

Exploring the Global Trend in Recruitment for Engineering and Technology Freshmen: Current Challenges and Suggested Solutions.

Dr. Rafiqul Islam
Dept. of Engineering Technology
Northwestern State University
Natchitoches, LA 71497
Tel: 318-357-5352
Fax: 318-357-6145
Email: islamr@nsula.edu

Abstract

'Going global' is a popular term in academia and industry today. In order to maintain leadership in interdependent global economy United States must possess an adequate technically literate workforce. Unfortunately there has been a substantial decline in enrollment in the engineering and technology programs in North American colleges and Universities since early ninety's. At this time of phenomenon growth, sweeping changes of technologies and the economic globalization it is rewarding to focus our whole hearted effort to recruitment. That is why, the author has identified the related target areas: to influence the students towards engineering and technology career in the K-12 level, to change the admission criteria and standards, to explore the need for global accreditation of engineering and technology programs, to launch special drive to attract underrepresented groups and to address employment opportunities and social status.

Recruitment is the first step towards ensuring the future of the engineering and technology education in this country. More emphasis should be given to influence the students at K-12 level which is the primary carrier goal decision time using collaborative engineering projects and curriculum development initiatives. The author has documented the overall trend of selective admission policy over open admission policy and it's effect on electronic engineering technology program of a Canadian institute. In recent years almost sixty percent of the continuously increasing work visas allocated by our Government are filled up by the engineers and technologists from Southeast Asian countries. A study of the reasons and means of enthusiasm and interest in engineering and technology programs there will be presented. A global accreditation in these fields should be helpful. The underrepresented groups specially the women whom represent nearly fifty percent of the population will be motivated to enroll and finish the program by understanding that the careers in these areas are exciting, rewarding and accessible. The overall job prospects along with ever lasting demands in some special categories will be

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pointed out to the employment concern students.

The goal of this study is to motivate and lure interested students to enroll in engineering and technology majors. A modest achievement in this area by each technical institute will definitely contribute to move US industries out of technical labor shortage crisis which nation demands and deserves.

Introduction

Shrinking enrollments in engineering and technology programs pose a potentially serious problem for American industry and society in general. It is important to mention that there is no substantial difference between the US and Canada in terms of published studies dealing with recruitments and retention of traditional college age students¹. It is also established that the monumental growth and sweeping changes in engineering and technology will keep on shaping our society throughout the 21st century as we have already entered into economic globalization. This is why, the combined problems of enrollment and retention are not only the concern of engineering and technology administrators but also the industry people. Indeed, the demand for engineering and technology graduates is expected to rise gradually in the foreseeable future as the industries are increasing seeking graduates with appropriate background and training in different conventional and emerging fields of engineering and technology². The nation must have to shift its reward structure from entertainment focus to technology focus. A limited number of students are seeking out higher education in engineering and technology fields due to limited exposure to engineering and technology related contents early on in education. It is vary important for a technologically advanced society that the students at the earliest age (k-12 level) must be inspired to learn by seeing engineering, science, and technology as opportunities that are fun, rewarding and achievable³. Selective admission policy institutes show a positive effect on retention in contrast to open-admission policy institutes. Global accreditation of engineering and technology programs can ease the transition of foreign born engineers to our desperately needed job market. At the same time our engineers find it rewarding and fulfilling to work in a global market through multinational companies. This is why, the author thinks that it is vital to focus on recruitment first and subsequently to retention for the health of the technological society in which we are living. Global recruitment is studied from several perspectives as mentioned earlier with more emphasis on K-12 level innovations, global accreditation and underrepresented groups.

K-12 level innovations

There is an impression problem about the engineering and technology profession among majority of Americans as they are not clear about what engineers do⁴. Too few high school students understand that a career in engineering and technology can genuinely be exciting and neat. The perception is that it is too difficult a career path and the students are quite afraid of math and science. The National reports support this impression as US students in k-12 level currently lag behind their peers in other countries in math and science achievement⁵. The on-going decline in freshman engineering and technology enrollments since mid-1985's provides an additional support². On the top of it there is a declining pool of high school graduates in some states. The

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problem seems to lie at K-12 level when students are making decision about their careers.

The result of a recent survey among 36 students in Electronic Engineering Technology program at the Northwestern State University is illustrated in figure 1 given below:

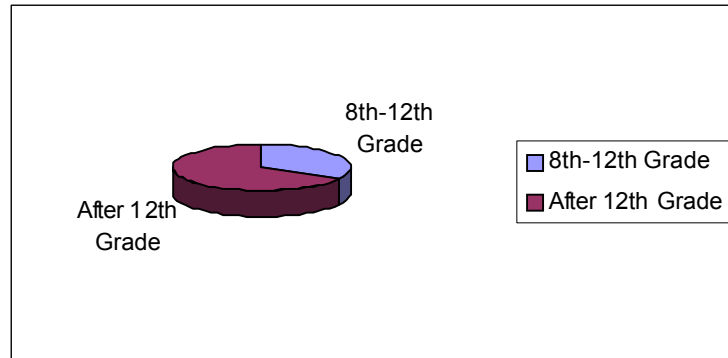


Figure 1 Distribution of decision effects at different grade levels

The result shows that 67% of the students decide about their career as engineers and technologists after 12th grade whereas 33% of them in high school levels (8th-12th). The author identifies that there is scope in 8th-12th grade levels to influence more and more students towards engineering and technology programs.

Traditionally outreach efforts are directed at early as middle school but primarily during high school. But we need to accelerate today's trend to change the traditional methods at k-12 levels, as the expected increase in interested students has not happened yet. Now a day, the primary age school children feel very comfortable using electronic equipment. We must work hard to keep up their natural inquisitiveness. The change must come from teaching level. The K-12 level schoolteachers are not well informed about engineering and applied mathematics and science. The lack of understanding of engineering and technology by curriculum designers and teachers make it difficult to introduce engineering concepts into courses. They must be educated first in terms of engineering and technology professions. It is established that the schoolteachers who have an appreciation for engineering and technology will convey that appreciation to their students, which, in turn will attract more students to choose careers in scientific and engineering disciplines. A collaborative relationship between teachers and university personnel to bring about the necessary changes has proved to be effective between North Carolina State University and North Carolina public schools. The primary goal has been the integration of science, technology and engineering tropics with math, reading and writing. A similar type of program has already assessed 15,000 students in Canada and suggested the same results⁶. A technology literacy course titled 'Toys with Technology' has been developed as an undergraduate course to be offered to elementary and secondary education majors. It has been an effective collaborative effort between engineering faculty and teacher education faculty that has brought fruitful results at the Iowa State University.

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Several Universities and colleges have developed workshops for high school teachers interested in developing pre-engineering curriculum. They have performed hands-on laboratory experiments that can be implemented at the high school level to introduce basic engineering principles and technology to inspire the students to study engineering⁷. The engineering students and the alumni (professional engineers) are also involved in supervising students completing various engineering projects under some engineering programs. All the states should follow the footsteps of Massachusetts that requires engineering education at all levels of public schools⁸.

Admission Criteria and Standards

Several Universities and colleges in the United States are replacing the open-door admission policy with selective admission policy. Those open access institutions have experienced high attrition rates especially in engineering and technology programs. The high rates of student attrition have been attributed in part to the under-prepared students⁸. The dropout of a student after first year of education is considered overwhelmingly by the education community as a terrible waste of human and financial resources. In this world of optimization rather than maximization it is more important to recruit the right student as his/her survival chances are higher. The selective access policy called 'Access Plus' program of Missouri Western State college increased the freshman-to-sophomore retention rate by 10 percent. The DeVry Institute of Technology at Calgary, Canada implemented the selective admission policy in the hope of boasting the retention rate during spring, 1998. The goal was to achieve a retention rate of 50% by 2005 from 44% during 1997/1998. The retention is slowly but gradually increasing since then.

Northwestern State University at Natchitoches, Louisiana has an open-door admission policy. The overall enrollment has gradually increased and exceeded ten thousand marks by the spring of 2002. Unfortunately the retention in some areas especially in education and engineering technology departments is declining steadily. The University administration has hired Noel-Levitz, an organization specializing in higher education enrollment, financial aid and student retention for help. The recent report submitted by Noel-Levitz has suggested adapting selective admission policy. The University has planned to implement selective admission policy from spring 2005 in the hope of improving the situation. The minimum requirement of composite ACT score is increased to 20 from 18 keeping all other parameters more or less constant.

Global Accreditation of Engineering and Technology Program

It is a familiar fact that we are not producing enough engineers and technologists from the segments of our own population. The engineering enrollment lags particularly among African Americans, Latinos and American Indians. The engineering pool is dominated by white males. But according to Census Bureau report the population of white non-Hispanic men is expected to decline by 10 percent by the middle of the century while that of the minority groups will gradually increase with the passage of time. We will keep on losing on both the accounts until something is done about it. For the last several years the US Government had no choice but to keep on increasing working visas for importing engineers and technologists from overseas to cope with the severe shortage. In 1995, 65000 visas were granted while that amount has been increased to

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215000 by the year 1999. Clearly we are relying on foreign-born engineers which is risky. It may push us to a human capital crisis like 1973-oil crisis. In recent years about sixty percent of the work visas are filled up by the engineers and technologists from Southeast Asian countries. Let us look at those countries for reasons of motivation towards engineering and technology professions. As a result of Government policy, public prestige, remuneration and education policy the high school graduates enthusiastically compete with one another to enroll to limited number of spots. As an example, in India all across the nation, hundreds of thousands of youths sit for two-day qualifying exams to gain the right to 2000 spots in the most competitive Universities for the most prestigious engineering careers⁹. Similarly in Bangladesh out of thousands of applicants only the first 4500 students on the basis of their nationwide 12th grade exams are allowed to sit for entrance exams for 800 spots at the top most engineering University. The other Universities and colleges also follow very similar procedures. This is recognition of influence of engineering education in the society of that part of world. The prestige in the society as well as the engineering friendly high school curriculum provide the means to create this kind of enthusiasm and interest for this remarkable specialties. Here in the US the engineering and technology profession is perceived as isolating and lacking in social relevance. Engineering is not featured in popular television program and usually gets overshadowed in news reporting even though technology dominates the social landscape⁴. General conception is that the math and science are hard and boring. Some students have short-term view that good-paying jobs are plentiful, so why take the really difficult courses. We should explore all the ways to turn these negative expressions around. In this situation the global accreditation of engineering and technology programs will definitely be helpful. In today's global environment the engineers and technologists must possess not only the technical skills but also cross-cultural knowledge and understanding. In order to increase the global competence of the US technical work force and to train them for leadership positions in the worldwide arena international education must be incorporated in the engineering and technology curriculum. Interactions in terms of international exchange programs, international internship program, specialized summer programs for engineering and technology must be developed.

A win-win co-operative agreement between the college of engineering and technology at Old Domain University and Rajagiri College under Mohatma Gandhi University, Cochin, India to flourish global engineering education has paid off. Rajagiri is benefited being able to begin an accredited engineering program whereas Old Domain University is benefited by attracting high caliber students that otherwise would not come to US for second half of their study time. Even though there has been no physical presence of the students from Old Domain University to Rajagiri College yet they have been closely linked electronically in today's global village¹⁰. Both parties have been introduced to each other's systems, which results in awareness of two cultures. The chemical engineering department of North Carolina A&T State University and Bangladesh University of Engineering and Technology (BUET) have collaborated to enhance pollution prevention activities in Bangladesh through joint curriculum development and research project programs sponsored by a USAID linkage program¹¹. The faculty and students are interconnected through electronic conferencing technology in order to save cost and to maintain sustainability. Eventually they have got the desired technical and cultural exposure.

Underrepresented Groups

As women constitute 50% of the population, an increase in women choosing careers in these fields could help curb the predicted shortfall in the professional workplace. In the United States the job growth rate for the scientists and engineers should be twice the rate of rest of the economy around 2000s. Women and minorities must be the other sources in the engineering workforce rather than the traditional white male. However, young women are not choosing technical careers at the same rate as young men. The motivation must start in high school level, as drop-off in the study of technical careers among young women is extremely steep from high school through college. They should be persuaded with the programs that support and encourage them to choose challenging career options in engineering and architecture¹². The WISE (Woman in Science and Technology) program in Newfoundland and Labrador during 1988 has placed 320 grade eleven female students in paid, eight-week summer research positions in Memorial University. They have enjoyed hands-on exposure to work, weekly tours and personal interactions with scientist and engineers. The aim was to demonstrate that careers in these fields are interesting, rewarding and accessible as well as to build self-confidence and to provide support network for the students. Other activities are organized to enable enough students to socialize with each other and other mentors and to be exposed to wide variety of career options. The WISE participants have conveyed very clear and powerful outcomes of the summer program which centered on education/career related advantages and on personal growth¹³. In secondary school, the boys and girls alike should be encouraged to keep their options open by selecting mathematics and science courses especially physics, chemistry and advanced mathematics, along with home economics and technology/shop courses. Empowering girls and young women to believe in themselves is another key objective of any program.

Though the enrollment of women in Canadian undergraduate engineering programs has increased steadily from 1989 to 1995 to about 20%, their enrollment in mechanical, computer and electrical engineering is low (9-12 percent). We must increase the enrollment in the later cluster as many of today's well-paying jobs are in these fields¹⁴. A closed loop co-ordination which includes all elements of education system especially parents and teachers can help remove obstacles and barriers. The women faculties in engineering have very positive effect on the retention of female students. The environment in the campus is also a decisive factor and issues such as accommodating education and family (childcare). The elimination of harassment, sexism, and discrimination will have a positive impact on the retention of women who have chosen to be engineers. Active participation of woman is also desired to make sure that their perspectives and needs are adequately reflected in the governance of the profession. The women student enrollment and retention are even more important when there is a projected decline in male high school students. Also the 'chilly campus climate' has identified the behavior that causes women to lose confidence, lower their academic goals and limit their career choices. The studies conducted in the US and Canada found similarities. The minority students are also considered as a vital source of graduates needed for engineering workforce. All the Universities and colleges should provide a sincere push to enroll and retain the minority students who have decided to pursue an engineering and technology education. It will enhance diversity in the work place as well as competitiveness in an increasingly diverse consumer market. From the corporation points of view it is established

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that diversity in the work place enhances creative thinking, improves decision making, increases worker retention, recruitment and productivity and decreases legal vulnerability in today's market place.

Employment Opportunities

The goal of the colleges and Universities is to prepare the technical workforce for immediate employment in a wide variety of industries and businesses. In today's education environment the graduates are coping with a combination of high debt and an uncertain job market. Evidence from the US shows that reducing the debt of first-year students from low-income backgrounds significantly increases college retention¹⁵. The occupations are influenced by the ups and downs of the economy, as some are more sensitive to economic fluctuations than others. Also the sectarian unemployment rate varies relative to overall unemployment level. Statistics Canada regularly produces unemployment data broke down by various demographic variations as well as by occupations and industries. In an excellent article 'unemployment-occupation makes a difference' the unemployment rates of different occupations are tracked over time to see the rate of growth of employment in a recovery time and a decrease of employment in recessionary times¹⁵. The labor market and the prevailing unemployment rates in particular affect attrition. Students are more persistent when they perceive that holding a diploma/degree will give them a competitive edge to find employment in a difficult time. The information about job markets and realistic employment prospects must be an on-going service to the students. They may realize their long-term benefit from completing the program by achieving increased marketability, flexibility and income potential throughout their working life. The students should also be notified that recession does not last for long time specifically in the engineering and technology fields. The recession of 1991 and the boom for the last decade (1991-2001) have proved it. There will be no shortage of jobs in the global market in these fields. Thus the clear picture about prospects of jobs in these fields will help students to enroll and hang around until completion of diploma or degree programs. A positive awareness about engineering profession in the society will establish the prestige they deserve.

Conclusion

Recruitment and subsequent retention of students is an important goal for the Universities and colleges throughout the globe. Meeting that goal requires both recruiting motivated and prepared students from every segment of our population and retention ensuring that those who do enroll complete their degree or diploma. The success of electronic Engineering Technology program of DeVry Institute of Technology at Calgary, Canada in terms of retention through selective admission policy is presented in this paper. The effect of implementation of selective admission policy of Northwestern State University will be presented in the subsequent paper. The result of a survey in the engineering technology program of the Northwestern State University identifies the need for motivation in the 8th-12th grade levels towards engineering and technology career path. The author believes that well trained technology friendly schoolteachers can convey their appreciation to the students. Collaborative engineering projects and pre-engineering curriculum development are the suggested ways to proceed. Some innovative approaches in these areas will

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make engineering pursuits more attractive. Global accreditation of engineering and technology programs should be the way of the future. This will provide a needed boost to the engineering and technology education in the United States. Interaction with more and more Southeast Asian countries in technology fields will bring tremendous benefit to our nation even though it is not a permanent solution to our overall shortage of skilled technical labor force. In today's world, human capital is our most valuable resource. The fields of engineering and technology can only become more diverse and broadly based as relatively untouched population such as women and minorities are involved. It is necessary to create unique opportunity to accelerate progress on the participation of women in science and engineering programs. Otherwise it may decline, if the obstacles, that are more systematic in nature and embedded in culture, the curriculum and teaching style, are not removed. We have the responsibility to convey the message that enrolling and completion of a diploma or degree program brings benefits such as increased employability and higher potential lifetime earnings. Increased awareness of market conditions will reduce unrealistic employment expectations and help students establish long term goals.

The author's goal is to help the colleges and Universities to recruit motivated and prepared students and to stare them to succeed which society deserves. It can be achieved by following the examples presented here.

Reference

1. Cheryl, Moller-Wong, Arvid Edie, 'An Engineering Student Retention Study,' Journal of engineering education, January 1997.
2. Mary Besterfield-Sacre, Cynthia J. Atman, Larry J. Sherman, 'Characteristics of First-year Engineering Students: Models for Determining Student Attrition in Engineering,' Journal of Engineering Education, April, 1997.
3. Dana De Geeter, Jenny E. Golder, Terri A. Nordin, 'Creating Engineers for Future,' Proceedings of ASEE Annual Conference at Montreal, Canada, June 2002.
4. Domenico Grasso, 'Engineering a Liberal Education,' ASEE Prism, November 2002, p 76.
5. Lawrence J. Geleno, Melinda Gallagher etc, 'An Engineering Linkage to K-12 Teachers,' Proceedings of ASEE Annual Conference at Albuquerque, NM, June 2001.
6. Laura J. Bottomley, Elizabeth A. Perry etc., 'Lessons Learned from the Implementation of a GK-12 Grant Outreach Program,' Proceedings of ASEE Annual Conference at Albuquerque, NM, June 2001.
7. Eric E Matsumoto, John R. Johnston, etc., 'A Simple Beam test: Motivating High School Teachers to develop Pre-engineering Curriculum,' Proceedings of ASEE Annual Conference at Albuquerque, NM, June 2001.
8. Virendra K. Verma, Judith W. Grimes, Huiming Wang, 'Impact of Open-Door Policy in Admission on Retention of ET Students,' Proceedings of ASEE Annual Conference at Albuquerque, NM, June 2001.
9. Travis Engen, 'Something to Shout About,' ASEE Prism, December 2000, p 80.
10. Stephen Saharan, Sacharia Albin, William Swat, 'Global Engineering Education: A Partnership between Rajagiri College (Cochin, India), and Old Domain University (Norfolk, VA),' Proceedings of ASEE Annual Conference at Albuquerque, NM, June 2001.
11. Keith A. Shimmel, Shamsuddin Ilias, Frankin G. King, A.K.M. Abdul Quader, 'International Development Partnership with Bangladesh University of Engineering and Technology in Pollution
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12. Prevention,' Proceedings of ASEE Annual Conference at Montreal, Canada, June 2002.
Camillie F. DeYoung and Suzanne D. Bilbeisi, 'Reaching Engineering and Architecture Career Heights: College Program To Interest Young Women in Engineering, Architecture and technology,' ASEE Annual Conference Proceedings at Charlotte, NC, June 1999.
13. Carolyn J. Emerson and Faye Murrin, 'I know I can be Whatever I Choose: Outcomes of a Summer Job Experience, Presented at the Women at the Workplace: Achieving Harmony Conference', Vancouver, B.C., May 22, 1988.
14. Monique Frize, Claire Deschenes, Elizabet Cannon etc., 'A Unique National Project to Increase the Participation of Women in Science and Engineering. ' Presented at the Engineering Foundation Conference on Women in engineering, Mont Tremblant, July 14-18, 1998.
15. Gower, 'Perspective,' winter 1991, Statistics Canada.

Biography

Dr. RAFIQUUL ISLAM is a faculty of the Northwestern State University at Natchitoches, Louisiana in the department of engineering technology. He had been on the faculty of the DeVry Institute of Technology, Calgary, Alberta, Canada, for five years. He also taught for four years at the West Coast University, Los Angeles, California. He has ten years of working experience in the areas of communications and computer applications in power and control systems. His areas of interest include cellular and PCS phones, microwave and satellite systems, fiber optics and wireline and wireless LANs and WANs.