A Survey of Faculty Teaching Practices and Involvement in Faculty Development Activities

CATHERINE E. BRAWNER
Research Triangle Educational Consultants

RICHARD M. FELDER
Department of Chemical Engineering
North Carolina State University

RODNEY ALLEN
COMP-AID

REBECCA BRENT
North Carolina State University

ABSTRACT

As part of its program assessment activities, the Southeastern University and College Coalition for Engineering Education (SUCCEED) conducted a faculty survey of teaching practices, involvement in faculty development programs, and perceptions of the importance of teaching in the faculty reward system. The survey was first administered late in 1997 and a modified version was administered late in 1999. This paper summarizes results from the 1999 survey that address the two questions: (1) to what extent do engineering faculty write instructional objectives and use active and team-based learning?; and (2) how effective are faculty development programs at changing professors' teaching practices? The results indicate that well over half of the 1999 respondents were using the stated teaching methods, with most attributing their use of the methods to their participation in teaching workshops and seminars.

I. INTRODUCTION

In 1991, spurred in part by a growing chorus of complaints from industry about deficiencies in critical skills of engineering graduates and the lack of success of previous efforts to institute widespread reform, the National Science Foundation instituted the Engineering Education Coalition (EEC) program. Coalitions of engineering schools were given up to ten years of funding to develop, pilot-test, and assess and evaluate new course and curriculum designs and instructional methods and materials and to institutionalize and disseminate the innovations supported by the evaluations. Among the coalitions is SUCCEED, an EEC that comprises eight engineering schools in the Southeastern United States: Clemson University, Florida A&M and Florida State Universities (which have a joint engineering program), Georgia Institute of Technology, North Carolina A&T University, North Carolina State University, University of Florida, University of North Carolina at Charlotte, and Virginia Polytechnic Institute and State University. SUCCEED was originally funded in 1992 and was granted an additional five years of funding in 1997.

The first five years of SUCCEED's existence were devoted primarily to development of new instructional methods, materials, and programs, and in the second five-year funding period the emphasis shifted to institutionalization and dissemination. At the beginning of the second period, a faculty development team was formed to promote the use of instructional approaches that have been shown to improve student learning. To assess the effectiveness of this program, members of the SUCCEED faculty development and evaluation teams designed a survey of teaching practices and attitudes on the coalition campuses. The survey was first administered to the coalition faculty late in 1997 and a modified version was administered late in 1999. Detailed summaries of the response data are available for both the 1997 survey [1] and the 1999 survey [2]. The results from the first two surveys will eventually be combined with results from a final survey and the combined data will be summarized in a report to be completed in 2003.

The survey data shed light on several important issues facing engineering education, such as the extent of faculty use of various traditional and nontraditional instructional methods and perceptions of the role of teaching in the faculty reward system. This paper focuses on the results related to two questions:

1. The benefits of writing formal instructional objectives and using learner-centered instructional methods such as active and cooperative learning have been pointed out in numerous books, journal articles, conference presentations, and workshops and seminars. After all that promotion, *how many engineering faculty members are actually using those methods?*
2. Similarly, many institutions have made substantial investments of financial and human resources in faculty development, and the pressure to do so even more in engineering has intensified with the institution of ABET's new outcomes-based accreditation criteria. *How effective are faculty development programs at changing professors' teaching practices?*

II. METHODOLOGY

The 1999 survey was sent by e-mail to 1,621 faculty e-mail addresses and a follow-up survey was sent a month later to nonrespondents. After blank surveys and duplicates were eliminated from the returns, 586 valid and usable surveys remained for a return rate of 36 percent. Of those, 75 were excluded from most analyses (except for demographic summaries) because the respondents had

not taught undergraduates in the prior three years. The demographic profile of the respondents closely matched that of the full faculty with respect to sex, rank, position, and engineering discipline.

One of the initial concerns of the survey designers was that faculty inclined to participate in instructional development activities would be over-represented among the respondents. This concern proved to be unfounded. In answering a survey question about participation in SUCCEED-sponsored activities (workshops, seminars, etc.), 42 percent of 509 respondents reported having participated. An independent database of engineering faculty participants in SUCCEED-sponsored activities (workshops, seminars, etc.) shows that near the end of 1999, 42 percent of 1563 faculty members had participated. The inference is that the 1999 survey respondents constitute a fair sample of the entire SUCCEED engineering faculty population.

The survey responses were classified according to the respondents' sex, rank, position, years of service, level of involvement with SUCCEED, and prior attendance at teaching seminars, and the Carnegie classification of the respondents' schools, and the classified data were tested to determine if there were any significant differences in response within these categories. Responses to questions were analyzed using either t-tests or one-way analysis of variance (ANOVA), with the Bonferroni multiple comparisons procedure used to compare mean responses among the various groups. Chi-square analysis was used for categorical data. For the purpose of determining significant differences, alpha was set at 0.05.

III. Results

The survey and the complete results are given in Reference 2. Results that relate specifically to the two focus questions given in Section I are summarized below and in Figure 1.

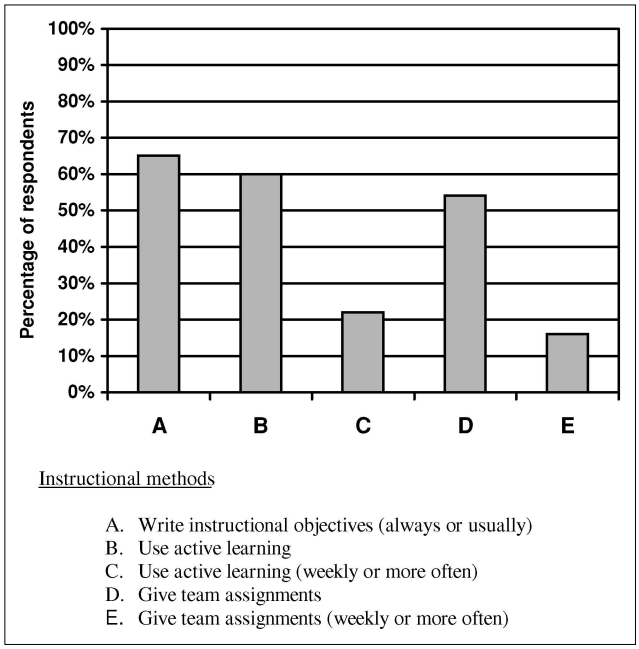

Figure 1. Frequency of use of selected methods.

A. Instructional Objectives

Writing instructional objectives (or in ABET terminology, course learning objectives) is strongly encouraged by SUCCEED teaching workshops. The number of respondents who reported usually or always writing them was 65 percent in 1999, a 5 percent increase from 1997. Assistant professors were significantly more likely to do so than were associate and full professors. The more teaching seminars respondents had attended, the more likely they were to write instructional objectives.

B. Active Learning

The instructional method emphasized most heavily in SUCCEED-sponsored teaching workshops is *active learning*—getting students to do anything course-related in class other than watch and listen to the instructor and take notes. In 1999 many of the survey respondents were using active learning to some extent. Sixty percent reported assigning small group exercises for brief intervals in their classes, with 22 percent doing so once a week or more, and 37 percent reported using active learning for most of a class period, with 8 percent doing so once a week or more. All of these percentages represent slight but not statistically significant increases from the 1997 values. Assistant and associate professors were more likely than full professors to use active learning, and the use of this method correlated positively with attendance at teaching seminars.

C. Team-Based Assignments

In the 1999 survey, 73 percent of the respondents reported giving assignments on which students had the option of working in teams, with 35 percent doing so weekly or more often, and 54 percent of the respondents reported giving assignments on which teams were required, with 16 percent doing so weekly or more often. The percentage of respondents using mandatory team assignments and the percentage doing so weekly or more each rose by about 7 percent from 1997 to 1999. Giving mandatory team assignments correlated positively with attending teaching seminars.

D. Participation in and Perceived Effectiveness of Faculty Development Activities

In 1999, 82 percent of the respondents reported having attended one or more teaching workshops on their campuses, 64 percent attended a meeting or brown-bag lunch dealing with teaching, 62 percent consulted books, 59 percent consulted a newsletter or a web site, 40 percent observed a videotape, 35 percent participated in a mentoring program, and 13 percent worked with a teaching consultant. Some of these activities were sponsored by SUCCEED and others by campus teaching centers. Assistant and associate professors were more likely than full professors to attend teaching workshops.

Sixteen percent of the survey respondents reported that they had been actively involved in SUCCEED as either principal investigators on research projects or as members of coalition management teams, and another 26 percent reported having attended coalition-sponsored programs, so that nearly half of the respondents were directly involved with the coalition to some extent. The percentage of faculty directly or indirectly affected by the coalition is undoubtedly greater, however. SUCCEED's primary goal is to establish sustainable engineering faculty development programs on all of its member campuses, and a number of programs begun

under SUCCEED auspices have been institutionalized and would not have been considered coalition programs by those attending them.

As noted previously, the frequencies of use of instructional objectives, active learning, and team assignments were positively associated with attendance at teaching seminars; however, this observation does not prove that attending the seminars led to adoption of those methods. To determine whether the association was causal rather than merely correlational, the 1999 survey asked the respondents which methods they had adopted as a consequence of attending teaching workshops, seminars, or conferences. Of roughly 500 respondents, 59 percent reported that they either began or increased their use of active learning, 43 percent wrote instructional objectives, and 43 percent used team-based learning. When asked how the changes they made affected their students' learning, 69 percent of the respondents reported improvements, 6 percent said that they could see no improvement, and 25 percent indicated that they had not made any changes.

IV. Discussion

A. Faculty Use of Alternative Instructional Methods

Extensive evidence from cognitive science and empirical classroom research supports the effectiveness of formal instructional objectives, active learning, and team-based learning at promoting acquisition of knowledge and skills [3], and considerable effort has been expended in recent years to encourage engineering faculty to use these methods. Since the demonstrated outcomes of the methods overlap with several of the learning outcomes specified in ABET's Criteria for Accrediting Engineering Programs [4], such efforts are likely to intensify in the future. The SUCCEED survey provides a unique snapshot of the extent to which the methods were in fact being used by a representative cross section of engineering faculty shortly before the use of the criteria became mandatory in 2001.

The results are encouraging. Of the survey respondents (who were representative of the total engineering faculty population of the eight SUCCEED campuses in terms of their participation in faculty development activities), 65 percent reported usually or always writing instructional objectives, 60 percent assigned small group exercises in their classes, and 54 percent gave required team assignments. The conclusion that significant numbers of engineering faculty members on SUCCEED campuses have chosen to move away from straight lecturing and individual homework and to adopt more learner-centered instructional methods seems clear. The observation that younger faculty members were consistently more likely than their older colleagues to use these methods is also encouraging, suggesting that the use of the new methods will probably continue to increase as faculty members wedded to the traditional methods retire.

While noteworthy, however, these results should not be overgeneralized. Since the SUCCEED schools have been exposed to extensive instructional development since 1992, their use of learner-centered methods may be greater than the average use across the country. Our hope is that other schools will begin to assess their teaching practices and evaluate their faculty development programs by administering a variant of the SUCCEED survey (which is given in its entirety in Reference 2). Sharing the survey results in public forums could eventually lead to the development of national norms and benchmarks for instructional programs in engineering.

B. Effectiveness of Faculty Development

When SUCCEED began in 1992, few engineering faculty members were inclined to participate in instructional development activities. In 1999, 82 percent of the SUCCEED survey respondents reported having attended one or more teaching workshops on their campuses, with smaller but still substantial percentages participating in other types of faculty development programs, and many of the respondents attributed their adoption of learner-centered instructional methods to their participation. While the SUCCEED faculty development program cannot claim exclusive credit for the increased use of the instructional methods it has sought to promote, it has clearly made a major contribution to the increase.

A likely reason that so many engineering faculty chose to participate in SUCCEED programs is that those programs were designed and delivered primarily by engineering faculty. Most engineering professors attach little credibility to pedagogical advice given by individuals who are unfamiliar with engineering content and so cannot offer discipline-specific examples, even if the advice is perfectly sound. An implication of the survey results is that engineering schools might do well to strengthen their internal faculty development efforts rather than relying primarily or entirely on campus-wide teaching centers for guidance in improving teaching. Guidelines formulated by SUCCEED [5] for the design and implementation of engineering faculty development programs might prove useful in this regard.

Acknowledgment

This work was supported by SUCCEED under NSF Cooperative Agreement EEC-9727411.

References

[1] Brawner, C.E., R.M. Felder, R. Allen, R. Brent, and T.K. Miller. 1999. 1997–1998 SUCCEED faculty survey of teaching practices and perceptions of institutional attitudes toward teaching. ERIC Document Reproduction Service Report #ED 428607.

[2] Brawner, C.E., R.M. Felder, R. Allen, and R. Brent. In Press. 1999–2000 SUCCEED faculty survey of teaching practices and perceptions of institutional attitudes toward teaching. ERIC Document Reproduction Service. Available on-line at <http://www.ncsu.edu/felder-public/Papers/99faculty_survey.pdf>.

[3] Wankat, P.C. 2002. *The Effective, Efficient Professor: Teaching, Scholarship, and Service.* Boston, MA: Allyn & Bacon.

[4] Felder, R.M., and R. Brent. In Press. Designing and teaching courses to satisfy engineering Criteria 2000, ERIC Document Reproduction Service. Available on-line at <http://www.ncsu.edu/felder-public/Papers/EC2000-monograph.pdf>.

[5] Brent, R., R.M. Felder, D. Hirt, D. Switzer, and S. Holzer. 1999. A model program for promoting effective teaching in colleges of engineering. *Proceedings, 1999 ASEE Annual Conference.* American Society for Engineering Education: Washington, D.C. Available on-line at <http://www.ncsu.edu/felder-public/Papers/ASEE99-FD.pdf>.

Author Biographies

Catherine E. Brawner is president of Research Triangle Educational Consultants. She specializes in assessment and evaluation of programs in engineering education and distance education, educational innovation, and technology use in the classroom. She has been the principal program evaluator for SUCCEED and currently advises the coalition on issues involving program assessment, evaluation, and dissemination. She is also the principal evaluator for two "Preparing Tomorrow's Teachers" grants in the University of North Carolina system.

Address: 6316 Lakeland Drive, Raleigh, NC, 27612; e-mail: rtecinc@bellsouth.net.

Richard M. Felder is Hoechst Celanese Professor Emeritus of Chemical Engineering at North Carolina State University and faculty development co-director of SUCCEED. He is co-author of the text *Elementary Principles of Chemical Processes* (3rd Edn., Wiley, 2000), co-director of the ASEE National Effective Teaching Institute, and a Fellow of the ASEE.

Address: Department of Chemical Engineering, North Carolina State University, Raleigh, NC, 27695-7905; e-mail: rmfelder@mindspring.com.

Rodney H. Allen is a research scientist and independent computer consultant. His company, COMP-AID, specializes in innovative applications, crisis consulting, e-commerce, Internet, computer-aided design, computer graphics, efficient computing, and teaching computer courses, short courses, and seminars.

Address: COMP-AID Inc., Box 12327, Research Triangle Park, NC, 27709; e-mail: comp-aid@nc.rr.com.

Dr. Rebecca Brent is president of Education Designs, Inc., a consulting firm specializing in university and college faculty development and assessment of pre-college and college teaching. She is the faculty development co-director of SUCCEED, adjunct associate professor of education at East Carolina University, and co-director of the ASEE National Effective Teaching Institute.

Address: Education Designs, Inc., 101 Lochside Drive, Cary, NC, 27511; e-mail: rbrent@mindspring.com.