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REPORT ON THE NAFSA/AID WASHINGTON SEMINAR

ENGINEERING EDUCATION AND THE

INTERNATIONAL STUDENT IN THE UNITED STATES

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## INTRODUCTION

The Washington Seminar on "Engineering Education and the International Student in the United States," held on Friday, March 11, 1983, was jointly sponsored by the American Society for Engineering Education (ASEE) and the National Association for Foreign Student Affairs (NAFSA), and funded by the U.S. Agency for International Development (AID). The sixty participants (nearly double the number originally anticipated) included, in addition to members of the two sponsoring associations, representatives of other organizations and associations involved in international educational interchange, faculty members, and representatives of government agencies.

In the general introduction to the seminar it was noted that for the past thirty-five years the educational resources of the United States have served as a magnet that has drawn to its colleges and universities students from across the world. This has been the cause of both satisfaction and concern to the U.S. educational community and given rise to some policy questions of major importance which require special attention. Included in these are the question of finance - who pays for what in the education of foreign students, of relevance - and the appropriateness of studies and research projects to the conditions which will face students on their return to the developing countries, of the end results of educating foreign students in the United States - how do they relate to the needs in their home countries and to opportunities in the United States, and of the short- and long-term impact of large numbers of foreign students in U.S. education.

While these problems are perceived as part of the total process of international educational interchange, they acquire a special significance in engineering education because of the large numbers of foreign students who are in engineering schools as undergraduates, graduates, teaching and research assistants and who are also to be found among the faculty. The comments, cautions, and proposals which resulted from the meeting are derived from the reports of the small discussion groups in which the participants examined and placed in context the information and concerns which were presented by the speakers.

## PERSPECTIVES

Five speakers provided different perspectives as background for the discussions.

### Policy Issues

Dr. Robert Morgan, now serving as Science and Public Policy Fellow at the Brookings Institution, examined policy issues affecting the training of international students in technology. He identified four items of current concern which stem, to a large extent, from the fact that "in the field of engineering particularly at the graduate level, foreign student enrollments have risen to become a significant proportion of the whole" ("Engineering Education and International Students in the United States: Policy Issues" R.P. Morgan, 1983). Thus the question of the relevance of U.S. graduate programs in this field to the needs and expectations of foreign graduates and their sponsoring countries is one which properly continues to be the object of scrutiny. Dr. Morgan noted that, although there has been continuing debate and discussion, curriculum modifications to provide a more relevant, responsive academic program for foreign engineering students have for the most part not been made, nor have they been deemed by some to be desirable. External financial support to stimulate some potentially useful modifications has not been readily available.

Of more immediate concern are the implications of making available to students from foreign countries the latest technological information on what Dr. Morgan described as "frontier engineering areas." Current pressure from various sources to limit the free flow of unclassified scientific information comes into conflict with the longstanding belief in the value of the free flow of knowledge in U.S. society and the role which U.S. universities play as an educational resource of worldwide significance. In Dr. Morgan's words, these tenets "are not to be tampered with lightly." In the spirited debate now taking place there are some very strong views on both sides of this question.

Another issue attracting attention at this time is the extent to which foreign students take away jobs from U.S. citizens or to which foreign countries lose their trained manpower through the non-return of their students after study abroad. The perception that foreign student impose a burden on U.S. society is reflected in new immigration legislation now being developed. Proposed regulations would require that foreign students return home for at least two years upon graduation before being able to accept employment in the U.S., perhaps to the detriment of certain specialties for which trained U.S. personnel are in short supply. After pointing out the benefits to the U.S. of a relatively open immigration policy, and recognizing that whether foreign students remain or return is obviously a concern of their home countries, Dr. Morgan suggested that the answer to the "brain drain" might depend to a considerable extent on whether the foreign countries themselves take sufficient action to attract their students back home and develop their own educational infrastructure.

Finally, there is the question of the specific impact of foreign students on U.S. engineering education and the possible negative effects of large numbers of these students in engineering schools, especially at the graduate level. This concern suggests the need for a cost-benefit analysis in which, in addition to the financial considerations, other factors such as, the possible decline in quality education and the exclusion of qualified U.S. students, could be carefully examined and balanced against the beneficial effects of filling class vacancies, providing personnel for teaching and research and the value of the international understanding and commercial relationships which accrue from the education of foreign students in U.S. engineering schools. In conclusion, Dr. Morgan stressed the need for more information and hard data in order to find the answers to these and other questions.

#### Manpower

Dr. William Upthegrove of the University of Oklahoma reported on the recent study "Engineering Manpower and Education - Foundation for Future Competitiveness" (Business-Higher Education Forum, American Council on Education, 1982). He noted that while there were a number of swings in manpower needs and the current situation is somewhat disturbed, these are temporary problems which should not obscure the fact that there is a continuing need for trained engineers. The national status is monitored by four principal sources of engineering manpower data and projections - the Engineering Manpower Commission of the American Association of Engineering Societies, the Bureau of Labor Statistics of the Department of Labor, the Scientific and Technical Personnel Studies Section of the National Science Foundation, and the National Center for Education Statistics of the Department of Education. The results of a number of studies from these sources are illustrated in the report by the diagram of projected engineering manpower transactions, 1978-90 (p.17). This indicates that, although the situation is somewhat confused by the lack of a precise identification of an "engineer" (for example, not all those who graduate in engineering subsequently function as engineers and there are, in fact, continuing transfers in and out of the profession), the projected demand for engineers will increase from the one million required in 1978 to one and a half million needed in 1990. Dr. Upthegrove pointed out that there are two factors which relate specifically to students in

engineering. The first is the changing patterns of accrediting and licensing which now affect engineering employment in a number of states. The second is the flexibility in the relationship between supply and demand in which, both by addition and exclusion, foreign students are used as the resource for the "stretching" part of the system.

### Technology Transfer

Dr. Vladimir Yackovlev, of the Organization of American States, examined the question of the transfer of engineering technology for development, focussing particularly on the situation and developments in Latin America. He also stressed the fact that our understanding of the situation is confused by the lack of factual information. He then directed attention to the mobility of the students who are the agents of the transfer of technology. Within Latin America their movement is determined by a number of factors - most importantly (1) changes in political regimes (2) the state of the economy and consequent employment opportunities (3) fluctuations in the money market and massive changes in the currency values. Turning to the question of relevancy as it affects these students he emphasized that first priority must be to maintain the highest level of engineering education for foreign students in the United States. The perception that there is some difference in the education offered foreign students will be interpreted (especially in the developing countries) to mean that this is an inferior education. The values in engineering education are universal, special needs may be met by an orientation to the requirements or conditions of different countries. He noted that these foreign students through whom technology is to be transferred are often viewed as a problem in the United States, while he is convinced that research would prove that this is not the case. Transfer of technology through "brain power" is infinitely more effective than the transfer of plant or equipment and the country which offers the training will inevitably be the long-term beneficiary through the relationships established with the receiving country.

Dr. Yackovlev pointed out that in sharp contrast to the lack of any national policy in the United States regarding the transfer of technology and the education of foreign students is the very specific role of the Soviet Union in offering training to students from Latin America. Scholarships are offered to students from low income families, who will return home to work in the public, rather than the private, sector and may eventually dominate the industry of their respective home countries. Re-emphasizing the mutual benefits of technology transfer to both donor and recipient, Dr. Yackovlev noted that the number of foreign students in the United States continues to rise despite great efforts in institution building in the developing countries to create and increase their indigenous educational resources. He suggested that this will continue because at this time there is no way that the developing countries can cope with the demographic explosion in their student population. In the field of engineering the Central University of Venezuela provides an excellent example. In the College of Engineering, in all departments in the year 1975 from one semester to the next the enrollment increased from 3,500-4,000 to 7,000 and further to 10,000 in 1976. Such circumstances indicate that in many developing countries the transfer of technology for some years to come can only be through study and training acquired abroad.

### Relevant Needs

Dr. Stephen Dunnett of SUNY, Buffalo spoke to the question of relevance in the total educational experience of foreign students from developing countries as revealed in studies undertaken through the cooperative efforts of NAFSA and AID. (Needs of Foreign Students from Developing Countries at U.S. Colleges and Universities, Motoko Lee, NAFSA, 1981).

Two particular areas of need least satisfied were identified: practical training and management skills. Following these general studies a more specific survey was made in relation to engineering education involving deans of engineering in some 200 schools in the United States. This resulted in the report "Management Skills Training for Foreign Engineering Students: An Assessment of Need and Availability" (NAFSA, 1982). Summarizing the report Dr. Dunnett noted that the need for these skills arises from the conditions in which engineering students from the developing countries will have to work upon their return home: they will move more quickly to positions of wide-ranging responsibility, and they will have to function without the supporting roles and services which are available in the more developed countries. The skills required were (1) the traditional, basic management skills (accounting, finance, economics, marketing etc.) (2) technical, analytical skills (project management, production scheduling, quality control, etc.) and (3) human resource skills (to manage and work with individuals). In conducting the survey an effort was made to ascertain the way these needs are now being met, and while there was general recognition that this kind of training was necessary, it was also clear that for a variety of reasons it was not easily available in the university setting. The survey also included a number of program models which might provide the training required to prepare these students for assuming positions of responsibility and the means most generally favored was a combination of a specialized Master of Engineering degree, followed by some practical experience, and then a Master of Engineering Management degree, although in practice it would seem that such a combination is not easily obtainable.

The results of the survey and the discussions which followed with engineering faculty, foreign student advisers, and others made it clear that the provision of management skills for foreign engineering students is an area which needs to be addressed. Both those involved in educating the foreign engineering students and the students themselves must be made aware that a necessary element is missing from their education. To further illuminate the subject it is now recommended (1) that a survey be made of U.S. trained engineers who have returned home to ascertain what management skills they are now using and how they were acquired (2) that a more detailed examination be made of those U.S. programs which do provide a managerial framework within their technical programs in order to identify and support those which are successful and place students from developing countries in them.

#### Institutional Impact

Dr. Wakeland of the University of Illinois provided an institutional perspective on the impact of large numbers of foreign students on engineering education. He noted that in the 1970's most engineering colleges in the United States began to experience heavy admissions pressures. At the University of Illinois at Urbana-Champaign (UIUC) the response to these increasing pressures (which have occurred at a time of decreasing economic support) has been the raising of standards - so that currently in engineering at UIUC they are dealing only with the top 2% of students (based on ability), and a progressive restriction in admissions policies - so that effectively no foreign students are accepted at the undergraduate level and admission at the graduate level, once 40-60% of graduate enrollment, has now been reduced to less than 20% in programs which themselves have been cut by 5% in doctoral enrollments, 10% in master's degree enrollments and 15% in the entering graduate class. In the light of anticipated additional pressures it is likely that foreign enrollments will be further reduced.

The significance of these facts is that they reflect the actual economic support now available for engineering schools. Unfortunately, the decisions taken run counter to the present and future desire of third world countries to send students to the

industrialized countries to provide the faculty needed in the effort to establish and maintain their own educational institutions. In the resulting competition for the diminishing opportunities U.S. institutions will seek to admit only the best qualified students from among those who have adequate financial resources, although some relief may be provided through the development of inter-institutional relationships with the setting aside of preferred admissions for foreign students from specific areas or in specific programs. It is probable, however, that in the government sponsored programs there will be a demand for additional financial support.

Concurrently with this decrease in the foreign student enrollment, there is an increasing awareness that U.S. engineering students with international skills or foreign language skills are becoming more sought after in industry so that at UIUC an international minor has been added to the B.S. degree in any of the engineering disciplines. It is designed to emphasize a special geographic area (for example, B.S. degree with international minor in African Studies - and so on) and the requirements include a period of at least eight weeks in work or study relationships in the geographic area of interest. The university has had considerable success in placing students in foreign countries for summer work experience through the International Association for the Exchange of Students for Technical Experience (IAESTE) although, unfortunately, this is not always reciprocal in that U.S. industries do not offer similar positions in this country for foreign students.

Looking to the future, Dr. Wakeland said that the priorities for the University of Illinois will be:

1. to emphasize excellence in admissions,
2. to optimize opportunities for Illinois residents wishing to study engineering,
3. to optimize the opportunity for Illinois students to participate in international programs,
4. to maintain an ability to respond to international programs related to third-world development, and
5. to maintain an international reputation and involvement.

## DISCUSSION

In their discussions following the presentations the separate groups gave more detailed attention to a wide range of questions relating to engineering education and foreign students. They examined further a number of issues which were referred to in the presentations and introduced a number of new items which merited attention. As many similar ideas and concerns were reported from each group, this account of the discussions has been organized so that all the comments, suggestions, recommendations and concerns are combined under a series of topics.

### Need to Know

Underlying all the discussions was the recognition that much more comprehensive and precise information is required about the entire process of educating students from foreign countries in U.S. schools of engineering. More base line data and the results of longitudinal studies are necessary for knowledgeable decision making. The areas where information is needed include:

- the correlation between admissions policies and decisions and the subsequent success or failure of foreign students,
- to what extent the presence of a high proportion of foreign students affects the teaching and learning process in U.S. schools of engineering,
- funding and the relation of costs to benefits and the proper assessment of fees to foreign students, especially sponsored students,

- The extent to which, in the long run, national security is prejudiced and the U.S. economic position is undermined by including foreign students in certain fields of study, and the possible justification of impeding the free flow and exchange of technical information,
- the effectiveness of the education provided to U.S. trained engineers as demonstrated in their subsequent work experience in their home countries,
- the extent and the availability of supplementary courses required to provide a more complete and relevant education for engineering students from developing countries.

### Policy Issues

Questions were raised and some agreements were reached about a number of current policy issues.

- There was a unanimous agreement that the primary consideration must be the maintenance of the standard of excellence in engineering education offered to all students in U.S. institutions, that quality is more important and more valuable to foreign students than relevance, per se, and that the latter may be obtained without compromising the basic curricula.
- It was agreed that in order to maintain their international repute engineering departments in the United States must continue to be international both in faculty and students. Realizing the importance of providing an international dimension in the education of U.S. students it was suggested that policies leading to the exclusion of foreign students would be counter-productive, it was also suggested that insufficient attention has been given to the potential benefit to the institution's educational programs which may be derived from the presence of foreign students on campus.
- In considering the proper role of government it was agreed that while the absence of national policy causes some disadvantages, the diversity of U.S. education is one of its greatest strengths and must not be sacrificed. Referring to the imposition of restrictions to control access to certain areas of technology, it was stated that any impediments must be placed by the government (presumably by curtailing admission to the United States of foreign students in certain fields of study), restriction of the free flow of knowledge has no place on campus.
- It was recognized that there should be a more active and productive partnership between U.S. industry and engineering education. A more enthusiastic and positive approach is required to such activities as cooperative programs and practical training for both U.S. and foreign students. In this respect it was suggested that some form of tax incentive might be beneficial and it was recommended that more attention be given to the wide range of small business and industrial enterprises which have significant international relationships. At the international level it was noted that a relatively unexplored potential may be found among the foreign alumni of U.S. institutions who are now in business and industry in their homelands and may also provide U.S. students with opportunities for a training experience abroad.
- Much has been written about the apparent problems of educating foreign students, more emphasis should be placed on the results of this process. Insufficient recognition is given to the competence of the third world graduates of U.S. institutions in the hiring policies of international organizations which still tend to seek professionally skilled persons and consultants from the more developed nations. At the same time U.S. institutions, instead of ignoring or even obscuring their presence, should acknowledge the contributions that have been made to their educational programs by foreign students, researchers, and faculty.

### Admissions

The process of admission is key to a successful educational experience. For foreign engineering students individual needs must be matched with institutional resources so that the right student enters at the appropriate level in the proper program. At the same time there must be conformity of standards and foreign students must meet the same entry requirements as U.S. students - this is particularly necessary as the pool of foreign students expands faster than enrollment increases in engineering education. A number of items of current concern in the admission of foreign students were raised. These include:

- the fact that the basic task of evaluating educational credentials from different countries, educational systems, and institutions is now complicated by the difficulty of obtaining reliable information needed to evaluate newly established institutions in the field,
- the continuing need for proper interpretation of TOEFL scores in determining the English proficiency of individual foreign applicants, in this respect it was noted that in some cases GRE scores may provide a better guide,
- the danger of an "elitist" admissions policy regarding foreign students, which may contribute to subsequent "brain drain" while at the same time losing the long-term advantages and relationships with foreign countries that may accrue from offering opportunities to a wider segment of society,
- the lack of long-term studies required to equate admissions decisions with subsequent success/failure rates.

It was noted that, in the admission of foreign students to schools of engineering, assistance may be obtained from those who specialize in international educational interchange (as, for example, foreign student advisers) both with regard to the evaluation of foreign educational credentials, determining financial resources and English language proficiency, and to the special responsibilities which are incurred in the enrollment of foreign students.

### Impact

A review of the question and comments in each of the discussion groups suggests that at this time there is no certain knowledge about how, or how much, the presence of a relatively high proportion of foreign students is affecting the way that engineering education is taught and learned in U.S. universities.

- It was recognized that the continuing increase in the number of foreign students over the past decades (who, it was agreed, have made a significant contribution to the development of a number of engineering schools) may now be coming to an end and we may perhaps see a reverse trend resulting in more balance between the number of U.S. and foreign students in engineering schools. In this respect it was noted that some balance has been achieved in some institutions, for example, Iowa State University, by a policy of limiting the enrollment of foreign students to 10%, with no more than 5% of that number from any one country.
- It was suggested, however, that a deliberate policy which may lead to the drastic reduction in numbers, or even the exclusion, of foreign students may in the long run be detrimental to the institution, by reducing the international dimension and thus detracting from the value of the educational programs offered to all its students, and to the state and national interest, by impeding the development of needed international relationships.

- It was agreed that there can be a conflict of interest between the goals of engineering education in the United States and the needs of students from developing countries. Among the items which contribute to such a conflict are the special needs of foreign students due to different learning habits, inadequate proficiency in the English language, and a lack of familiarity with newer computers, all of which slow up the process of teaching and impose an additional load on the already overburdened engineering faculty.
- The engineering education process may also be prejudiced by the fact that, without an adequate resource of U.S. graduates, there has been an increase in the use of foreign graduate students as teaching assistants. Difficulty in understanding their spoken English, and differences in cultural approach and teaching style have caused some resentment among the U.S. students. There is an urgent need to provide advice and assistance to foreign graduate teaching assistants to remedy this situation.
- In an overview of the various aspects of both the positive and negative impact of foreign students on engineering education it was recognized that the situation is not static. Institutional needs and the international pressures of former years give way to new imperatives and there is a constant need for continuing study and new research to monitor developments on campus, at the undergraduate and graduate level, in employment, and in the eventual activities of U.S. trained engineers in their homelands.
- In the present circumstances, in order to further clarify the question of impact, there is a need to examine the implications of the relative costs and benefits of educating foreign students, to scrutinize the assumptions which inspire the proposed new immigration regulations governing foreign students and scholars in the United States, to evaluate both what is known as brain drain and what is meant by what may be called the export of brain power.

### Relevance

There was general agreement that the basic curricula must not be compromised and it was also recognized that attempts to provide a relevant education are too often equated with the offering of an inadequate or inferior education.

It was also agreed that any broadening of the engineering study program need not, and must not, result in a lessening of the acquisition of technological knowledge.

There was a consensus that the education of foreign engineering students can be significantly enhanced by such means as the selection of the most appropriate elective courses, the inclusion of field trips and pertinent extra-curricular activities, the addition of courses required to provide needed skills, and the provision of opportunities for practical training.

It was suggested that the key to a successful educational program for foreign students lay in the academic advising which they receive on the way to translate their U.S. learning to meet the conditions of their home countries.

Acknowledging that many faculty members, while recognizing the value of training in cross cultural communication, feel that this is a luxury for which they can afford neither the time nor the energy, it was proposed that a pamphlet be prepared to instruct and advise faculty about their role in assisting foreign students to acquire an education that will be most suitable to their needs.

Referring to the question of appropriate research, it was suggested that the situation would be improved if there was more cooperation between universities, government agencies, and foundations to prevent overlap and eliminate waste of effort. It was also suggested that long-term research both at the national and international level can provide needed opportunities for post-degree "apprenticeships."

### CONCLUSION

The nature of the meeting precluded the presentation of any formal conclusions and recommendations. The discussions served to illustrate the complexities of educating foreign students, especially those from developing countries, in engineering schools which are inevitably, and properly, oriented to the needs of United States students. The apparent success of this effort may be inferred from the statistics which show the high proportion of foreign students among those who enter and graduate from U.S. schools of engineering. The comments of those who are engaged in the activity illuminate the real problems which do exist and offer some suggestions for the development and improvement of the engineering education provided to foreign students.

Reported by  
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