Restructuring pre-engineering "Prep-Program" to bridge the gap: a proposal for the Arab Gulf States

Waddah Akili
Professor (retired)
Principal, Geotechnical Engineering
Ames, Iowa
w.akili@isunet.net

Abstract

The paper focuses on pre-college education in the Arab Gulf States- in as much as it affects engineering education - and argues for urgently needed reform of the public school systems in the Region. Until these systems are overhauled, a well-structured, two-year pre-engineering "prep-program" is the plausible alternative. Current prep-programs have fallen terribly short of equipping students, entering engineering, with the necessary tools to enable them to meet the challenges ahead. In this paper, a proposed "prep-program" intended to bridge the gap, is outlined and discussed.

Introduction

Engineering education in the Arab Gulf States (Saudi Arabia, Bahrain, Kuwait, United Arab Emirates, Qatar, and Oman) faces many challenges today. Changes in the external environment (e.g. reduced funding, increased costs, demands by industry for well-seasoned graduates, and rapid advances in technology) coupled with the quest for educational relevance, are pressuring colleges of engineering in the Region (*the Arab Gulf States)* to "rethink" engineering education and to undertake steps towards reforming the systems of education. There are eight public colleges of engineering in the Region.[1,2] See Table 1 for details. These colleges have operated with curricula, standards, and procedures drawn by advisory boards made up of faculty members from North American colleges. Pre-college education (K-12) in the Region- the main theme in this presentation- has adversely impacted engineering outcome. It suffers from obsolescence, rigidity, and a passive approach to transmission of knowledge. The paper argues that until the K-12 systems are reformed, a properly executed "prep-program" bridges the gap and equips students with the skills to embark on engineering. The author draws on his own experience as a faculty member in the Arab Gulf region, recently in Qatar and earlier in Saudi Arabia. The paper is a recapitulation of a presentation to the ASEE

2003 Annual Conference in Nashville, Tennessee[3] intended to share information and views with colleagues on issues that beset academics in many parts of the world.

K-12 Education

Pre-college education in the Arab Gulf States (public schools in particular) has undergone a major change over the last three decades. Number of students in elementary schools has more than doubled over the last decade, and the number of students in all schools (K-12) has quadrupled since the mid 60s.Triggered by wealth derived from oil revenues, public schools have made tangible progress on many fronts. Improvements realized have included:(i) provision of well-equipped modern school buildings;(ii) substantial modifications to curricula in conformity with standards of neighboring Arab countries;(iii) availability of more qualified teachers;(iv) provision of special education for physically and/or mentally challenged students and; (v) the emergence of a more concerned general public with educational issues.[2]

Teaching learning Issues: Despite progress made over the last three decades; there remains more difficult, harder to overcome, intrinsic traits that have persisted over the years. In other words, it is the *traditional* approach to teaching, practiced on a large scale- where students are bombarded with information, and little attention, if any, is given to proper learning. The view shared by many is that: teachers are primarily dispensers of information in a rigid setting with no room for discussion or discourse. As a result, emphasis on *rote memorization* over cognitive learning takes precedence. The pressure experienced by most students is how to memorize vast amount of" testable" information so they can do well on the exam. Education, by and large, is" one way". Teachers lecture and students listen without questions or open discussion.

Curriculum: In the Region, curricula are drawn by the Ministry of Education in the respective state with no direct link to, or feed back from, the higher education sector. Existing barriers (rigid administration, red-tape, conflicting views) have deterred collaboration between the two sectors (K-12 versus higher education administration). In the absence of a government mandate and/or guidelines for a working relationship, the burden falls onto educators on both sides of the isle to try to work together to help develop a framework for curricula design that allows for ease of transfer to the university, and engineering in particular.

Typical curriculum of primary schools, in any of the Arab Gulf States today, is made up of blocks of information (assigned teaching material) that could be lumped into five differing categories. Table 2 displays the specifics of each category. The Math/Science block is in bad shape and needs major overhauling. Within this category, courses' contents are outdated material, often

irrelevant and improperly sequenced. Students handle physics and chemistry by “cramming” thus retaining very little as a base for future college courses.

Within the Humanities& Social Studies’ block of the curriculum, courses are a few with no electives. Course content in most cases is extremely limited in scope. Courses in this category don’t usually appeal to students planning to get into applied science and/or engineering. The author is of the opinion that this category of compulsory coursework needs reform. Wider selection of courses, allowing for broader views, and more appropriate delivery methods would make this block more appealing to students.

Teaching Staff: Teachers in the Region are either nationals, or thus civil servants for life, or contracted individuals drawn from Arab countries for a specified duration. Marked differences in terms of: rights, duties, privileges, and financial compensations exist between the two groups. Nationals are far more secure and draw considerably higher salary. Most teaching staff are university graduates, or have finished a two-year teachers college. The view often expressed by concerned and informed educators is: in order to succeed in reforming education, the teaching work force has to take a proactive role. Teachers, therefore, are called upon to abandon the old passive approach to the transmission of knowledge in favor of a more positive stance.

Pre-Engineering “Prep- program”:

The Status Quo: As previously stated, pre-college education in the Region has weaknesses and deficiencies that need to be addressed and rectified. The reluctance of decision makers to reform public education (K-12) has continued to adversely affect outcome. Students finishing primary schools (high school) and wish to apply to engineering are only marginally prepared to get into the first year. The challenge becomes greater when the engineering education in contention is modeled after the North American system, such as the case with the eight engineering colleges of the Region. The deficiencies that are most apparent in K-12 education- for students entering engineering- fall under three categories: (1) students’ *insufficiency in English skills*. After six years of learning English in schools, students could hardly compose a sentence and/or read a paragraph. (2) Students’ *inability to build on math& science* acquired during K-12. It is as if what students have learned in math& science classes never happened, or what has remained in their minds is so “fuzzy” that they are unable to use. (3) Lack of: *intellectual curiosity, critical thinking, and self-confidence*. The traditional approach to teaching in combination with creativity-suppressing examination system has profoundly affected students’ learning abilities. Colleges of engineering in the Region have set up pre-

engineering programs to help prospective engineering students get over their deficiencies. Unfortunately these programs were instituted to teach English only, and paid very little attention to reviving math/science or building up desirable traits through a proper learning environment.

A Proposal: The author's proposal to reform the current "prep-programs" stems from a personal conviction of the inappropriateness of the "status quo", supported by other sources in the same vain, namely: limited data, informal reports, and opinion of concerned and involved individuals. All seem to unequivocally support the need for reform. Over and above the English component of the program, the "proposal" has four major objectives.

1) *To broaden the scope of the learning experience:* It is proposed that math& science be added to the program, such that high school math& science would be linked at exit point, with comparable subjects at college entrance level.
2) *To focus on student learning:* To avoid traditional teaching and adopt modern approaches with emphasis on: student- teacher interaction, and personality- building measures.
3) *To help develop positive traits and attitudes:* The passive approach to transmission of knowledge, has adversely affected outcome and left its indelible marks on student's personality and traits. The author believes that a proper learning environment will undo prior damage and help develop positive personality and attributes for success.
4) *To expose students to engineering work environment:* A student would be provided with the opportunity to perform engineering tasks, as a junior member. Such an experience would help students decide their future and help build self-confidence and independent thinking.

The three components of the proposed pre-engineering "prep-program", shown in Table 3, are briefly discussed under three separate headings.

Acquiring English Skills: Upon graduation from primary schools, an average student ends up with very little knowledge of English. A two-stage English learning program is hereby proposed. *Stage One*-(a building stage) a one year period of English learning that carries the student forward, from virtually no prior knowledge to a "pre-set" level of English sufficiency. *Stage Two*-(a capping stage) a one semester of additional English to enable students to "sail through" first-year engineering with hardly any difficulties due to English. Here, students become familiar with technical terms, and improve their writing skills.

Reviving Math & Science: Despite the wide exposure to math and science in primary schools; students' ability to apply such knowledge or build upon it has been met with failure. The author proposes to include in the "prep-program" a "prep" math course and a "prep" science course: bridging to "gateway courses" (calculus, physics and chemistry). The intent is to achieve the following goals: (1) rekindle tacit knowledge; (2) expose students to technical

English; (3) help students develop links between primary school courses and first-year "gateway" courses; (4) provide an opportunity to revisit high school math& science in order to learn what may have been forgotten; and (5) introduce students to lab experiments (physics lab/chemistry lab), to develop an appreciation for lab component.

Practical Training: An eight week period of "on the job training" as part of the "prep-program" would go far in reconstituting attitudes and creating awareness of the engineering work place. Key partners in this exercise are the industrial sector and/or government agencies. At the start, the training program has to be set up properly, identifying essential ingredients for its success. Planning, training, supervising, and other aspects of the program tend to fall on the shoulders of the industrial partners. Typically, a trainee would be assigned to a unit or a group that provides a service or a product. He would be assigned a mentor and be shown the specifics of the tasks he is to perform or contribute to. The trainee would come in contact with team members and other groups or divisions, to see the "big picture" of the company.

Concluding Remarks

The ideas, views, and suggestions proposed to reform the present pre-engineering "prep-programs" in the Arab Gulf States, if carried out, would dramatically improve students' readiness to pursue an engineering education. The impact of such transformation would be felt more distinctly during the first year. The proposed "prep-program" is aimed at (1) building up English language skills; (2) revisiting high school math& science to revive prior knowledge and link up with "gateway" courses; (3) creating an awareness of the role of engineers in the work place through a short-duration "practical/hands-on" training period; and (4) developing proper learning environment to help instill positive attitudes and desirable personal traits. A properly conceived and a well-run "prep-program" will aid in planting the seeds for creative thinking and other desired characteristics such as: good grasp of fundamentals, good communication skills, desire to learn, and appreciation of team work.

Bibliography

1. Akili, W., "Engineering Education in the Arab Countries: Problems& Solutions," *Soc.of Petroleum Engineers/Qatar section*, in-house report, June1999.
2. Akili, W., "Engineering Education in the Arab Gulf States: Stagnation versus Change," *Proc. The 2002 ASEE Annual Conf.*, Montreal, June 2002.
3. Akili, W., "On Reform of Engineering Education in the Arab Gulf States: A Focus on Pre-Engineering "Prep-Program," *Proc. The 2003 ASCE Annual Conf*. Nashville, TN, June 2003.

Country	*College of Engineering*	*Year Established*
Saudi Arabia	King Saud University – Riyadh	Early sixties
Saudi Arabia	King Abdul-Aziz University - Jeddah	Early sixties
Saudi Arabia	King Fahd Univ. of Petroleum and Minerals (KFUPM) – Dhahran	Late sixties
Bahrain	University of Bahrain – Manama	Mid seventies
Kuwait	College of Eng. and Petroleum at Kuwait University - Kuwait City	Mid seventies
Qatar	University of Qatar – Doha	Early eighties
United Arab Emirates	UAE University - Al-Ain	Early eighties
Oman	Sultan Qaboos University – Muscat	Mid eighties

Table 1. The Eight Engineering Colleges of the Arab Gulf Region

	Components	*Coverage (Areas)*	*% Time / Effort of Total*	*Comments*
1	Values/Culture/Religious Studies		20±5%	Outside the scope
2	Arabic Language and Literature		15±5%	Outside the scope
3	**Math and Science**	• Trigonometry, Algebra, , Geometry, Calculus • Life Sciences • General Physics • General Chemistry	45±5%	Requires **major reform**
4	**Humanities and Social Studies**	History, Geography, Research Methods	10±2%	Requires **major reform**
5	**English Language**	English as a foreign language	10±2%	Requires **major reform**

Table 2. Simplified Breakdown of Primary School Curriculum in the Arab Gulf States

Component	**Duration**
English Skills • ***Stage One*****:** Building up knowledge and skills from scratch to a "preset" level • ***Stage Two*****:** Addressing writing skills, comprehension, and technical English	Two semesters One semester
Math and Science • ***"Prep" Math*****:** To link high school math with first year college math • ***"Prep" Science***: General physics and/or general chemistry at high school level with hands-on laboratory experiments	One or two semesters One or two semesters
Practical Training • ***Field or Office experience*****:** To familiarize students with engineering work and help instill positive attributes	Eight weeks

Table 3. The Three Components of the Proposed Pre-Engineering "Prep-Program"