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ABSTRACT

The problem of educating foreign engineering students who will return to their home countries is discussed. Often these students are from economically underdeveloped countries, and they therefore may not be able to apply the sophisticated technology of their educational programs to the problems of their own countries. One suggestion is that these students participate in cooperative programs with industries, in order to become acquainted with a wide variety of technological problems and solutions. (MLH)

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HOW WOULD THAT WORK BACK HOME?

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ABSTRACT

To get foreign graduate students in Chemical Engineering to ask this question is imperative if they are to function in their own socio-economic environment. Defining their heterogeneous needs and attempting to fulfill these needs should be of utmost importance in the education of foreign students. Laboratory and industrial experience are vital. Environmental concern and technology transfer for their national scene is necessary.

There is no question that Chemical Engineering departments in this country are training a large number of foreign students, particularly at the graduate level. If the past enrollment statistics is an indication of the future, we will continue to have increasing number of students from abroad. In 1973, the foreign student accounted for more than 30% of the total chemical engineering graduate enrollment.(1) The percentage of foreign students is even higher—close to 40%—if it is estimated on the basis of full-time graduate student population.

Often the term "Foreign Student" seems to imply a single, homogeneous group; in actuality, wide differences exist among both national and regional groups. This is especially true among students from developing countries of Far East, Middle East, Latin America and Africa. Even though a detailed breakdown by region or country is not available, it is estimated that they account for two thirds of our international student body.(2) These students stand in sharp contrast from U. S., Canadian and European students in terms of their cultural and educational background. The heterogeneity of such a student body, makes any fixed or predetermined program ineffective. Perhaps this is the

reason that there is no generally acceptable policy or program specially designed for the training of foreign students, particularly those from developing countries. These students have to struggle along side with all others to sink or swim. If they can use the education that they receive, it is not a matter of planning that is to be credited. In some cases things worked out well, but many times we fail to prepare them to cope with the future role which they will play in their own countries.

Ideally we would like to evaluate each new graduate student individually and design a program especially suited to his needs and potential. The student from China, India, Chile or Egypt all need different educational training because of their unique background and aspiration. In practice, we cannot do this because of the limitation of resources and teaching staff. In most chemical engineering departments, there is rather limited flexibility in the core course offerings at the graduate level. However, there are elective courses and research/independent study projects that can be channeled to meet the special educational needs of the student.

In the analysis of the special educational needs of students from developing countries, we are facing with

one central question, "How would that work back home?"

This question can be visualized as a three-fold problem which consists:

The Student

The Purpose

The Program

Clearly, these three aspects of the same problem are themselves interwined, but it is best to look at them separately in order to bring out the problem areas.

The Student

The foreign student from a developing country must always keep before him a sense of his national awareness. It is easy when he is in the States for a few years to become accustom to various convenient facilities and efficient operations. There are usually excellent libraries and well equipped laboratories. He can pick up the telephone to call another institution to find out needed information on the spot or he can go to the computer center to solve a complicated engineering problem in a matter of seconds. Such conveniences are rarely available or accessible to a

chemical engineer in developing countries. The mere awareness of the fact that the lack of large computer facilities and fast telecommunication networks would force one to consider alternative modes of operation. In the meantime, one should also realize the fact that most of the technical problems encountered in developing countries are of different nature. These problems might not require the use of electronic computer and might be best solved by using different methods. The pace of each individual operation might be slower in comparison with its counter-part in the United States. However, the relative accomplishment (measured in local standard) achieved could indeed be much greater. It is such local variations present both the challenge and the opportunity for a foreign student who is prepared to apply his chemical engineering back home, sometimes, in the most unusual and unlikely fields. He does not necessarily need to work in a large chemical plant or petroleum refinery to contribute his engineering know-how. A small family industry in the food or cosmetic area may just require his talents to expand and to improve its operation and product. It is such national awareness which can provide the motivation and self-direction for a foreign student pursuing

graduate study in this country.

The Purpose

The issue of purpose has been under discussion from the start for any educational program. What is chemical engineering graduate education for foreign students from developing countries? This has been a constant question, particularly for those who were dissatisfied with the current answer. At bottom, this question of purpose has usually come down to the priority assigned (in accordance with policy of individual department and faculty) to the preparation of a student for basic (or academic) research as against applied (and practical) engineering.

Many faculty will agree that, in general, the graduate education (regardless field) is mainly for training "research scholars" and training college teachers (Ph.D. program) with emphasis on basic research. Such a purpose is probably reasonable for U. S. students, but it is certainly open to question when applied indiscriminately to the training of foreign students, especially those from developing countries. Most foreign graduate students go to industrial and governmental services when they return to their own countries. If they were trained in "basic research," their educational

experience would provide, at best, peripheral or incidental contribution to their future career. Even for those who choose to enter college teaching in developing countries, they might find their "basic research" experience being in a wrong area and not in consonant with local needs. Almost without exception, developing countries cannot afford the luxury of diversity and non-essentials in both academic and non-academic development. Thus, foreign students from such countries must prepare themselves in a relevant area of research. Our chemical engineering departments must allow such flexibility. For those departments which cannot meet the specific needs of certain students must advise them to seek admission to another university. We believe this is one of the most serious problem areas facing many foreign students and chemical engineering departments today.

In addition, the growth of organized research activities with the chemical engineering faculty resulted from the environmental concern, the energy crisis and other national (U.S.) needs has caused unexpected problems. Frequently, sponsored research projects have been imposed on foreign graduate students in providing their financial support. Such an imposition has often distracted the students from pursuing their own educational objectives.

We believe some alternative to this practice must be found in order to provide a more relevant graduate education to foreign students in chemical engineering.

The Program

Intimately related to the purpose is the problem of the program. The debate on program is often centered on two aspects:

The breadth vs. specialization.

The basic fundamental vs. engineering practice.

Obviously, such a programmatic debate is important for all graduate students, but it takes on special significance for foreign students when their unique background and special needs are considered. Here again, the central question "How would it work back home?" plays a leading role.

1. The Breadth vs. Specialization: This issue touches closely on the very conception of what graduate training is for. Is it to produce a man of wisdom and broad cultivation or a man of specialized skill? Is it for a chemical engineer to know basic unit operations and reactor design, or should he also learn business administration and applied psychology?

We believe it is enough for a foreign student, especially those from developing countries, to concentrate in a basic chemical engineering curriculum, including required mathematics and natural science courses. He should resist the frequently heard outcry of "more breadth." Though many peripheral courses are nice to have, yet more often than not these are either survey-type courses or socio-economic courses which have little relevance when applied to problems in developing countries. A case in point is the recent development of energy related interdisciplinary program participated by many chemical engineering faculty. It would be an obvious mistake to encourage a student from an Arab country to study coal conversion processes to produce sythetic fuel while back home abundant petroleum and natural gas are available.

While the question of breadth vs. specialization is difficult to resolve, generally it can be settled for foreign students in terms of their special needs. We believe, in most cases, a foreign graduate student should try to avoid the temptation of "more breadth" and to pursue "more depth."

2. Fundamentals vs. Practice: The great majority of foreign students from developing countries has been found to be

well prepared in the fundamental science, mathematics and engineering courses. On the other hand, they are often found deficient in laboratory skills and experimental practice. Fortunately, this is one of the very strong areas of most chemical engineering departments in this country. We stand ready to privide the necessary training in laboratory work in terms of the method of investigation, the experimental techniques, the gathering of information or data, the reporting of technical findings. However, chemical engineering practice cannot be completed in the university laboratories. One must seek further educational experience with real life engineering problems in chemical industry. Unfortunately, such opportunity is seldom available to foreign students. It is in this area, we must seek the assistance of industrial institutions. The reluctance of industry to take on foreign students as trainees or co-op students is understandable. However, it is hoped that the long term benefit to the students and possibly also to the chemical industry (indirectly through company's foreign subsidiary or agency) will induce some large chemical cooperations to open their doors to foreign graduate students. Short of such direct industrial participation in the training

of these students, some chemical companies may be willing to provide extended two- or three-day plant trips to foreign students. In either case, it would provide the student with "real" life industrial experience, which has been solely missed by the foreign students.

In addition to the training in engineering practice, foreign students must be made aware of the benefit and pitfall of "technology transfer" from a developed country to a developing country. Many manufacture facilities and technical personnels were literally "transplanted" to developing countries by the U.S. after the Second World War. Few of these, if any, achieved desired success. These failures were resulted from the simple axiom: "When a full grown plant is stuck into the ungenial soil, it will not take root and it is destined to wither." Thus, a recognition of local needs and conditions is an absolute prerequisite for successful technology transfer.

Similar arguement can be advanced for the environmental area. The foreign student must be cognizant of how environmental laws will influence the development of his own country. He naturally does not wish to cause environmental catastrophe but at the same time he must not

propose unnecessary constraint to hinder an orderly development of industry. Again, there is a need for national awareness to be present for the correct appreciation of environment problems and development in the U. S. by foreign students.

In conclusion, we would like to repeat the question, "How would that work back home?" for both the student and the faculty to consider. Only when this simple yet difficult question is fully answered, we will then be able to avoid the "hit and miss" in educating thousands of foreign graduate students who come to us each year with high hopes and aspirations.

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