A Comparative Study of Engineering Education in Iran and USA: An Attitude Survey of Iranian Students Abroad

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Abstract
While all societies around the World have developed some kind of educational system to help themselves grow and develop, there are major differences among the systems. Education in Engineering, which is a major component of development in a society, has wide array of components within it which makes it more diverse among societies. A study of differences in engineering education among different societies can help to promote deeper understanding among societies in addition to helping one develop a more efficient educational system by combining the different positive aspects of each system studied.

The following paper is a report comparing engineering education system in high ranked engineering schools in Iran and USA. The report is based on a pool of different views of some Iranian graduate students in engineering fields at Texas A&M University in College Station, Texas. We define an education system as: students, professors, technology and facilities (hardware) and rules and regulations (software).

The study focuses on four different aspects of engineering education. The first part deals with the purpose of an educational system with emphasis placed on need for industry collaboration. Then the two major components of an educational system which are the faculty and students are discussed. The need for recruitment and retainment of faculty and students are covered in addition to studying the motivations leading students to join a specific field of study. Teaching philosophy and methodology which is another important issue with some major differences between the two systems is studied. The teaching philosophy deals with teaching focus, offered courses, and course materials. Lastly we discuss the differences between facilities, technologies, and services offered for both teaching and learning purposes. The experiences of having attended both educational systems has enabled us to find out the major differences among the system and more importantly, be able to state the methodology that has worked the best in our engineering education. In the conclusion, the presented information is used to provide some suggestions that may help planners in improving the Iranian engineering education system.

Introduction

An educational system is the backbone of a society as almost all of its functions and developments depend upon the outcomes from the educational system. In order for a society to prosper in all aspects of life including spiritual, economical, and physical, it needs to have members who are well educated in each field and can develop and advance methods and systems to achieve improvements in all of these facets of life.

A look through history shows extensive examples of developments in human life through the outputs from efficient educational systems. One of the main necessities of society is to have a skilled engineers who can provide products and services that are needed for survival and improvement of people's lives. The need for skilled engineers impels us to develop an engineering education system that can provide such an outcome.

Purpose of Engineering Educational System

As the importance of an educational system in the everyday life of a society has been shown, it is essential now to develop such a system to meet the needs of the society. It is clear that an educational system must be based and focused on meeting the needs of the society as it is the main component that helps to quench the necessities of life and make developments toward improving all aspects of life for everyone. This holds especially important for an engineering educational system which strives to develop the equipments and services that are needed for everyday function of society in addition to developing technologies for the future.

As the educational system must be based on people's needs, it must be developed within the same members of the society with the available resources in order to be able to deal with the local needs of the society. However as the society is not perfect and does not have all the solutions at the time, the educational system will also have some shortcomings and problems associated with it which must be dealt with as time goes and the system begins to realize those deficits and develops solutions for them. Hence, an effective educational system must be based on the needs of society at the time and developed with the resources available, however it must be improved over time as needs change and developments are made in available resources.

Industry Collaboration

The importance of developing an engineering educational system based on the society's needs leads to the necessity of having industry connected and involved in the educational system. As the industry's main focus is to provide services that are needed for the society, it can help guide the educators in terms of how to prepare the future task force in order to be able to solve problems being faced in the society. University-industry collaborations pursue the discovery and dissemination of knowledge which results in application of that knowledge to the creation of goods and services needed in the society.

However as most corporations operate in a dynamic environment exposed to quickly-changing conditions, maintaining the university-industry collaborations requires continuing effort. On the other hand, with the increase in global competitiveness, industry is facing intense pressure to increase innovation, contribution to economic development, and profitability which helps in development of such collaborations with universities. Consequently, there must be an effort and a comprehensive program at universities to develop and extent collaborations with the industry.
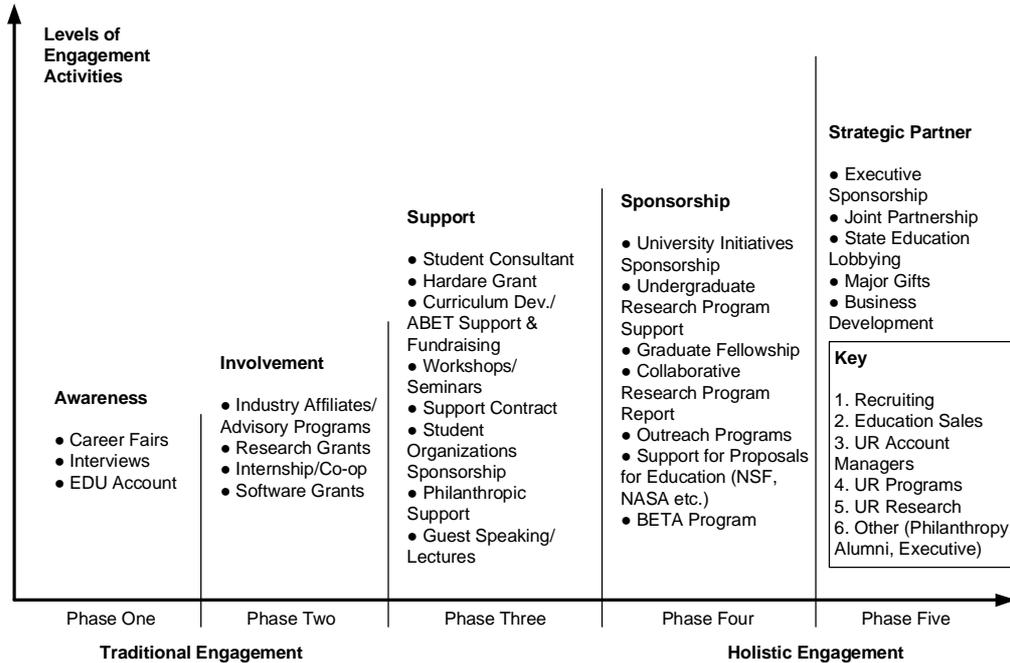
The challenge in developing strong collaborations lies in understanding how the missions and objectives of both industry and educational system can be met in a mutually positive relationship. While the core mission of the university is to educate, create and disseminate knowledge, industry's mission is to create value for investors through providing useful goods and services and expanding the state of the art.

In promoting the university-industry collaboration, stressing the mutual benefits both sides could enjoy is of high importance. Industry could benefit from research innovation and the academic's ability to approach problems from angles that are not encumbered by commercial concerns. Universities benefit by having real-world problems for their students and faculty to investigate-problems whose solution can generate economic and social benefit.

In addition to providing guidance on the needs of society and skills required of the graduating students, the industry can utilize the educational institutions to solve some of their problems through research projects. While the research projects help the industry in developing a solution to their needs, it will provide the educational system with a valuable tool of being able to put theoretical knowledge of students into work in solving problems that are currently faced in the society. Furthermore, this interaction will provide a greater understanding to the students about their field of study and application of their knowledge in solving real problems, while at the same time; it generates a skilled work force for the industry to have in the future. The educators will also greatly benefit as this positive relationship will enable them to develop up to date course materials which are applicable to the current needs in addition to helping them become familiar with and involved in developments in their field of study.

In the U.S., collaboration is implemented in different levels aimed at meeting the objectives of both parties. From the very beginning, students notice the presence of the industry representatives in universities. This presence ranges from holding career fairs and interviews, providing internships and co-ops to awarding research grants and long-term research programs. Although, a level of university-industry collaboration has always existed in Iran, there are lots of shortcomings which should be addressed. In order to promote the university-industry collaboration, it is suggested that a committee including delegates representing university research administration, large and small companies, and other interested members of the research community be established. The main agenda of such committee might be to clearly address the objectives of each party and to propose different levels of engagement activities for university-industry collaboration. As an example, the Hewlett Packard's model for university-industry collaboration is shown in Figure 1.

Levels of
Engagement
Activities

Strategic Partner

● Executive Sponsorship
● Joint Partnership
● State Education Lobbying
● Major Gifts
● Business Development

Sponsorship

● University Initiatives Sponsorship
● Undergraduate Research Program Support
● Graduate Fellowship
● Collaborative Research Program Report
● Outreach Programs
● Support for Proposals for Education (NSF, NASA etc.)
● BETA Program

Support

● Student Consultant
● Hardare Grant
● Curriculum Dev./ ABET Support & Fundraising
● Workshops/ Seminars
● Support Contract
● Student Organizations Sponsorship
● Philanthropic Support
● Guest Speaking/ Lectures

Involvement

● Industry Affiliates/ Advisory Programs
● Research Grants
● Internship/Co-op
● Software Grants

Awareness

● Career Fairs
● Interviews
● EDU Account

Key

1. Recruiting
2. Education Sales
3. UR Account Managers
4. UR Programs
5. UR Research
6. Other (Philanthropy, Alumni, Executive)

| Phase One | Phase Two | Phase Three | Phase Four | Phase Five |

Traditional Engagement   **Holistic Engagement**

Source: Wayne C. Johnson, Vice President, HP University Relations Worldwide

Figure 1. The Hewlett Packard's model for the development of a strategic collaboration between universities and industry

Recruitment and Motivation

Once the educational system has been designed based on the needs of the society with the involvement of industry in the system, there must be a system put in place for recruiting and motivating students to join the programs which are in need to solve current problems of the society. In addition, a comprehensive program to attract and provide a supportive environment for faculty members must be designed. Once qualified and dedicated educators are gained and provided with a supportive environment for educational purposes, while at the same time, students who are fully committed to their field of study are recruited, then the educational system can be successful.

There should be great effort and resources utilized in attracting students to join the engineering programs that are in demand for solving society's problems. As a society develops, there will be new needs and demands that must be met which require also new fields of study in the educational system. The university system which is based on needs of the society will be able to adapt to changes by offering new appropriate degrees, however it must also be able to bring in students who would like to pursue those degrees. We have observed several effective methods for attracting students in the USA. One of these was career seminars and fairs for high school students where students were informed about advantages and tasks involved in the most needed degrees. People with experience in these fields of studies speak to students about the different projects that they have worked on and how it has impacted the society. There are also

recruiters from different universities with information about their programs who work to give the students a glimpse of the different courses and projects that they will work on during their degree program. Another system that universities attract students to the needed fields of studies is by providing financial support for students entering those programs in addition to having more spots open for admission.

In the US, a student's primary reason to pursue his education after high school is to find a better career. He follows his potentials and interests to choose a major that best fits his goal. Some students may change their major of study several times before they are finally satisfied with their subject of study. This is mainly because the student is responsible for his education expenses and he intends to build his future based on his studies. The summary of these factors leads to a reasonable distribution of students' talents over different fields of study: engineering, medical sciences, arts and humanities and basic sciences. However, American (non-international) students tend to show little interest in graduate studies especially in the doctoral level. In Iran, however, several other factors play role in this area like social status of certain university degrees, compulsory military service, and family pressures. The demanding and gruesome competition for the nationwide universities entrance examination pushes many good students to select engineering or medical fields regardless of their original interests merely because they are believed to be top majors. This has resulted in an unbalanced distribution of student talents in basic sciences, art and humanities. The students who study in governmental universities may not feel obliged to do their best as they are not paying directly for their education and some may consider that as their secondary task besides working part-time or full-time. Also a higher percentage of Iranian students tend to pursue their education to graduate level because of the aforementioned reasons.

One of main components of a successful engineering educational system is the teaching staff. Qualified and dedicated instructors are required to teach courses and ensure students are obtaining knowledge and skills needed to solve the problems in the society. In addition, the faculty members must be part of the same society in order to be in touch with the current problems and have knowledge of skills that must be gained by students to handle the future needs of the society. In order to have such qualities in a teaching staff, educational systems must have a recruitment and retainment program for faculties. In such a program, incentives must be provided to attract instructors while at the same time; a retainment system that ensures faculties are satisfied with their jobs must be in place.

In our observations from both educational systems, we have noticed some major differences between the two countries handling of this issue. In the USA, universities provide great incentives like comparative salaries to industry, funding for research, graduate students for research, and funding for travel, to their faculty in order to attract them to join the universities. Most professors are encouraged to provide support and consulting to industry through the university. While this consulting service provides faculty members with additional income and contact with industry, it also improves the reputation of the university and helps students in gaining jobs in the industry. Most professors work full time as instructors and do very little outside work as the university provides them with sufficient income and support to keep them happy and without a need to seek outside income and support. However in Iran, due to lack of financial and personal support for faculty members, many are forced to have two jobs with substantial amount of their time and effort spent outside the university. Their job at the educational institution actually becomes their second job and a source of stable fixed income. We believe that the educational system in Iran needs to provide better incentives to attract good quality faculty members and have a system in place to keep them happy and satisfied in order to make their job as faculty members to be their first priority and there should be no desire nor need for them to pursue a second job that takes a lot of their time and effort away from their teaching and research.

Teaching Methodologies

Even though an educational system could have qualified faculty with interested and dedicated students, it may not be successful if an appropriate teaching philosophy and methodology does not exist. In order for students to be successful in terms of gaining the skills required to handle the needs of the society, the educational system must provide suitable teaching techniques to ensure objectives are met. These teaching techniques include method of teaching, courses offered, and course contents.

One of the main important focuses of the teaching must be to ensure students learn the skills required to be able to handle the needs of the society. It would not be of any benefit if students learn concepts and methods which they can not or do not know how to apply to solve real world problems. The objective of the teaching of any course must be to give students the required basic knowledge and how this knowledge can be applied for solving real life problems. One main difference that we have observed has been that the US educational system concentrates on application of knowledge while the Iranian system focuses on conceptual and theoretical knowledge. As a result, students in the US are more capable in handling problems faced the society, while the Iranian students are stronger in theoretical basis of materials and how to explain them to others. A good system must provide the basic theoretical knowledge that is done in Iran while at the same time provide the practical aspects of application of the knowledge which is done in the US.

Once the purpose of teaching becomes clear in giving knowledge with application for solving real life problems, selection of courses and course materials becomes an easy task. One important way to improve the quality of education in a university is to optimize the diversity and the content of the course materials that are available for the students. Courses offered must cover a wide range of areas that students may face in the future. There should be a great deal of diversity in order to keep students interested and engaged while at the same time allowing them to pursue their area of most interest. Also diversity in courses allows students to develop more their personal and social skills in addition to learning to work in multidisciplinary teams. Similarly, the course materials must be provided from wide sources with emphasis on recent developments through research work at universities in order to ensure students realize the value of their work.

Through our experiences, we have felt that the US education system offers wider variety of courses with more updated and society related materials as compared to the system in Iran. The students in US are encouraged to take a wide variety of courses including those not related to their field of study in order for them to appreciate other fields of study and realize how the whole system comes together in the society. Also students are encouraged to read and discover the new inventions in their field of study through seminars, field trips and reading of current journals. However in Iran, available courses are normally and mostly required courses for the specific field of study with very few optional courses which are also still very much related to the major of study. Also the ideas and examples that are reviewed and discussed in classes are normally some basic and simplified engineering problems without much mention of real practical problems which require proper simplifications and assumptions of theoretical knowledge. As a result, students gain extensive and detailed basic knowledge about their own field of study but lack the ability and skill to solve real engineering problems and to be able to realize how other fields of studies are related and affect their work.

Facilities and Technologies

Another important component for a successful educational system is the facilities and technologies needed to enable effective teaching and learning to take place. These include access to materials, teaching aid technologies, research facilities, and others. A good educational system must have a comprehensive plan to provide services and facilities needed to learning and teaching purposes.

One of the important parts of the teaching and learning process is the ability for the instructor to be able to get the material across to students. This process is greatly helped with use of teaching aids such as presentations, quizzes, graded assignments and online access to course materials. In addition to resources for teaching, there are certain services that are required for students to have in order to be able to develop their personal and social skills. As an example, there should be a writing center that provides help and guidance on preparing a well written scientific paper that can be published for use by others. The university should provide easy access to different resources like databases, journals, and other materials that help the learning process. There should be specialized staff that can help students in conducting literature research and finding required information to do their work.

Unfortunately, there is a great lack of these services in the educational system in Iran. As a result, students are forced to spend a lot of time searching for materials rather than concentrating on doing actual problem solving and research tasks. While students do become more self-reliant, they can not perform their work properly due to lack of resources. In the US, there are many different and comprehensive academic services that are provided by the university system which helps students have easier access to materials with more time to spend on improving quality and efficiency of their work. However, it should be noted that students in US become much more dependent on getting help from others and do not learn to be self sufficient.

Conclusion

There are many different aspects that affect the quality of an engineering educational system. In order to have the most effective system, all of these aspects must be considered and systems implemented to incorporate essential elements in the educational system. There is a need to ensure educational system is in line with the needs of the society in addition to being flexible to accommodate changing conditions. In the same line, educational system must develop a strong and mutually beneficial collaboration with the industry to ensure the best possible influence of educational system on the future of the society. Once the system has been organized based on the needs of society and collaboration with industry, a comprehensive plan to attract and maintain high quality and dedicated faculty members must be implemented which should go in hand with a program to attract and provide support for students to pursue degrees which are in need of high quality members to develop the needs of society. Finally, with such a system, there is a need for both teaching techniques and facilities to enable such a system to produce efficient results.

In our comparison of engineering educational system between Iran and US, we have observed some major differences and have made recommendations on what should be done in Iran to improve the system based on what we have seen to work best for us. We recommend a greater connection between university and industry through different systems of collaborations. There should be more emphasis placed on offering better incentives and support for faculty members in order to ensure they can concentrate mainly on their work as educators. Also the program to ensure students pursue their study in fields that are in need and also are inline with the skills of the students must be implemented. There are the most important aspects that need to be rectified while improvements in teaching tools and facilities can be made much easier afterwards.

We have been privileged to be able to study in these two different educational systems. We have gained a lot of benefits in each educational system and we are grateful for having gained our initial and basic knowledge in Iran. Our success in the educational system of US comes mainly from the work and effort of our education in Iran. We would like to thank administrators and educators in Iran for giving us the skills to succeed in a different environment like the US. We hope that our recommendations help to improve the Iranian engineering educational system and make it more beneficial to the Iranian society.