An Emerging STEM Era in the Middle East

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Abstract

The Middle East region, particularly counties such as Qatar, the United Arab Emirates, and Saudi Arabia, has witnessed interest in attracting the upcoming generation of their population to Science, Technology, Engineering, and Mathematics (STEM) career paths. The region has historically well documented its leadership and interests in STEM for many centuries. With growing interests in creating derive in innovation and discoveries, the leadership in these countries have significantly invested in the STEM areas over the last two decades and the dividend of these investments are being observed in the region. Qatar, the smallest country in the region by land, has made one of the largest investment per capita in engineering and science education since the mid-1990s. Texas A&M University campus in Qatar is one of the six American university campuses existed since 2003 in Qatar and is part of a unique universal education model developed by Qatar Foundation.

Texas A&M University at Qatar has been offering Bachelor of Science degrees in four engineering disciplines namely chemical, electrical, mechanical, and petroleum.

This paper summaries some of the unique STEM education activities initiated by Texas A&M University in the region and the achievements made compared to similar regional engineering education systems.

KEYWORDS

STEM Education, Engineering Education, Engineering Education at TAMUQ

INTRODUCTION

Since late 1990s, several countries in the Middle East and North Africa have directed their focus on investing in education infrastructure as one of the primary pillars for the countries prosperity. Among the countries in the Middle East, both Qatar and United Arab Emirates have made significant investment in attracting North American universities to the region to establish academic and research campuses. Among the most universities with branches in the region, Weill Cornell Medical College, Texas A&M University, Carnegie Mellon University, Virginia Common Wealth University, Northwestern University, Georgetown University, all in the Education City in Qatar , Rochester Institute of Technology, New York University, and the Mater Institute (affiliated with MIT) in the United Arab Emirates are the most notable. These schools have been offering their home campus degrees in some select field of specializations and each has a growing number of alumni in the region.

Texas A&M University at Qatar

Texas A&M University established its branch campus in Doha, Qatar in September 2003. The 600,000 sq. ft. campus is located in the Hamad Ben Kalifa University campus (formerly known as Education City) Education and offers undergraduate degrees in Chemical Engineering, Electrical Engineering, Mechanical Engineering, and Petroleum Engineering. All undergraduate degrees offered by Texas A&M University at Qatar are accredited by the ABET. The programs are highly ranked well regarded in the region. The admissions standards are similar to the main campus and admission is very competitive and granted based on applicants high school grade point average (GPA), SAT/ACT test scores, TOEFL exam score, and personal interviews. In addition to four undergraduate degree programs, Texas A&M University at Qatar also offers two graduate degrees in Chemical Engineering. The primary language of instructions is English and applicants are interviewed prior to the final admissions.

Students currently enrolled in programs represents over 30 different nationalities and the total number of students annually enrolled in the four programs is about 470 and the graduate program currently enrolls about 65 students. A very large percentage of students participate in study abroad and service learning opportunities offered on campus annually. A strong multi-cultural environment cultivated since the inception of the campus has been exemplary and proven to be beneficial for students and a large percentage of students fluently speak three to more languages. The first year retention rate is over 85% and almost 100% of students graduate within six years which are significantly above the national rate in the North American universities. The campus Academic Success Center provides assistance with writing and communication courses and peer tutoring proven to be highly effective in assisting students to catch up with their subject materials. Since 2007, over 600 degrees were awarded in chemical, electrical, mechanical, and petroleum engineering disciplines combined. More details about the uniqueness of Texas A&M University engineering programs in Qatar is provided elsewhere [1].

Preparing Next Generation of Engineers at Texas A&M University at Qatar

Texas A&M University at Qatar has strong commitment to maintain its demanding standards in recruitment of highly motivated and talented students in its four engineering programs. One of the major pillars of education provided at Texas A&M University at Qatar its small faculty to students' ratio which provides ample opportunities for students to have access to faculty members. Modern laboratories and skilled laboratory technicians have significantly enhanced students skills with regards to hands-on experience required for engineering disciplines. Over 50% of undergraduate students are actively engaged in research with unprecedented outcomes of publishing their research in top tier peer reviewed academic journals and conferences. This has been a direct result of a major funding provided by Qatar Foundation and its funding agency (Qatar National Research Fund or QNRF) to academic institutions to encourage undergraduate students to participate in research projects of national interest to Qatar and the region. One of the strongest features of the undergraduate engineering degree programs at Texas A&M University at Qatar is the availability of research opportunities for undergraduate programs through local companies' sponsorship or Qatar National Research Fund Office through its Undergraduate Research Program (UREP). Over 50% of the graduate participate in the available research programs annually and our institution fund for six years exceeded three million dollars from this program [1]. Texas A&M Qatar significantly benefited from this program and large number of our students in this program before graduation. Similarly, the industry in Qatar provided additional fund to support the students' research experience.
Although the Petroleum Engineering discipline is the only program which requires mandatory internship experience for students prior to the graduation, over 90% of graduates finish their degree programs with internship experience. The impact of these programs on the students' academic performance as well as soft skills have been discussed in good details in our previous study in this field [2, 3].

As part of Texas A&M University Qatar continued commitment to quality education and developing well rounded engineers, a large number of classes require writing and oral presentation to variety of audience. Industry sponsored paper competition, participation in variety of international conferences, and ability to communicate in multiple languages, have significantly contributed to growth in personality, maturity, and ethical responsibility and have made Texas A&M University at Qatar highly demanded by the regional industries. The feedback the programs received for members of their advisory board primarily focused on the graduates understanding of the engineering fundamentals, knowledge of their disciplines, and ability to communicate both in writing and oral communications. Texas A&M University Qatar offered monthly seminars in which industry leaders and alumni take the stage and

speak with students regarding ethics, effective communication skills, time management, project management, leadership, and many other soft skills required for the advancement in the profession.

Science, Technology, Engineering, and Mathematics Workshops

The recent investment in education in the region and moving public focus from the hydro carbon economy to the knowledge based economy, has resulted in significant attention to improving middle and high school students performance in the science, technology, engineering, and mathematics (STEM). Among the countries in the region, Qatar, the United Arab Emirates and the Kingdom of Saudi Arabia have been noticeably ahead of the rest.

Texas A&M University has been leading these efforts by developing and implementing workshops to further encourage students to take career pathways in science, technology, engineering, and mathematics. These workshops have systematically been offered to elementary, middle school, and high school students since 2013. The elementary, middle school, and high school workshops are all gender neutral and offer a wide range of activities for participants to get engaged. These programs are varied in duration normally between one-day to 10 days based on the participants' age. In concert with students, appropriate workshops are offered to teachers as well to enhance their skills in teaching and critical thinking. These workshops are also intended to introduce teachers to more effective methods to present concepts in STEM and their applications in the daily activities in more creative fashion. During these workshops teachers are exposed to numerous examples of technologies which have been developed based on STEM principles in less technical terms. Numerous digital tools and their applications are presented during the course of workshops to teachers.

The Academic Outreach Office in collaboration with academic programs propose and review new programs to further engage industry, governmental offices with responsibilities for education, and independent school systems in creative programs to further motivate Qatari young talent to science, technology, engineering, and science. Two of the latest programs offered in summer 2015 include Summer Engineering Academy for the National Vision Scholars and Future Engineers. Candidates for the national Vision Scholars program were selected based on their scholastic achievements, high school grade point average and personal commitment to excel in advanced science and mathematics classes in high schools from among students completed 11^{th} grade and rising to 12^{th} in fall 2015. This year, 24 students were chosen to participate in the Summer Engineering Academy for two weeks (10 days). The program was limited to five hours per day which combined brief lectures followed by hands-on research. Students were given the opportunities to select a research area among from Qatar Research Grand Challenges which include Water/Environment, Renewable Energy, Cyber security, fuel characterization, and robotics and control with petroleum applications. In this program, students were divided in research team with four to five members and each team were assigned by their primary choice to one research laboratory under a faculty member's supervision. All teams were asked to prepare a short presentations based on their finds and a panel of judges reviewed their projects and assessed the presentations. A brief course evaluation assessment was conducted in which 19 students (9 males and 10 females) participated. The program and its contents were highly ranked and acknowledged by participants. In one of the questions in the assessment questionnaire, students were asked if after this two week workshop, whether they would apply to engineering school for admission. All 19 respondents expressed their desire to apply and peruse engineering as career paths.

Conclusions

The Middle East and North Africa region has long realized the contribution of engineers and scientists to fuel the engine of prosperity. The investment made to establish and equip engineering schools has started paying dividends in the region particularly in Qatar, the United Arab Emirates, and the Kingdom of Saudi Arabia. To further motivate students enrolled particularly in the local independent school system, the Texas A&M University at Qatar finding over the past several years clearly indicate that the familiarization and appreciation of engineering and science as career paths must as early as while students are in elementary or middle school. The programs developed by Texas A&M Qatar and briefly described in this communication are helping us in recruiting and retaining highly qualified national and other students to the science and engineering disciplines who are currently playing a critical role in several energy and other corporations in Qatar, the region and the world. The data collected by Texas A&M University Qatar also indicate that teacher and school consolers can positively influence students and some awareness workshops delivered by the universities will be highly beneficial and could positively impact the process.

Biographical sketches of authors

Hamid R. Parsaei is a professor of mechanical engineering and director of the academic outreach program at Texas A&M University at Qatar. He serves as associate dean for academic affairs (September 2010-Augusut 2014) and chairman of department of industrial engineering (January 2001 – August 2010) at Texas A&M University at Qatar and University of Houston, respectively. Dr. Parsaei is a registered professional engineer in Texas and a Fellow of Institute of Industrial Engineers (IIE), and American Society for Engineering Education (ASEE).

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