Foreign Language and Cultural Understanding in Engineering Curricula

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Introduction

Today's transnational organizations recruit engineers who are multilingual and possess cultural understanding. Foreign language diversity and cultural understanding enrich both the corporation and the university. Global diversity deepens an organization's ability to establish and maintain a competitive edge. Progress has been made in recruiting, hiring, retaining, and promoting engineers with foreign language and cultural skills. How should engineering educators support corporate goals and encourage placement of graduating engineers in a global environment?

Objectives:

- Profile engineering/technology academicians from China, India, South America and the Middle East to enhance understanding of country differences
- Share Fortune 500 transnational engineering recruitment preferences
- Explore marketing techniques to successfully attract international students
- Create an environment for retention of all students

Profile 1: China

Higher education opportunities in China are very limited as compared to the United States (US).[1] The Chinese government heavily funds economic growth, yet this is not the case for education. The government of China invests merely 2.3% of its GNP[2] into the educational system, as compared to an investment of 5.4% in the US. An expanded list of GNP expenditures for education is provided in the *appendix*. China's population increased rapidly and educational investment remained status quo. Thus, admission into a Chinese university is possible for a very small percentage of aspiring students.

Chinese students learn English as a required subject for the Chinese College Entrance Examination. The English learned, however, is text book. It is common for Chinese students to be able to read and write English well, however, their pronunciation lags. The level of English required for Chinese entrance exams is not adequate to compete scholastically on the university level in the US. Thus, students often enroll in English courses prior to or in conjunction with studying at a US university.

In general, Chinese students are well disciplined. Chinese junior and senior level schools levy great pressure on students. Much time and energy is required to compete. Summer break is approximately two months versus the US average of three months. Schools offer "extra study" on Saturdays, and an additional three to four weeks of "extra study" during the summer months.

If a school would not offer extra study, parents would question the educators to the point of almost demanding the opportunity. When extra study is arranged, Chinese students must attend.

Although a small percentage of Chinese youth are successfully accepted into the finite number of national colleges, almost every parental pair saves without fail to be able to fund the child's advanced education. Since wages are low in comparison to other oriental cultures (ex: Japan), both parents must work to be able to afford food and education for the child. Usually a Chinese couple has only one child due to a law passed in the late 1970's that allowed each family only one child without penalty. The reason: to curb a rapidly rising population before the country could no longer support its own peoples' needs. If a couple in China has a second child, the family is required by law to pay for medical care, school, and other benefits that are usually provided by the government.

The Han race composes 94% of China's population. Members of minority groups, including Mongolian and Muslim, do not have birth rate restrictions. Minority students are allocated additional points on their final scores for the College Entrance Examinations. China remains an agricultural country. Farmers struggle financially as farm income has lagged the national average income. Farm children face more obstacles to access higher education than city dwellers. China offers national financial aid, yet the application process is not convenient and is rather difficult.

Cultural differences include:

- Stronger exam pressure in China: The final exam accounts for 90-100% of a course grade. Chinese students may be quite relaxed earlier in the semester. However, once final exams are a month away, everyone becomes very serious.

- Part-time jobs: In China, students do not work and attend school. The strong pressure to dedicate substantial time and energy to study does not bode well for working students.

- Instructional style: Chinese professors teach content and assign homework. Students are not empowered to research, learn on their own, and apply knowledge (application). In China, the focus is on the textbook.

- Grading: In China, grades are not a secret. Grades are posted by name, highest to lowest. At times, Chinese educators will use black pen to enter the lowest scores on the list to indicate "study harder".

- Courses: Coursework in the US may lag what was learned in China. Due to pressure on students to be competitive for the future, students arriving at campuses in the States may be bored with initial math or science courses.

- Socially: Chinese students are not encouraged to date. Dedicating time and energy to studies in order to be competitive in the future is stressed.

- School/Work day: Students as well as employees observe two-hour lunches. The work day may span from 8 AM to Noon, then 2 PM – 6 PM. Most Chinese people go home for

a freshly prepared lunch and a nap. Few people in China have freezers. Fresh food is cherished and wholesome eating is foremost for the Chinese people. Fresh, "live" food is a valued commodity. Wal-Marts in Beijing sell live fish for dinner. The very best restaurants house a fish tank with live fish (similar to lobster tanks in the US).

Profile 2: India

The opportunity for a university education in India is good, yet competitive for higher learning[3]. Some institutions offer advanced doctoral degrees. The government of India invests 3.2% of the GNP into education, versus 5.4% in the US. India's K-12 program is very rigorous. Summer break spans merely six weeks. There is substantially higher emphasis on science and math than in the States. This bodes well for future Indian engineers and educators.

Cultural differences include:

- Academic preparation: Educational standards in India surpass the US in math, science, and computer technology.

- Food: Pizza is a different concept. Some are unsure what "hamburgers" or "burgers" are. Most people from India do not eat beef. Even cheese pizza is a surprise: people in India eat very little cheese.

- Temple: Eighty percent of the Indian population is Hindu. Initially some students will find it difficult to locate a Hindu temple.

- Settling in: Indian students may not have transportation. Locating staples such as milk and bread are not the issue. Discovering where to purchase Indian food favorites and needed ingredients for authentic Indian cuisine pose a challenge. Students, once acquainted, may carpool to an Indian grocery store.

- Dating: In India there is no dating. Women and men occupy separate benches on campus. Dating practices and cohabitation of US students may surprise Indian students.

Profile 3: Columbia

By South American standards, Columbia is a very developed country[4]. In comparison with the US government investment of 5.4% GNP, Columbia allocates 4.1% GNP to education. Families in Columbia may have owned computers and TV sets before families in the US. The educational system in Columbia is strong: a bachelor's degree historically is a six-year commitment. Current legislation is attempting to compact undergraduate degrees to a total of five years. From a university stand point, textbooks in Central America, South America, and Mexico are fairly uniform: as is the written Spanish language.

Adult South American students may enroll in English classes in preparation for, or simultaneously with, university coursework. Some students may ask to tape record lectures and write notes in English outside of class. Time and translation are the reasons. Some may

translate the textbook into Spanish as they study. In general, Columbian students are very strong in math and science. All Columbian students take English: the government requires this from elementary school through high school. Young adults transition readily to English spoken in the US. Some may need to work on vocabulary (pronunciation) as well as to develop non-technically oriented English skills.

Universities in the States will likely see an increase in undergraduate students from Columbia due to guerilla activity. In Columbia's major cities, some guerillas pay the tuition of student informants to gain information about and access to university students who are targeted for kidnapping. Almost all kidnapping is monetarily driven: guerillas are after the ransom. Guerillas target the wealthy-those who can pay ransom. The opportunity to have a loved one returned is best if ransom is paid soon after a kidnapping. When time elapses, kidnapped victims are sold and moved into the country.

Cultural differences include:

- Formula sheets: These are not permitted in Columbia. Some students may misunderstand the use of formula sheets in exam situations. Some may even suspect other students are cheating.

- Additional work: Students in Columbia expect additional assignments. Students in the US complain more about additional expectations than Columbian students.

- Climate: Columbia is a temperate climate. Owning clothing for four seasons is not necessary.

- Entrepreneurship: The Universidad La Gran Columbia is the Civil Engineering school. The emphasis is on entrepreneurship; creating companies rather that working for someone else.

- Cultural misunderstanding: Some Americans expect South Americans to either be like the people of Mexico or live in jungles (true accounts). There is a narrow understanding of the cultural diversity of Hispanic people. As well, Columbians may find Americans to be cold and unapproachable. Columbians do not phone first to see a friend; they arrive at their home instead. If the family to be visited is dining, food is shared with the visitor.

- Food: Compared to Columbia, the US has very limited supplies of fresh food, fruits, and variety. Even food imported from Columbia lacks flavor and freshness as it is harvested too early in order to meet transportation requirements. Like the Chinese, people of Columbia do not have freezers or have very small freezer compartments. Freshness is valued.

Profile 4: Egypt and Kuwait

Middle Eastern countries are diverse. Logically they vary in educational investment. Leaders in percent of GNP expenditures into education are Israel (7.6), Saudi Arabia (7.5), Jordan (7.9), and Yeman (7.0). Others closely mirror the US: Kuwait (5.0) and Egypt (4.8). For sake of cultural diversity discussion, this author will focus on Egypt and Kuwait.

In Egypt, the majority of universities are public and thus nationally funded[5]. Students accepted at public universities cannot choose majors. Testing and high school grade point averages determine the area of study for each student that attends a public university. The Maritime Transport Academy of Alexandria, Egypt is a private university. Tuition is paid in US dollars. Some students choose private enrollment so they are able to choose a degree path.

The majority of post-graduate students are leaving Egypt to seek employment. Although graduates were well educated in technology careers, career opportunities are limited. Factories lack equipment and technology. Jobs available do not align with what university students have learned. If graduates want to put into action what they have learned academically, they needed to relocate. Attractions for students from the Middle East to study in the States include access to technology. Labs in Egypt are very limited if available at all.

Cultural differences include:

- Instructional style: Egyptian universities teach theory. In the US, application is stressed.

- Varying admissions procedures: In Egypt, universities are either private or public and admission procedures are easy to interpret. Universities in the States vary dramatically. This is confusing to incoming international students. Long waiting times for acceptance along with a wide variation in admission fees and testing requirements frustrate incoming students from Egypt.

- Language diversity: Egyptian students are most likely to study German, English, French or Russian as a second language. Difficulty in communication can result in extreme culture shock.

- Low numbers: As a proportion, Middle Eastern students are a small group compared to international students from other cultures. Thus, professors need to deal with each student on an individual basis, keeping his/her personality in mind.

- Religion: Some Muslim students who do not affiliate successfully with a local mosque return home.

- Food: Most members of the Muslim faith do not eat pork. Many may need to ask if foods contain pork or pork products as this is not obvious to ascertain.

Fortune 500 Transnational Recruitment Preferences:

Fortune 2: ExxonMobil

"At ExxonMobil, we realize our success depends on attracting and retaining the best, most innovative results-oriented employees. The way we view it, our people are our competitive advantage and the key factor in achieving our goals.[6]"

ExxonMobil's corporate website is designed to attract engineering candidates. At the first level, BS or MS degrees, four engineering disciplines are outlined: chemical, civil, mechanical and petroleum. They regard themselves a technical and **global** powerhouse. Thus, working on major projects in diverse settings is advocated.

"Just as a civil engineer would not construct a building on a weak foundation, successful engineering professionals do not build careers on weak foundations"

Fortune 5: General Electric

"When you work at GE, you work with people who have a passion for learning. Their obsession with finding better ways … creates exhilarating work environments.[7] We recognize the power of the mix, the strength that results from successful diversity. Our business and workforce diversity creates a limitless source of ideas and opportunities. GE's diverse culture has given rise to networking groups, including African American Forum, Asian American Forum, Hispanic Forum, and Women's Network"

In an interview with Steve Canale, Manager of Recruitment and Staffing for GE, Mr. Canale shared these perspectives with this author on behalf of all ASEE contingencies:

Academic Profile: Because this is a competitive, **truly global corporation**, there is a mandatory GPA cut off at 3.0/4.0 for consideration of employment with GE. The average engineering new hire has earned a GPA in excess of 3.6. Internships or coop experience is almost mandated. Canale, a top recruiter for GE, stated he looks for engineering candidates that are also articulate and have a personality. "Many of the top students are getting it…they realize they need more than a resume: they need to be able to present themselves. We look for very strong team players; people who have ambition and want to succeed. Above all, candidates should have a burning desire to grow, learn and a good work ethic."

GE spans 100 different countries. Of the 130,000 GE employees, one-half are located outside of the United States. Financially, GE generates half of its 150 billion dollars of revenue outside the US. In general, GE hires from the country of origin (in China, they hire Chinese engineers; in India, the hire Indian engineers). Students from other than US cultures who complete a degree within a US university and are willing to return home to their country of origin are VERY attractive to this global corporate recruiter. GE does not hire engineers from other countries for work in the States except at the PhD level. This is largely due to US employment guidelines.

The overall decrease of foreign engineering students in US universities is a concern to Canale and GE. One of GE's biggest concerns is the availability of technical talent in the US, from grade school on up. As GE needs to recruit the best, skilled employees people with the skills needed, GE recently added Research and Development (R&D) centers outside of the US. They have 500 PhD's employed at the R&D center in New York. This historically was the *only* corporate R&D location. In recent years, GE added three international R&D centers. They now have 150-200 PhD's employed at each of the three newer centers: Shanghai, China; Bangalore, India; and Munich, Germany. Their decision was NOT driven by cost, but rather by the availability of engineering talent.

Fortune 9: International Business Machines (IBM)

"Diversity...the bridge between the workplace and the marketplace"[8]

IBM offers opportunities for chemical, electrical, environmental, industrial, mechanical, and microelectronics engineering. A diverse, global corporation, IBM recruits for The Americas (Argentina, Brazil, Canada, Chile, Colombia, Ecuador, México, Paraguay, Perú, United States, Uruguay, and Venezuela); Asia Pacific (Australia, China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, New Zealand, Philippines, Singapore, Taiwan and Thailand); and Europe/Middle East/Africa (Austria, Belgium/Luxembourg, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Egypt, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Lithuania, Morocco, Netherlands, Norway, Pakistan, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Tunisia, Turkey, UAE, United Kingdom, and Zimbabwe).

Every time an engineering problem is approached with a pale, male design team, it may be difficult to find the best solution, understand the design options, or know how to evaluate the constraints.

-- Wm. A Wulf, Diversity in Engineering [9]

Explore Marketing Techniques to Successfully Attract International Students:

With continued threats of Al-Qaida terrorist activities against US interests, the government has made it more difficult for international students to attend universities in the States. At Purdue University's main campus, West Lafayette is a leader in diversity. This campus hosts approximately 5,500 international students. Due to immigration restrictions adopted in Washington, D.C., lobbying may be the most important marketing tool for today's university president. As an example, Purdue University President Martin Jischke traveled to Washington to advocate for a bill last November that would assist international student recruitment.

The primary issues center around F-1 visas. Terrorists entered the States with F-1 visas prior to the World Trade Center attacks under the façade of studying aeronautics. The results for universities today include the necessity to report international student data at the beginning of each semester. International students are not allowed to work off campus unless previously approved by the campus contact. International students must also supply information to show

financial solvency for tuition and housing. Specific information can be found on the Immigration and Customs Enforcement website: www.ice.gov.

What are other techniques for marketing the university to international students? Many academic websites include some information. Web marketing, however, is a passive tool. Frequently international students cannot access clear and comprehensive information regarding opportunities to study abroad. International students remain frustrated and unclear about application processes in the United States. Confusion and lack of clear information abound. An international marketing opportunity exists for US universities to further partner and network with universities abroad.

Create an Environment for Retention of All Students:

Fostering a diverse, well-rounded and globally-oriented engineering workforce requires retention of international students who enroll as well as the development of American engineering students to include cultural awareness and language capabilities.

Retention of international students should include:

- Encourage testing in academic areas in which students excel (ex. math, science, computer technology) to ensure more applicable enrollment in these areas.
- Recognize that international students who transfer or are pursuing additional degrees may be more advanced theoretically yet need additional assistance in application.
- Increase the pool of qualified international students by providing academic and career exposure to pre-college and university students abroad.
- Listen to international students' concerns regarding language barriers. Offer reasonable accommodations to bridge language gaps. Be open when students ask for clarification.
- Understand humor is difficult for an assimilating international student to interpret. Some feel left out when humor or movies from the 1960's are referenced.
- Until international students assimilate with classmates, encourage class participation and mutual understanding.
- Relay to class members that international students pass many different tests to have the opportunity to be study in the States. They want to be here.
- Communicate with students to evaluate whether a large, central campus or a regional campus would best fit their academic and social needs. Large university hubs offer a proportionately larger population of international students. They likely offer new student orientation specific to each international population. A large campus, however, is not always the best match for an international student. Many international students thrive when a regional campus can provide them with more personal attention. One example: Susan Wilson, Associate Director of Admissions at Purdue North Central has allowed students to drive her car for experience to encourage international student success in obtaining a driver's license.
- Match international students with local host families. Many people reside near university campuses because they enjoy the cultural opportunities a university community provides. Local families are often willing to mentor/host an international student. These

relationships usually include invitations to dine with the host family and to stay with the host family for breaks when an international student does not return home.
- Form or participate in a campus international student organization. Encourage all students to attend cultural presentations that the international students could develop and present on campus.
- Provide services and resources to ensure international student success. Identify local religious centers, ethnic grocery stores, transportation options, etc.
- Work with university faculty, staff and students to create an invigorating and supportive environment for all.
- Assist in the preparation of international students for graduate studies and engineering careers.

Development of American engineering students should consider:

- Encourage language minors. Americans are quite limited in language capabilities as compared to other cultures. An American who speaks one additional language may feel accomplished. In reality, many cultures encourage people to learn three, four, or five languages.
- Inspire students to study the companies they hope to work for, identify geographic areas of the world they may be working in, and develop language capabilities and cultural understanding of the countries.
- Encourage internship programs and service learning opportunities that provide multi-cultural experiences for students.
- Promote diversity, understanding, acceptance and goodwill.
- Partner new international students with a class mentor to assist assimilation. Both will learn in the process.
- Form teams that include international and American students to balance theory and application.
- Include adequate theoretical instruction behind an applications approach to ensure global competitiveness of American engineering graduates.

Conclusion

This is truly a global society. Professors in higher education must recognize the challenges and opportunities presented by global diversity and transnational corporations. Engineering curricula can benefit greatly from an evaluation of theory versus application. Balanced curricula support theory and application alike. This will not only enhance international student learning through application but also strengthen theoretical knowledge of domestic students. When Fortune 500 companies like GE develop multiple, internationally based R&D centers to seek the best engineering talent, a red flag is raised. Another warning sign is the decrease in minority student enrollment. Educators must ensure domestic students understand the theory behind the formulas. Given two engineers in two different countries, many believe the engineer who understands the theory will derive the solution more quickly than the application educated engineer. And in today's competitive, global market time equals money, market share, and success.

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Biography

SARAH J SMITH, Assistant Professor of Organizational Leadership and Supervision, teaches for Purdue North Central's Engineering/Technology division. She has traveled to 31 countries. Ms Smith was a bilingual recruiter and trainer for Pioneer Hi-Bred International; a Fortune 200 company that became a DuPont Company during her tenure. Areas of interest include global diversity, human resources, and continuous quality improvement.

APPENDIX

Human Development Index (HDI) Rating	Country	Public expenditure on education (as % of GNP)
136	Nigeria	0.7
102	Indonesia	1.4
45	United Arab Emirates	1.7
108	Guatemala	1.7
72	Armenia	2.0
82	Turkey	2.2
86	Dominican Republic	2.3
87	China	2.3
65	Lebanon	2.5
95	El Salvador	2.5
73	Peru	2.9
26	Singapore	3.0
101	Viet Nam	3.0
23	Greece	3.1
57	Bulgaria	3.2
115	India	3.2
129	Nepal	3.2
37	Uruguay	3.3
70	Philippines	3.4
34	Argentina	3.5
55	Russian Federation	3.5
9	Japan	3.6
39	Chile	3.6
27	Korea, Rep. of	3.7
62	Colombia	4.1
6	**United States**	**5.4**
3	Canada	6.9
19	New Zealand	7.3
68	Saudi Arabia	7.5
38	Poland	7.5
10	Finland	7.5
94	South Africa	7.6
22	Israel	7.6
1	Norway	7.7
88	Jordan	7.9
15	Denmark	8.1
4	Sweden	8.3