopardy, and the thought of legislators and politically appointed trustees attempting to dictate academic policy is truly frightening. But our profession has weathered serious financial and enrollment crises before, and I have no doubt that we will get through this one too.

What *is* different about this crisis is its potential positive impact on the quality of undergraduate education. The trends just described—notably the rising chorus of complaints about the status and quality of undergraduate education and the availability of external support for improving teaching and advising—have given rise to an eruption of curriculum reform initiatives and innovative teaching and advising programs. Faculty participation in these programs is increasing rapidly, and even professors who are not active participants—including some who are heavily involved and successful in research—are starting to examine their own teaching and to explore ways of doing it better. Consider some examples.

Innovative Programs, Methods, and Instructional Materials. Current educational reform efforts involve virtually every aspect of engineering education. There is Purdue's proactive counseling program for freshman engineering students; minority education programs at Arizona State, California State at Los Angeles, and Georgia Tech; instructional software development at Cornell and other schools in the SYNTHESIS Coalition and also at Michigan, Connecticut, Virginia Tech, and Purdue–Kokomo; integrated freshman engineering curricula at Texas A&M, Rose-Hulman, and other schools in the FOUNDATION Coalition, and also at Drexel, North Carolina State, and Colorado; freshman engineering design and laboratory programs at Maryland, Florida, and other schools in the ECSEL and SUCCEED Coalitions, and also at the Colorado School of Mines, Pittsburgh, and Wisconsin; and programs all over the country designed to help students develop skills in problem-solving, computer applications, creative and critical thinking, teamwork, and communication. Some of these programs are experimental, but more and more are becoming institutionalized on a large scale.

Leadership. Reformers and innovators have been around in engineering education for many years. In the 1960's and 1970's folks like Jim Stice, Don Woods, Charles Wales, Helen Plants, John Lindenlaub, Billy Koen, Lee Harrisberger, Larry Grayson, and Lois Greenfield were a congenial bunch who did wonderful work and had some memorable times at gatherings of the Educational Research and Methods Division of the ASEE. For years their numbers did not grow, however, and their calls for educational reform went largely unheeded outside of their own dedicated community.

Many of those pioneers are still gratifyingly active, but now their ranks are swelling as younger colleagues enter the game with growing effectiveness. In the literature and on

campuses around the country you can see the influence of creative educators like Karl Smith of Minnesota, Phil Wankat, Bill LeBold, and Dan Budny of Purdue, Dick Culver of SUNY-Binghamton, Ed Lumsdaine of Michigan Tech, Ray Landis of Cal State–Los Angeles, Susan Montgomery and Scott Fogler of Michigan, Steve LeBlanc of Toledo, Doug Cooper of Connecticut, Cindy Atman and Larry Shuman of Pittsburgh, Don Evans and Lynn Bellamy of Arizona State, Tom Regan of Maryland, Charley Yokomoto of IUPUI, and Ron Miller, Barbara Olds, Mike Pavelich, and Dendy Sloan of the Colorado School of Mines.* Significantly, some of the strongest participants in the reform movement are deans, like Lyle Feisel at SUNY-Binghamton and Lumsdaine, Landis, and Shuman, who are putting their talents, energy, and money behind the usual administrative rhetoric about the supreme importance of teaching on their campuses. Equally significantly, some of the emerging leaders are untenured assistant professors, whose deans and department heads are gambling that a few new faculty members can be allowed to dedicate their careers to undergraduate education without causing the entire system to collapse. This display of courage on the part of both the administrators and the new professors is a particularly hopeful sign.

Growing Faculty Interest in Educational Methods. Some engineering professors—Smith, Stice, Wankat, Landis, Woods, Fogler, and Felder, to name a few—regularly present teaching workshops on campuses around the country. Historically, engineering professors have regarded teaching workshops with indifference, skepticism, or disdain, but in recent years interest in them has skyrocketed. Some of us now get more invitations than we can handle, and as many as 150 professors have shown up at a single workshop. Also, for the past five years Jim Stice and I have codirected the National Effective Teaching Institute at the Annual Meeting of the ASEE. The NETI has reached over 250 professors so far and is oversubscribed each year, to the point that Jim and I are contemplating a second offering to accommodate the overflow. On many campuses, NETI participants have with our encouragement used our workshop materials in their own faculty development programs.

In short, the growing pressures on universities to pay more attention to the quality of their undergraduate education programs, the availability of external funding to support educational reform and innovation, the proliferation of programs to improve education on campuses around the country, the increasing amount of faculty involvement in these programs, and the increased willingness of professors to learn about and try better ways to teach, all suggest that engineering education is on the brink of a major renewal. Granted, the same thing might have been said in

* These are just a few of the people whose innovative work I admire. There are many more I would also have cited if I had more space.

other periods—most recently in the early 1970's. Call me an incurable optimist if you will, but I'm convinced that this time it's for real.

Epilogue: How can you get in on the action? If you're a faculty member currently putting most of your time and energy into disciplinary research, and you're doing it successfully (as measured by, say, number of citations and invited presentations, not just dollars and papers) and enjoying it, and you're also doing an adequate or better job of teaching, you don't need to do anything differently. Academic research is a vital university function, and doing it at a world-class level is a full-time pursuit. More power to you.

If, on the other hand, you have the inclination to improve undergraduate education on your campus or just to improve your own teaching, there are several ways to go about it. Read McKeachie (*Teaching Tips*) and Wankat and Oreovicz (*Teaching Engineering*). Join the ASEE, read *Prism* and the *Journal of Engineering Education* (both of which come with ASEE membership), and attend the annual ASEE conference in June or the Frontiers in Education conference in November to get ideas and to avoid reinventing the wheel. If you hear or read about new instructional software or a new approach to a course you teach, think about giving it a test run. If a teaching workshop is given on your campus or at a conference, invest a few hours or days and take it, especially if you've heard good things about it. Find out which of your campus colleagues are already involved in educational reform and see what they're doing. If their work strikes you as potentially important, consider the possibility of participating. If you plan to try something innovative to improve teaching in your department or school, seek support for it (including release time for you) from public and corporate funding agencies and alumni—you might be surprised at how much is out there.

Finally, if your efforts to improve teaching quality are successful, share your results at conferences and in journals, and make sure the administration, alumni, parents, prospective students, trustees, legislatures, and local newspapers know about it. As with disciplinary research, spreading the word about successes (and even unsuccessful but instructive attempts) helps both the profession and your university's reputation. It won't do you any harm either.