ChE views and opinions

IMPROVING COLLEGE TEACHING In Chemical Engineering

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This paper touches upon some aspects of a program which would better prepare prospective college teachers for their careers and at the same time be of benefit to small and/or young Schools of Engineering.

THE NEEDS OF PROSPECTIVE COLLEGE TEACHERS

Many Chemical Engineering Departments have long realized that some experience in teaching assistance by graduate students is a valuable part of the educational program. As such, most graduate students during their tenure serve at least one semester as Teaching Assistants. This experience, however, seems to be insufficient for the student who does plan to enter a career in college teaching.

A prospective college teacher needs to have experience in all espects of teaching in order to be prepared for his profession. Among those aspects are preparing lectures, delivering lectures, assigning homework, preparing examinations, counselling students, preparing laboratory sessions, directing laboratory work, and grading student work. It is only the last two that are ordinarily encountered by the Teaching Assistant.

THE NEEDS OF DEVELOPING COLLEGES

For the purpose of discussion, "developing college" may be considered one in which the Chemical Engineering program is below accreditation level and has four or fewer faculty members (at publication time there are some 10 or 12 institutions meeting this description). The pros and cons of actual accreditation are not considered here, but it is assumed that the specifications for accreditation are sound educational requirements. Selected qualifications for an accredited program as set forth by the American Institute of Chemical Engineers[2] are (1) instructional methods should provide close faculty-student contact, (2) teaching loads must not be excessive, and (3) staff activity in research is desirable.

THE NEEDS OF ACADEMICALLY DISADVANTAGED STUDENTS

There are many students now in college and soon heading for college whose academic background is not of top quality, both in terms of subject matter coverage and motivating influences. Students of this type are in need of some motivation to stimulate them to more fully realize their abilities and opportunities. Such students in engineering need a modern presentation of fundamental engineering and an introduction to advanced engineering developments. Many students meeting this description are now in or plan to attend the previously mentioned developing colleges (the reasons for this may be family or ethnic tradition or admission policies or other, but will not be discussed here).

PROPOSAL

Generalities. It is proposed that a partial fulfillment of all the needs as mentioned above can be realized by a program under which graduate students are placed as short-term faculty members in some developing colleges. This program should be optional and voluntary, simply an opportunity open to any interested graduate student. The experience gained in this teaching situation can materially benefit the graduate student in his teaching career and also be an aid in his own education as he more clearly organizes the fundamentals of engineering.

The college can gain needed manpower to help in the instruction of laboratory and computational classes (both of which can be most effectively conducted by recently educated engineering graduates) and in reduction of teaching load. Then, too, if the teaching assignment were little enough to allow the graduate student to continue his thesis research, this example could infuse

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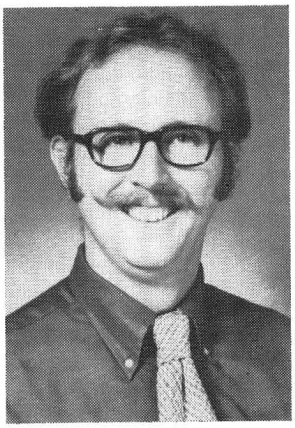

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within the other college personnel an ambition to further their professional activity. The youthful approach to instruction and close faculty-student contact which the graduate student should exhibit could contribute added freshness to the college's program, faculty, and students.

The example set by this graduate student in achievement and his personal counselling would be of tremendous benefit to the student body. The interim teacher could advise on higher career objectives to the students, possibly encouraging some to continue their education in graduate school.

Technicalities. This proposed program could be developed on a continuing basis among several colleges or as **ad hoc** relation for a particular college or student. It is thought that a convenient time in the graduate student's tenure to participate in such a program would be the semester following the qualifying for the Ph.D. candidacy or a semester during which his advisor is on leave (or some combination of the two). The length of the teaching assignment should be determined as a balance between short term (one semester) which would be least interfering to the graduate student's progress, and long term (three or more semesters) which would be of greater value to the school and its students. One year, or two semesters, seems to be a "natural" suggestion because of various mundane outside constraints (e.g., "standard" contracts, registration in graduate school, draft boards, housing arrangements).

The continuing of research by the graduate student would probably be restricted to theoretical or computational aspects and/or experimental design in connection with his thesis topic. Even the performance of some preliminary experiments may be feasible, not ruling out some cooperation from the school's Chemistry Department. It is not uncommon to find good, well-equipped Chemistry Departments in small colleges, eager to utilize research man-power.

Salary arrangements for the teaching student should be solely between the school and the student. This period at "regular pay" will surely be welcomed by the graduate student and will release his assistanceship from the graduate department for other use. Whether either of these latter benefits is real or not may be debated.

The single evident hindrance to implementation of this proposition is the matter of relocation. With some coincidental exceptions this teaching appointment would require a change of residence by the graduate student. A working spouse or school children would make this particularly troublesome.

Alternatives. With respect to the needs of the developing colleges and their students, several alternative teacher-placement services are in operation. These range from the ASEE arrangements for retired faculty, through various programs for visiting professor appointments, to the Woodrow Wilson Teaching Intern program for graduate students and new Ph.D.'s.

The needs of most Chemical Engineering graduate students, as discussed above are not fully met by existing arrangements. Satisfying these needs in post-doctoral appointments is entirely reasonable, and is not to be discredited; however, post-doctoral appointments usually emphasize the research rather than the teaching activity of universities. The placement of graduate student teachers as proposed here is intended to supplement and quite possibly even reinforce existing internship programs at the post-doctoral level. In addition, most likely the graduate student returning from this proposed teaching assignment can stir interest for college teaching in Chemical Engineering among other graduate students.

CONCLUSIONS

A program for college teaching practice as proposed here will be of benefit to the growth in

Chemical Engineering education. The experience gained by the practice teacher is not incompatible with developing professional engineering experience. By considering a broad definition of engineering, the profession of developing available resources to be useful to men,[3] the services rendered in assisting developing colleges and training under-achieving students are definitely legitimate egineering activities. In addition, the experienced teachers that the program can provide will be an asset in whatever positions they may assume after graduate school. As beginning faculty in universities, the trial of initial teaching duties will not be unduly burdensome at a time when some new research interests are being explored.

The small Chemical Engineering Departments that may participate in this program will be benefited in the short term simply with respect to more faculty. In addition, possibly some of the "practice teachers" will be induced to return to the same college and aid its development. The benefits to the students of a practicing teacher may be more psychological than educational. The new teacher will make mistakes in academic matters at the expense of the students, but as a symbol of youth and scholarly excitement, the new teacher can favorably motivate many students to higher goals. □

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ChE laboratory

Chemical Reactor Laboratory

BIOLOGICAL REACTIONS: KINETICS OF YEAST GROWTH

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This is the third in a series[1] of articles describing an undergraduate chemical reactor laboratory designed for seniors in the Department of Chemical Engineering at Princeton. Professor Richard H. Wilhelm provided the inspiration for the successful development of the laboratory. The basic objectives are outlined in the first article of the series.

The experiment described here provides students with an introduction to biological processes and techniques by demonstrating the transfer of reaction engineering knowledge learned in non-biological systems to the kinetics of yeast growth. The increasing understanding of biological systems and recognition of their importance in chemical processing indicate the value of familiarity with biological processes. The growth of yeast under aerobic conditions is a relatively simple experiment for which the kinetics of growth may be compared with theoretical behavior.

The experiment is patterned after the commercial process for growing yeast in which an initial charge of yeast in a nutrient solution is allowed to multiply and grow. An excess of all nutrients except sugar is provided. Under these conditions the rate of growth is a function of the yeast present and the amount of sugar present. After an induction period the yeast growth rate is rapid. As the sugar present is depleted the growth rate decreases and falls to zero at the end of the experiment. The yeast cell volume and sugar concentrations are measured over the period of the experiment and the results compared with predictions.

The growth of yeast is carried out over a ten-hour period. An additional three hours is required for analysis of samples for sugar concentration. Yeast cell volume is determined by centrifugation while sugar concentration is de-

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