FOSTERING EXCELLENCE IN ENGINEERING EDUCATION: THE EXPERIENCE OF THE UNIVERSITY OF SHARJAH

Nabil Kallas[1], Abdallah Shanableh[2], Adnan Basma[3]

1: Associate professor and Acting Dean, College of Engineering, University of Sharjah
2: Associate Professor, Civil Engineering, University of Sharjah
3: Associate Professor and Chairman, Civil Engineering, University of Sharjah

Emails: nabil@sharjah.ac.ae, shanableh@sharjah.ac.ae, aabasma@sharjah.ac.ae

ABSTRACT

In wake of the global changes that are re-shaping engineering education, the focus must be on quality and excellence in designing and delivering educational programs. In what has been referred to as a paradigm shift, engineering education has been evolving from knowledge-based to skills-based, where emphasis is heavily placed on the outcomes of the educational program in shaping not only the knowledge, but also the skills and attributes of its graduates. In the new climate, many engineering programs have reformed their curriculum either proactively, to maintain a competitive edge, or reactively, to comply with the new international accreditation criteria.

Pursuing excellence in engineering education is a major goal of the college of engineering at the University of Sharjah. The college of engineering started four years ago with three programs in Civil, Electrical and Computer Engineering. As a new college, the development of the educational aspects of the programs is being systematically addressed taking into consideration national and international engineering accreditation criteria. This development is achieved through a variety of formal and informal activities, some of which are highlighted in this paper. Currently, the college is pursuing four commitments that aim at fostering a culture of excellence in engineering education. These are: (1) faculty development; (2) student development; (3) program development and accreditation; and (4) innovation in teaching and learning. This paper focuses on some of the lessons learned and the challenges and opportunities associated with pursuing these commitments.

Keywords: *Accreditation, Education, Engineering, Effectiveness, Continuous Quality Improvement.*

1.   INTRODUCTION

The University of Sharjah was established in 1997, and has started with five colleges, including the college of engineering. The vision of the university founder, His Highness the ruler of Sharjah, is to provide quality higher education to the country's youth and to support the rapid technological development in the UAE society. In order to realize this vision, the university has made three significant commitments:

1. Link each college with an internationally recognized partner through a formal twin-hood agreement to help fast-start the college's programs

2. Attract experienced faculty and staff from developed countries and support them well

3. Build world-class facilities to ensure quality instructional delivery and research productivity, as well as support campus life for all students.

After four years of continuous building and relentless work, the university today has attracted more than 4000 students, has expanded its programs to include eight colleges, and has graduated its first class of students. The university is currently devoting significant efforts to gain national accreditation for its undergraduate programs as well as to obtain international recognition for some of its programs, including engineering. The University of Sharjah presents a unique case study in GCC countries for many reasons, including:

-   The university has a separate, but duplicate, campuses for men and women students.

-   The university admission policy is open to all qualified students, regardless of nationality

-   The university exists in a competitive environment, with many other institutions providing higher education opportunities in the UAE

The college of engineering at the University of Sharjah has grown very rapidly since its inauguration in 1997 [Annual College Report, 2001]. More than 800 students are currently enrolled in our three undergraduate degree programs in Civil, Computer, and Electrical & Electronic Engineering. The college has also succeeded in attracting 40 faculty from internationally recognized institutions and industries, with rich and diverse background in academia and research. The year 2002 marked the graduation of our first class of engineering students. All programs in the college are recognized nationally as accreditation-eligible, and are planning to seek full accreditation in 2002. The college programs were developed based on international standards, incorporating ABET criteria and best practices.

Among the college's accomplishments achieved in the past four years are: (1) The continuous improvement of the engineering programs to meet national and international accreditation criteria; (2) The significant progress in developing the engineering laboratories with modern

equipments to serve the educational needs of the programs and faculty research; (3) The active participation of the college's faculty in offering their expertise to the local society and specialized industry through joint research projects, continuing education and consultancy; (4) The increased research productivity of the college's faculty and their active role in promoting the stature of the college and the university through refereed journal publications and participation in many international conferences; and (5) The recent approval of the university's Board of Trustees to offer Master's degrees in our three engineering programs.

Mindful of the increased emphasis on measurable educational outcomes, the college has initiated and maintained an active assessment and review system for many aspects of its degree programs. As a result, the college is continuously revising its curricula to address the recommendations of the UAE Commission for Academic Accreditation [UAE Standards for Licensure, 2001] and satisfy the criteria of ABET EC2000 [ABET- EAC, 2001]. The college is currently pursuing four commitments that aim at fostering a culture of excellence in engineering education. These are (1) faculty development; (2) student development; (3) program development and accreditation; and (4) innovation in teaching and learning.

This paper presents the program of assessment and continuous quality improvements that has been adopted by the college of engineering at the University of Sharjah. The paper discusses the process of effective internal and external assessments and evaluations that are used to enhance the undergraduate engineering programs.

2.   EFFECTIVENESS AND EXCELLENCE IN PERSPECTIVE

The requirements of the US Accreditation Board for Engineering and Technology (ABET) are used in this paper to define the elements of effectiveness or relative excellence in engineering programs. ABET defines and uses a number of accreditation criteria [ABET- EAC, 2001] that are required to prepare graduates for a successful role in real life as productive engineers. The ABET criteria can be summarized as follows:

1. Students attracted into engineering programs must be of high quality and they must be provided quality educational opportunities supplemented by practical experiences.

2. Program educational objectives must be clearly and publicly stated, reviewed and updated, must be assessed and monitored, and must be achieved.

3. Program Outcomes and Assessment- This criterion represents an attempt to define the capabilities and qualities of an engineering graduate and the assessment needed to ensure the achievement of such capabilities.

4. Students must be prepared for professional practice through a balanced curriculum and teaching/learning activities.

5. Faculty in engineering programs must be of high quality and must be given adequate support and opportunities to grow and excel in their careers.

6. Appropriate facilities must be made available and maintained.

7. Institutional and financial support demonstrating commitment, support and constructive leadership for faculty as well as support for services and facilities.

8. Specific program criteria must be followed.

The college of engineering at the University of Sharjah is systematically addressing all of the ABET criteria, in addition to the UAE national accreditation criteria for effectiveness and excellence.

An important aspect of achieving quality and excellence is the issue of assessment. To meet the challenges associated with the rapid advancements in the engineering profession, the college of engineering is strongly committed to implementing a rigorous program of assessment and Continuous Quality Improvement (CQI) for all engineering programs within the college. In this regard, the college has initiated a process of continuous assessment and evaluation to enhance its undergraduate programs and ensures that its resources and facilities meet the national and international standards. The college is following an academic CQI model similar to that suggested by ABET for EC2000 criteria (Figure 1).

Significant efforts are devoted to implement a culture of continuous program improvements in the various aspects of the college's activities. The college strongly believes that this COI process can be successful only if all stakeholders, including faculty, staff, students and external partners from industry and government agencies are committed to adopting it and support it. It is in this spirit that the college has been actively promoting this CQI process through internal seminars and workshops as well as providing support for faculty to attend relevant conferences and training workshops.
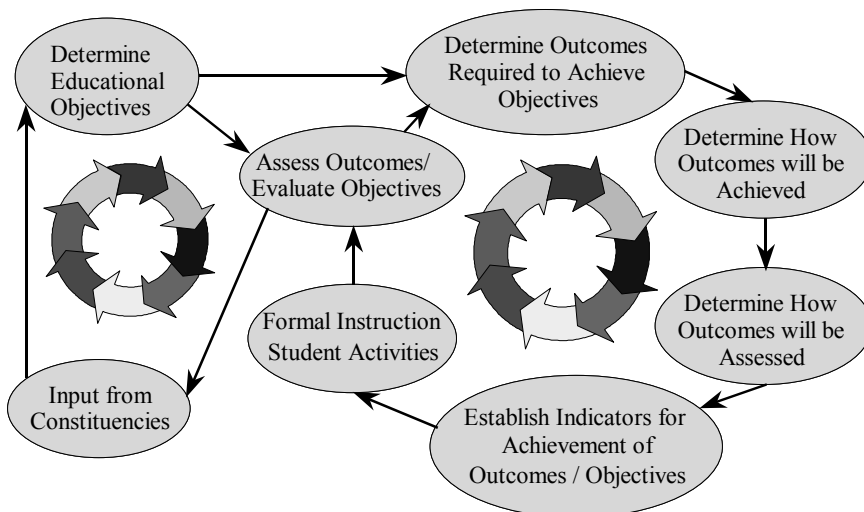

Figure 1. Model academic CQI being followed by the college of engineering at UOS.

To ensure that society and industry partners have an opportunity to provide their valuable input into our improvement process, the college has made significant efforts in promoting its partnerships with industry. Towards that end, the college held an open "College-Industry Forum" in 2000, and has formed an effective "Program Advisory Committee" that meets regularly to provide its input to the college on future trends and opportunities in the profession as well as to advise and monitor the college progress. An essential element in the CQI model shown in Figure 1 are the loops that symbolize the fact that while assessment instruments are of great importance, it is the subsequent actions that are the key to actual program improvements. Therefore, one must place great emphasis on carefully analyzing the assessment results and employ all the constituents in developing the warranted actions towards program improvements. The following sections discuss particular activities in key elements of the college's mission.

2.1. Quality of Students

The undergraduate admissions criteria at the University of Sharjah were selected to ensure attracting high quality students. These criteria are consistent with university's bylaws and with national and international standards of accredited programs.

One of the major challenges for new Universities is attracting quality students. A carefully planned new program directly fits in the needs of the community and as such attracts quality students from the start. In this regard, the engineering programs at the University of Sharjah were fortunate as they met a need in the community and this attracted good quality students of diverse background. In addition, the University of Sharjah is fortunate with the continuous support it receives from its founder and Supreme president, His Highness, Sheikh Dr. Sultan Bin Muhammed Al-Qassimi, Member of the UAE Supreme Council, the Ruler of Sharjah. Among the many positive incentives provided to the students to excel in pursuit of excellence are:

- Substantial tuition discount (50% discount) for excellent students whose GPA is 3.6/4.00 or higher

- Financial Assistance to excellent students that can not find the means to support their higher education

- Substantial recognition and an annual university-wide event to recognize excellence and achievements of excellent students

- Recognition and generous gifts for students that complete their degree with distinction

These positive incentives have influenced and encouraged students to compete with their peers and always seek better performance in order to deserve these rewards and recognition. Relating rewards to excellence has effectively demonstrated the university's commitment to

the highest educational standards in its aspiration to become a provider of quality higher education in the region.

While the initial admission criteria to the engineering program were chosen following careful study, the college continues to monitor the progress of its students and graduates. As such and to ensure that the admission criteria continue to meet the needs of the profession, the college has established formal procedures for review and assessment, as stated in Table 1.

Table 1- Mechanisms for assessment of student admission and progress.

1. The admissions criteria and quality of admitted engineering students are reviewed annually. Continuous progress of students is studied and correlation is made with performance prior and after college entry.
2. Department and college committees are charged with monitoring the relevant indicators and conducting their own review process.
3. The indicators include students' actual progress and performance, market needs, input from peers and professional advisors, and applicable university policies.

2.2. Educational objective

The University of Sharjah caters for the needs of local and regional communities as well as international exchange programs. As such, and while the engineering programs have been developed with the view of serving mainly the local and regional markets, the international standards for engineering education have been adopted. In line with best practice, the engineering programs have clearly stated and published objectives and outcomes that are periodically reviewed. Department and college committees have been set-up to proactively review, on a regular basis, the program objectives in view of demand, community needs, and degree of attainment of stated outcomes. A systematic review and assessment approach has been adopted to ensure that the engineering programs meet their stated objectives (Table 2). The results of the review process are used to modify and update the objectives of the engineering programs to ensure their effectiveness and quality.

The initial curricula have been designed in view of community needs and are subject to regular review and improvements. All engineering programs have been through a major update in the year 2000 following a process of continuous peer review and assessment by external and internal constituents.

Table 2. Mechanisms adopted to assess the achievement of educational objectives.

1. Peer evaluation of teaching & content

2. Continuous professional feedback of regional industries that are represented on the college's Program Advisory Committee.

3. Department review of overall performance of individual students.

4. Peer review of programs by invited imminent professors and through established formal process of cooperation with sister universities

5. Surveys of direct supervisors of students doing their practical training

6. Surveys of markets, students (Exit and Alumni surveys), and employers

2.3.   Program outcomes

The undergraduate programs in engineering are outcome oriented. They aim to prepare students for a productive career as practicing engineers, and as such they emphasize the professional aspects of engineering education. Gradually, the college is building its industrial contacts of employers and professional bodies and proactively promoting the interest of its graduates.

The capabilities and qualities of a graduate engineer are issues of active discussion and assessment (Table 3) in the college. In fact, the college is organizing its second regional engineering educational forum in May 2002 with a focus on the "Generic Attributes in Undergraduate Engineering Education." The aim of this activity is to support the efforts of the college in continuously improving its undergraduate programs by incorporating feedback and best practices from regional employers and educators. The Forum is also used to raise the awareness of faculty on the value of committing time and efforts to improving the quality of the educational services offered to our students. The college seeks to play a major role in establishing a regional engineering education society that provides a means for sharing best practices and improving the quality of engineering education in the region.

2.4.   Program resources

The University of Sharjah has invested significant resources in building state-of-the-art IT and computing infrastructure, modern engineering labs, and library resources in the various engineering disciplines. In addition, the basic educational capabilities are duplicated in separate men and women facilities. With the goal of continuously monitoring and improving the progress of building its resources, the college has established special committees responsible for the assessment and future acquisitions of educational and research resources. Engineering faculty have also produced a significant volume of printed and electronically

available materials to advance the students' learning process. The policy of the college is to make the best possible use of the university computer network, both the Intranet and the Internet, as a valuable supplemental learning resource assisting the delivery of our courses. The college website is continuously updated and enriched with relevant resources. We currently have forty engineering courses with significant web resources, and faculty are investing additional efforts to realize the college's goal of having all engineering courses on-line.

The college assesses its library resources on a continuous basis to ensure that they continue to meet the needs of its students, faculty and the community. The assessment tools used the evaluate the adequacy of current resources and make acquisition plans include:

1. Students surveys

2. Faculty evaluation and semi-annual acquisition proposals

3. Benchmarking of resources against other national, regional and international programs.

4. Peer Review of resources by invited imminent professors and through established formal process of cooperation with sister universities.

Table 3. Mechanisms adopted to assess outcomes of engineering programs.

1. A range of examples of student portfolios are kept and evaluated independently.
2. Portfolios of professional design courses are kept and evaluated.
3. Benchmarking of program content, assessment, and students' performance against other national, regional and international programs are undertaken.
4. Alumni survey is developed and will soon be undertaken.
5. Employer surveys are regularly undertaken.
6. Portfolios of accomplishments of graduates will be documented.
7. Course assessment procedures are evaluated and results documented.
8. Exit surveys of graduates are conducted.
9. Employer surveys will be conducted.
10. Regular Input from Professional Advisory Committees are regularly incorporated.
11. Peer review of programs by imminent professors (invited) and established organizations are continuously undertaken
12. Students will be involved in national, regional and international professional events.

2.5.   Faculty development

The college of engineering employs a diverse team of professors at all academic ranks that are appointed, after a careful recruiting process, for their strong international experience in teaching, research, administrative, and professional and community service. Assisting the professors, the college employs lecturers and laboratory technicians to support the teaching and learning as well as research activities and students projects. The college provides ample opportunities for staff development through mentoring and financial support for participation in professional development activities, including specialized conferences and training courses.

Given the pressures associated with the start-up of undergraduate programs, it is gratifying to note that engineering faculty members have made significant efforts to promote the research profile of the college and university. For the past two years, more than 100 research papers are annually published in refereed journals and international conferences. The college has adopted a number of periodical review and assessment mechanisms to promote faculty development and monitor quality of performance, including:

1. Monitoring of students/staff ratio across disciplines.

2. Student assessment of teaching and course content.

3. Peer evaluation of teaching and research.

4. Mentoring of academic and non-academic staff.

5. Annual performance assessment.

3.   CHALLENGES AND OPPORTUNITIES

Strong and continuous commitment from the highest university levels and careful planning have provided great opportunities for the engineering programs to pursue the highest standards of excellence. These opportunities were translated into developing effective engineering programs in the relevant disciplines, establishing modern resources and facilities, recruiting well qualified faculty and experienced support staff, and establishing proper policies and procedures.

The development of new programs is achieved in a relatively short and very intense period, during which the college has counted on the extra efforts from its faculty, staff and administrators. The rewards, however, for participating in building new programs are enormous. During this building period, the focus has been on establishing and fine-tuning the educational programs and academic resources. This emphasis does not leave adequate time for pursuing all of the desired objectives of the college on equal footing. Nevertheless, the college has made significant achievements in terms of research, and has established professional links and provided valuable community services. With the graduation of the first

class of engineers, the college has completed a full cycle of experience of its programs. The college is now approaching a steady state in terms of its normal activities associated with the current undergraduate programs. The introduction of graduate engineering programs will be slowly felt over the next two years, as enrollment is planned to grow at a comfortable pace.

The next significant task for the engineering programs is to seek full national accreditation during 2002. The college also plans to seek international accreditation in the near future, and has continuously kept up to date with the international criteria by attending conferences, workshops, and training courses.

4.   SUMMARY

From the start, the University of Sharjah represented by its Supreme President, Board of Trustees, Chancellor and all senior administrative and academic staff has committed itself to pursuing a path of excellence for the long term. The college of engineering has proactively been implementing a plan for achieving quality and effectiveness. Some of the fruits of this effort have already been realized, with the graduation of the first generation of engineers from the college and their involvement in the professional workforce.

The college has adopted a rigorous program of assessment and Continuous Quality Improvement for all engineering programs within the college. In this regard, the college has initiated a process of effective internal and external assessments and evaluations to enhance its undergraduate programs and to ensure that its resources and facilities meet the national and international standards. Significant achievements were made in various areas of excellence, as discussed in this paper.

To great extent, the process of building new engineering programs in a competitive environment resembles swimming as fast as possible towards a target, while surviving frequent high waves that consumes some energy along the way. It is a challenging process, but as most academicians would admit, it is easier to start well than to correct a wrong start. Academicians have long struggled with maintaining the proper balance of providing quality higher education, research and scholarship, and serving the community and society. In a start-up program, this balancing experience is only intensified as the demand for additional efforts to fill the gaps is greater in a period where the university is continually expanding its infrastructure and establishing the needed support services for its students, faculty and staff.

The college of engineering is committed to continue its progress and leadership in providing excellent engineering education, promoting scientific and applied research, and serving the community and the profession. Our goal is to create the very finest educational, research and continuing education programs that address the needs of the UAE and regional societies.

ACKNOWLEDGEMENTS

REFERENCES

1. Annual College Report. (Submitted to the Board of Trustees), College of Engineering, University of Sharjah, Sharjah, United Arab Emirates, 2001.

2. Commission for Academic Accreditation- UAE Ministry of Higher Education and Scientific Research, *STANDARDS FOR LICENSURE*, 2001.

3. Engineering Accreditation Commission- ABET, Accreditation Policy and Procedure Manual, 2001.