ChE views and opinions

BRIDGING THE GAP

An Integrated Approach to Curriculum

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FACULTY IN MANY institutions are trying to study and analyze their respective curricula in order to bridge the gap between theory and practice. One method of gathering data for analysis is the survey method. Recently, several articles [1-9] have appeared dealing with curriculum changes that academic institutions need to make in order to bridge the gap between what is being taught in the classroom and what is actually needed in the workplace. One such article, "A CE Survey—Putting College Back on Course," is particularly striking. Essentially, the article, using the survey method, solicited responses from working chemical engineers and chemical engineering professors in order to find out if curriculum changes are needed in the undergraduate discipline so that theory and practice can be meaningfully brought together [3]. There is a serious gap in their research design; industry's environment and role in regard to bridging the gap was totally ignored. No information was solicited regarding the engineer's job environment and his perceptions of the company's role in job placement, training, and career development. Accordingly, this paper suggests an integrated approach for the study of curriculum changes in academic institutions in order to bridge the gap between theory and practice.

The study of chemical engineering curriculum used the traditional or common approach to curriculum redesign. The authors summarized the results of 4,759 responses to an education survey in the April 18, 1983, issue of *Chemical Engineering*. The analysis and results focused on the role of the respondents as past students who are now practicing chemical engineers. The authors addressed two time periods in their presentation of the data: "in college" and "after college."

In the chemical engineering survey, several conclusions were offered as a result of the analysis of responses. Two of these we feel required in-depth analysis of the job environment in addition to more academic analysis. The first conclusion stated that "many students graduate from a four-year course in chemical engineering with a hazy or inadequate idea of what chemical engineers do and what careers are open to them." The authors of the article explicity put the total blame on academic institutions and their respective curricula. There is no doubt that academic institutions and curriculum changes can help define what chemical engineers do and what careers are open to them. However, industry can and should shoulder some of the responsibility in this regard. Specifically, industry should communicate to academic institutions what a chemical engineer is expected to do in process engineering, in research and development, in sales, etc. This information can be communicated via industrial seminars, video tapes, or in the recruitment of students. In addition, it is industry's responsibility to match the interest, talent, and academic background of the recruited engineer with a job that requires such talent and background. If a mismatch occurs, the working engineer is not going to be effective on the job and most likely will be unhappy with the job. Given this situation, it is quite possible that the engineer, when asked about the curriculum he had during his college education, might view it in a negative way. This kind of response is then translated into curriculum recommendations and changes. We feel that questions about the engineer's job setting, whether the engineer was happy with his job and whether he was properly matched to it, should be asked. Only then can we meaningfully analyze curriculum changes to bridge the gap between theory and practice.

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The second conclusion stated, "These engineers are less well prepared for their long-term careers in

that they lack essential management skills (ten years after graduation three-quarters of our sample have become managers)." [3, p. 48] The authors then recommend that "more and better business and management courses should be available to students, perhaps as electives—even at the expense of some of the more advanced scientific and engineering courses, such as reactor design."

This conclusion fails to recognize 1) the organization's role in the education process, and 2) the time lag associated with the engineer's move to management positions. Just as a college curriculum cannot be all things to all people, course work designed for entry into specialized fields of endeavor cannot be expected to cover all aspects of a career that might possibly span thirty years. The education process is dynamic in nature. The analysis used a static model which does not provide for changes over time. Respondents indicated that after being on the job they recognized the need for management/business courses. Surely, taking some business courses might help initially, but after being on the job for a period of time, one would expect the company to absorb some of the responsibility for specialized on-going training to prepare the engineer, who has been on the job for a long time, for a managerial role. Matching the type of courses or training to the time period when it is needed recognizes the inherent time-lag associated with the need for management skills for professional engineers. This can be done in a myriad of ways—by offering non-credit courses in the area of business and management or perhaps by encouraging and paying the engineer's way to a nearby institution that offers an MBA program. In fact, there are many companies which prepare their engineers for a managerial role in the company in this way [2].

By ignoring the organization's perspective, it is evident that alternative recommendations and/or solutions are arbitrarily eliminated from consideration. In addition the life-long learning approach and its impact on both the individual and the organization with regard to their respective responsibilities is being ignored. It should be evident from the discussion that an integrated approach should be used when studying curriculum changes.

The chemical engineering survey addresses serious concerns in the area of curriculum design/redesign. The results warrant serious consideration. The analysis, though, must be integrated; both curriculum and industry recommendations should be addressed. In addition to curriculum recommendations, the study needs to make recommendations for industry. The two are intimately related; data collection and analysis must be done concurrently. For example, it is possible that the respondents feeling they should have had certain other courses in college to help them on their jobs, may be due to improper placement of their talents and skills rather than a deficiency in their college education. In this case, the researcher will be able to alert industry to do a better job in recruiting placement, and perhaps in training.

CONCLUSION

This paper presented a critique of existing methodology used in curriculum updates in academic

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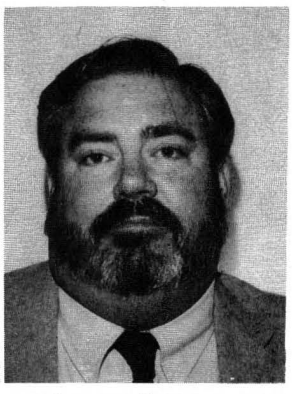

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tive" or "very effective" in teaching process control. The bulk of the remaining responses rated it "OK." Virtually all students agreed that the sacrifice of lecture time for the use of ACS was well worthwhile. We are confident that their responses would differ from those of the engineers who participated in the *Chemical Engineering* magazine survey. At both Purdue and Waterloo, other indicators of positive student reaction were

- **Students worked at a faster pace than anticipated by the instructor. Only ten units were originally planned for the introductory course; the last four had to be added to keep up with the students.**
- **Students arrived as much as half an hour early, even for sessions scheduled at 7:30 AM, explaining that they wanted the additional time to experiment in greater depth.**
- **The original enrollment limit for the follow-up elective course was set at 38 students. Due to demand, this had to be increased, and even the larger figure was quickly oversubscribed. This is particularly unusual for process control, which is regarded as one of the most difficult subjects in the curriculum.**
- **The ACS facility was visited by over a score of industrial recruiters, on a "drop in" basis. They indicated their interest was spurred by the comments of their student interviewees, who almost invariably listed it as one of their favorite educational experiences.**

SUMMARY AND FUTURE WORK

We are enthusiastic and excited over the use of ACS in the undergraduate process control course. Our future plans are focused on the development of a wider base of process simulations for additional senior process control courses, and making the coursework modules available to any other universities desiring them.

Plans are already being implemented to make ACS and the study guides available to the chemical engineering department at Northwestern University and to the pulp and paper technology department at the University of Wisconsin-Stevens Point, both by remote dial-up to the Purdue facility. Other ACS sites now include Louisiana State University, Imperial College (England) and Queensland University (Australia).

The authors are grateful to the many people at IBM and IBM Canada Ltd. whose steadfast and enthusiastic support has made this valuable tool available to the chemical engineering academic community. Specific acknowledgment is given to Ross M. Aiken at Purdue as well as to Jerry van de Hoef and Blair Thompson at Waterloo for their dedicated system and tutorial support. □

ACCREDITATION

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ticipate only by invitation. Some university administrators would be delighted to see accreditation disappear. Who needs those interlopers putting more heat on for scarce resources for their favorite discipline? Who cares whether someone else likes the curriculum? I suppose the answer is that our profession is collectively interested in knowing what type of graduate is being produced beyond a potluck process.

This brings me back to my initial comments—those of us involved in the accreditation system represent AICHE and the chemical engineering profession, a profession involving educators and practitioners in industry and government. I conclude by confessing that participating in the camaraderie of the Exxon suite sure beats grinding through a mountain of accreditation reports and sitting through literally days of meetings. Anyone wish to trade places? □

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institutions. It is suggested that an integrated approach is more realistic and meaningful to study and to bridging the gap between academic curriculum and industry's needs. Specifically, we recommend that curriculum-related data and job-related data be analyzed simultaneously. The authors feel that this approach should give us better insight to the much reported 'gap' between theory and practice.

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