Development of a New Engineering Education in the Middle East

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Abstract
An emerging engineering education model in the Middle East has been created by Texas A&M University to be part of a unique universal education model developed by Qatar Foundation. Texas A&M University opened its third branch campus in 2003 to offer Bachelor of Science degrees in four engineering majors: chemical engineering, electrical engineering, mechanical engineering and petroleum engineering. The main objective of the Qatar campus is to support Qatar’s National Vision 2030 by building high-quality engineering education model and to prepare highly skilled engineers and scientists to sustain Qatar’s industry and economic growth. This paper highlights the success story of this new engineering education model. Furthermore, this paper highlights the differences of Texas A&M at Qatar model compared to similar regional engineering education systems in the Middle East and East Asia. The success of this model in creating unique research program and internship models for its undergraduate students has already been highlighted in our paper to the International Division of the American Society for Engineering Education last year (Parsaei & Elbashir, 2014).

Introduction
The State of Qatar, surrounded by the Persian Gulf by water, and the Kingdom of Saudi Arabia by land, is one of the fastest growing nations in the world. The country’s vision, in transforming its carbon-based economy into a knowledge-based economy, has made this
nation an icon in the Middle East. Qatar’s economy and wealth is based on its hydrocarbons resources and particularly its natural gas reserves. Qatar National Bank considers this wealth to be around forty nine percent of the country GDP as of late 2014. Qatar figured out that the transformation of its economy requires the building up of a strong education system that ensures sustainability and diversification of its economic status. The concurrent establishment of programs that enhance social development and the building of human capacity were required for such success.

Qatar Foundation for Education, Science, and Community Development, a non-profit organization that was founded in 1995, is the primary driving force behind Qatar’s National Vision 2030. This vision plans to provide the skills and education that are necessary to move the State of Qatar to a knowledge-based economy. Qatar Foundation attracted number of prestigious universities to establish branch campuses in the premises of its Education City, including Texas A&M University, Georgetown University, Carnegie Mellon University, Northwestern University, University College London, Virginia Commonwealth University, Weill Cornell Medical College, and HEC Paris. These universities compete with the Qatar’s largest public university, Qatar University, for qualified students for college education level both from inside and outside Qatar and other international universities such as College of the North Atlantic and the University of Calgary.

Qatar Foundation made a major investment to build up new college level education models by inviting several western universities to establish specialized campuses in its Education City in Doha. This project started in early 2000. The Engineering Education model has been assigned to Texas A&M University who established its third branch campus in Qatar, Texas A&M University at Qatar (Figure 1). Texas A&M at Qatar opened its doors for both Qatari and international students.

**Figure 1:** Texas A&M University at Qatar building in Qatar Foundation’s Education City
in 2003 to four undergraduate disciplines: chemical engineering, electrical engineering, mechanical engineering, and petroleum engineering. These programs have been supported by solid engineering faculty as well as by faculty from different fields of Science and Liberal Arts. The campus also offers Master of Science and Master of Engineering programs, but only in chemical engineering. The available undergraduate degree programs are all accredited by the Accreditation Board for Engineering and Technology (ABET) as well as by the Southern Association of Colleges and Schools (SACS). SACS is one of the six regional accreditation organizations recognized by the United States Department of Education and the Council for Higher Education Accreditation. The curricula offered at Texas A&M at Qatar are materially identical to the ones offered at the main campus in College Station, Texas; the courses are taught in English in a coeducational setting. The university recruited top professors, researchers and staff from all over the globe to support its program, as well as building a unique working and living environment in this part of the world.

Several other Gulf countries established engineering education colleges and programs with and without the support of Western institutions and other industry/academic institutions. Bahrain started this model in the mid-1980s with the merger between the Gulf Polytechnic Institution and the University College of Sciences, Arts, and Education to form the College of Engineering of the new University of Bahrain (Al-Sammak & Al-Shehabi, 2006). The United Arab Emirates presented another model by establishing several new universities and education models supported by North American academic institutions. Nevertheless, Thompson highlighted the challenges in developing and accrediting the North American-based aerospace and mechanical engineering programs at a new university in the United Arab Emirates (Thompson, 2008). Beyond the Gulf region, Singapore is the leader in forming advanced engineering education models. They implemented major modifications to their engineering curriculum and diploma courses. They reframed a number of their diplomas using the Conceive-Design-Implement approach developed by Massachusetts Institute of Technology (MIT). The success stories of this unique engineering model have been highlighted in Sale’s book (Sale, 2014). These stories provide an evidence-based learning approach for creative teaching; they also illustrate explicit models for developing good thinking and a design framework for producing effective and efficient blended learning experiences.

Among other developed nations, Russia has made major modifications to its engineering education models from the original structure that survived for more than 100 years. These efforts started immediately after Russia signed the Bologna agreement, aimed at standardizing the rigor of the Bachelors and Masters degrees in Europe. Besides reframing their engineering degree plans, they have made other major changes in the engineering courses to ensure the following (Sanger, Ziyatdinova, Barabanova, & Ivanov, 2012): (1) broader knowledge in the field and to shift away from a deep specialization knowledge in their Bachelor’s degree; (2) involvement of industry and other employers in the standardization process by communicating to them the capabilities of the new type of Bachelor’s degree; (3) reduction of the centrally controlled curricula, which has led to large variations in the curriculum content from one university to another; and (4) better organized accreditation entity and process that is capable of replacing the former centrally-dictated curriculum realization uniformity.
Texas A&M University at Qatar: The engineering education model

As the nation strives to develop a knowledge-based society, Texas A&M at Qatar recognizes the profound need for highly skilled engineers to lead the next generation of discovery. The university developed and implemented solid recruitment plans that start in middle schools all the way to high schools in Qatar, in order to identify a pool of highly qualified students for its engineering programs. As a result, Texas A&M at Qatar total undergraduate enrollment reached 500 students in the Spring of 2015 semester, with the percentage of Qatari nationals reaching 49% of all undergraduates. The most impressive record of our institution is the number of female engineering students — 40% compared with 18–20% in the United States per National Science Foundation records. In May 2015 Texas A&M at Qatar celebrated the graduation of its 600th engineer and 250th Qatari engineer since its first graduation ceremony in 2007. Texas A&M at Qatar witnessed comprehensive growth from its inaugural class of 29 students in 2003 to one that boasts more than 500 current students, as well as a graduate program in the chemical engineering discipline. Part of the Dean of Texas A&M at Qatar’s message during the celebration of its 10th anniversary in 2013 can be seen in this video. More importantly, the buildup of the university’s research program resulted in a research fund of more than $200 million.

In 2006, Qatar Foundation created a funding agency, the Qatar National Research Fund (QNRF), to foster original, competitively selected, research in the following areas: engineering and technology, physical and life sciences, medicine, and humanities, social sciences & the arts. One of the QNRF programs is the Undergraduate Research Experience Program (UREP), developed to stimulate a broad array of undergraduate research opportunities within Education City and Qatar University through faculty- and other researcher-led projects involving one or more undergraduate students. UREP promotes “learning by doing” and “hands-on” mentorship activities as effective methods for undergraduate education, which is very relevant to Texas A&M at Qatar’s mission as an engineering education institution. Texas A&M at Qatar is taking full advantage of this program. As of the end of 2014, total funding from the UREP program reached $3.3 million since its start date. More than one hundred students have participated in the program. A previous study (Elbashir, Parsaei, & Elmalik, 2013) highlighted the success of these UREP projects in building up both soft and hard skills of Texas A&M at Qatar students to help marketing themselves for industry jobs.

New programs to support our mission: The ELITE program

The university has developed a unique model to support its engineering education vision, named as the initiative in Engineering Leadership, Innovation and Teaching Excellence (ELITE). The ELITE program is mainly aimed at promoting partnerships, collaboration and discourse that contribute to educating and preparing young people to address Qatar’s, the region’s, and the world’s grand challenges of tomorrow. This critical stage involves the university in the early education process to support the schools in teaching Science, Technology, Mathematics Engineering (STEM)-related subjects (Parsaei & Elbashir, 2014). Therefore, the ELITE vision recognizes that post-secondary education is only one of several important phases of that development process. The initiative endeavors to provide support, innovation, and inspiration throughout Qatar’s educational enterprise to promote students to their greatest potential to become engineering leaders. The initiative’s activities include several building blocks, such as: (1) partnering with Qatari schools (aiming at middle- and high-school students) to support the STEM education subjects to prepare
the students for college-level education; (2) developing recruitment activities in collaboration with the schools and sponsoring industry in Qatar; (3) providing professional development for teachers of math, science and technology to enhance their teaching effectiveness; (4) refining Texas A&M at Qatar’s engineering curricula to ensure they meet Qatar’s evolving needs and to advance students’ knowledge in fields of common interest to industry in Qatar, the region, and the world; (5) bolstering teaching, researching, and outreach in energy, environment, sustainable technologies, ethics, project management, and other such topics; (6) encouraging undergraduate students to participate in research in specific fields relevant to the Qatar National Research Strategy (QNRS); (7) encouraging undergraduate students to undertake internships and cooperative learning experiences that increase their soft skills and hands-on experience to help guarantee success in the workplace; (8) contributing to Continuing Education at Texas A&M at Qatar to support professional advancement of engineers working in Qatar and the region; (9) promoting scholarship and research in engineering education, and recording findings in a peer-refereed journal created under the initiative’s auspices; and (10) establishing an advisory committee comprising representatives from industry and government to support the aforementioned programs and to provide continuous assessments of their effectiveness in providing Qatar, the region, and the world with highly skilled engineers.

The impact of undergraduate students’ research experiences on engineering education

The ELITE program has significantly improved Texas A&M at Qatar’s recruitment efforts. Because local industry and government institutions support this program, a significant number of Texas A&M at Qatar’s undergraduate students are able to engage in well-funded research programs in energy, petroleum, communications and other fields relevant to QNRS. Texas A&M at Qatar is known to provide significant opportunities to its undergraduate students to voluntarily participate in its faculty members’ research projects. The students work under the supervision of faculty members on building the proposal, conducting the research and reporting its outcome. Texas A&M at Qatar developed several research programs in collaboration with the support of its faculty, Qatar Foundation and its funding agencies (e.g., Qatar Science & Technology Park, QNRF-UREP and other programs, in addition to the support of industry and governmental agencies). Also, the branch campus has well-established industry internship programs with the support of both national and international industry in Qatar and the region. These programs also provide sponsorships and opportunities for our undergraduate students to join research and internship programs and gain cooperative learning experiences that increase their soft skills and hands-on experience that help guarantee their success in the workplace. In summary these programs: (1) support the engineering design courses by proving the students the opportunity to investigate real life problems with hands on experience relevant to their field of study; (2) provide Texas A&M at Qatar faculty members and industry collaborators the opportunity to work with the students outside the classroom; (3) allow Texas A&M at Qatar’s postdoctoral fellows, research associates, and graduate students the opportunity to enhance their mentorship activities to support the institution in the undergraduate education program; (4) develop problem-solving skills and other soft skills necessary for the success of Texas A&M at Qatar graduates, such as team-work activities, presentation style, writing proposals and technical reports, and presentation preparations; and (5) enhance the job-hunting opportunities for our
graduates, and allow industry and governmental agencies to recruit and train their sponsored students and/or employees.

Conclusion
Texas A&M University has developed a unique engineering education model that enables its graduates to make positive impact on the operation and the sustainability of both local and global industry sectors in Qatar and the region. This program has also had positive impact on the intellectual culture of its students and created an education model that is well supported by the industry and the governmental agencies in Qatar. Texas A&M at Qatar has also played a critical role in supporting both fundamental and applied research activities and created a culture that its students extremely benefited from. The research activities of Texas A&M at Qatar that address issues important to the State of Qatar are valued at more than $200 million. Recently, Texas A&M at Qatar took first place in a top-five table for research impact drawn up by Times Higher Education for the Middle East and North Africa (MENA) region (Havergal, 2015). This ranking has been determined based on the citations received by an institution’s publication output between 2009 and 2013, and the total citations that would be expected based on the average of the subject field. The undergraduate students of Texas A&M at Qatar made noticeable contributions to this research program and its success, which is a clear indication to the success of Texas A&M at Qatar model.

Notes
1 Life at Texas A&M University at Qatar: https://www.youtube.com/watch?v=lgj3RZ9jclk
2 Texas A&M University 10th Anniversary Celebration: https://www.youtube.com/watch?v=WaStGpSbX78

References