

## **Suggested Plans and Practices for Further Development of Engineering Educators in the Arab Gulf Region**

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### **Abstract:**

The increased mobility of engineers worldwide poses new and difficult challenges to country and/or region-based systems of engineering education, whose advocates now face the possibility that their graduates may not possess the skills recognized as valuable in other countries or by international employers operating within their own country or region. One of the world's regions where engineering education is rapidly evolving, and becoming increasingly international is: the Arab Gulf Region ((Saudi Arabia, Bahrain, Kuwait, United Arab Emirates, Qatar, and Oman) which faces significant challenges as it seeks to meet the demands on the engineering profession in the years to come. Engineering faculty in the Arab Gulf Region, and the young in particular, need to expand their technical knowledge and develop new competencies to further their technical and professional development and keep up with modern approaches to teaching and learning. This paper explores ways to effective professional development of Region's engineering educators to enable them to assume the roles they are entrusted with. The purpose here is to offer a new way to think about the development of the professional engineering educator. In this respect, the paper focuses on:(i) the cognitive processes that faculty would follow as they grow and learn more about teaching and learning,(ii) the discipline-based industrial/practical experience they need to acquire in their locale to add to their repertoire as "practitioners" of engineering, and (iii) the institutional initiatives, including administrative support, encouragement, and resources. What is needed is to create a change in culture within the institution, the department or college, to generate a comprehensive and integrated set of components: clearly articulated expectations, a reward system for good teaching aligned with expectations, and opportunities for professional development to occur. The ultimate goal is to identify what Arab Gulf Region's engineering educators and their institutions can do to generate more powerful and responsive forms of education that improves the quality of student learning.

### **Introduction**

Engineering education in the Arab Gulf Region ((Saudi Arabia, Bahrain, Kuwait, United Arab Emirates, Qatar, and Oman) faces significant challenges as it seeks to meet the demands on the engineering profession in the future. This paper focuses on professional development of faculty members (teaching engineering subjects in the Arab Gulf Region), and argues that good teachers of engineering are those who keep up with new developments in their areas of specialization; and, at the same time, learn new approaches to teaching and learning.

Traditionally, engineering research and teaching have been approached in very different ways. To prepare for research we undergo years of rigorous training, both in scientific knowledge and in methods of gaining new knowledge through experimentation, analysis, and modeling. To prepare for teaching, most of us acquire the same knowledge, except for a stint as teaching assistants; we receive almost no training in how to impart it to students. Fortunately, there is now a well developed science of human learning that has been very explicit in the ways in which students should learn, and how teachers should teach <sup>(1, 2)</sup>. Further, they address different learning styles <sup>(3, 4)</sup>, focus explicitly on communication, teamwork, and leadership skills <sup>(5, 6)</sup>, and stress on educating students for life by helping them learn how to learn. <sup>(5, 7)</sup>

“Skilful engineering teachers” are those who are committed to the profession, and at the same time, do possess knowledge in three domains: engineering knowledge (i.e., their main disciplinary expertise and its related areas), pedagogical knowledge (i.e., how students learn, effective pedagogies in achieving learning goals), and pedagogical content knowledge (e.g., how best to demonstrate procedures, relate concepts, and correct students’ misconceptions within given constraints) <sup>(8)</sup>. However, expertise in any domain is usually developed over time through determination, personal effort, and years of practice, and teaching is no different! It is a skill that can be acquired and improved with the right information, practice, and corrective measures through proper feedback <sup>(9, 10)</sup>. An increasing number of engineering educators are sharing valuable approaches, strategies, and techniques on teaching and learning. Characteristics such as “enthusiasm”, “care”, and “knowledge of subject matter” show up almost on everyone’s list of the qualities of a good teacher.

But, it is becoming increasingly clear that effective teachers do possess some basic understanding of the learning process (i.e., they are able to make the connections between what students already know and what we want them to learn). <sup>(11)</sup>

In the Arab Gulf Region, young faculty (recent graduates with PhDs) who decide to get into teaching, and embark on it with hardly any prior preparation or training, except perhaps when they served as TA’s in a couple of classes (when they were graduate students), have faced some disappointments. They have found themselves, often, unable to cope, and many have begun to view teaching as an unpleasant “chore” they have to put up with. These frustrations and ill feelings, unless properly addressed and dealt with early on, would result in serious consequences, such as: opting out, changing jobs, or else: continue to face problems in the classroom, and eventually, become demoralized, thus adversely affecting outcome. Given this rather unpleasant situation, how may young faculty members of the Arab Gulf Region, overcome these difficulties and survive in this maelstrom of indecisiveness and uncertainty? What is the role of the institution in assisting young faculty in overcoming the initial hurdles at the start of their journey?

The paper addresses issues and concerns that beset the majority of young engineering faculty in the Arab Gulf Region at the start of their academic career, and argues that the introduction, early on, of “well thought out” professional development strategies

of engineering educators would raise their self-confidence as teachers and help in equipping them with the tools they need in disseminating knowledge in the classroom. This does not mean that learning and teaching does not go on in Region's colleges of engineering; I think that a great deal does. But there is every reason to believe that introducing a higher level of professionalism would enable young faculty to create and sustain a more powerful form of engineering education for the Region.

The author draws on his own experience in the Region, as a faculty member and an administrator, and looks forward to a new paradigm in engineering education that will lead to widespread reform, to ensure the vitality and currency of engineering education in the Arab Gulf Region.

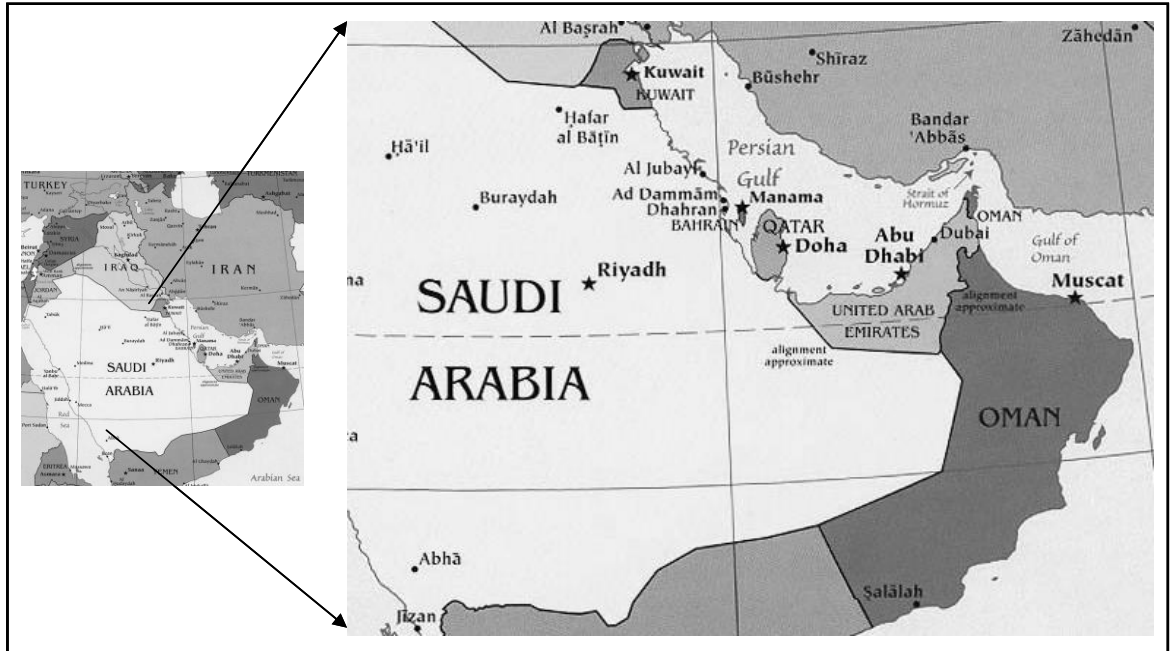
### **Some Benchmarks of Engineering Education in the Arab Gulf Region**

In most Middle East countries we witness an increase in the numbers of: engineering colleges, students, and engineering graduates. This trend has continued for decades and has exceeded expectations. But, unfortunately, the education process in nearly all government-run programs within these countries, continue to suffer from: antiquated programs, improper teaching methods, poor management, and lack of resources. On the other hand, engineering institutions in the Arab Gulf Region have, by and large, been spared. Region's colleges (a map of the Region is shown in Figure1) have, from the start, "got on the right foot" and founded - what appeared to be at the time - modern engineering colleges with a decisive advantage over most of the engineering institutions of the broader Arab Middle East.

Engineering education in the Arab Gulf Region started, in earnest, during the early to mid sixties. Initially, colleges of engineering were founded in Riyadh, Jeddah, and later in Dhahran, Saudi Arabia. In the other smaller states of the Region, engineering colleges were founded soon after these states have gained their independence <sup>(12, 13, 14)</sup> The strong political and economic ties between the States of the Region and some western countries- the USA in particular- has helped enormously in setting up, manning, and providing needed guidance to these fledgling institutions during their early years. The dramatic increase in oil revenues during the 70s, and 80s, coupled with lack of skilled professionals in areas deemed necessary for growth and development of oil-related industries of the Region, has been pivotal in the start-up of higher education in general and engineering education in particular.

There are today eight public colleges of engineering in the Region (Table 1) in addition to several, recently established, private and semi private colleges and/or universities that offer engineering programs. These eight public colleges have, since their inception, been guided by advisory boards made up largely from faculty members and administrators drawn from US colleges. Previously, the Grinter's Report <sup>(15)</sup> and the Goals Report <sup>(16)</sup> have been used to guide the educational process. Recently, ABET Engineering Criteria 2000<sup>(17)</sup> has been the subject of seminars and workshops, intended to shed light and assist engineering colleges in the Region in making use of the EC2000 whenever possible. Indeed, the EC2000 has generated a lot of interest and challenges in the Region. Whether or not it will be fully

implemented, will depend on: institutional vision, available resources, students' preparedness, and prevailing traditions and norms.



*Figure 1. Map of the Region Showing the Six Gulf States (Saudi Arabia, Bahrain, Kuwait, United Arab Emirates, Qatar, and the Sultanate of Oman).*

The public colleges of engineering - eight in all - are part of the public university systems of the Region, and thus are government-run and almost totally government financed. The organizational structure is nearly the same in all. Students are mostly nationals of their respective countries and graduates of similar public education systems. Admission policies, for nearly all eight colleges, are based on grades obtained in an official examination sanctioned by the Ministry of Education, upon completion of the 12th grade. Additionally, an entrance exam and evidence of proficiency in English, a requirement imposed by many of these colleges, may exempt the applicant from a pre-engineering “prep year”, administered as a separate unit from the college. Statistics have shown that over 80% of first year engineering students do attend the “prep year,” during which students embark primarily on improving their English skills.<sup>(13)</sup>

The author has proposed to reform the “prep year” by making it two years, and widening the scope of the subject matter to include (in addition to building up English language skills to a pre-set level), the following components:(i) math and science courses in preparation for engineering “gateway” courses;(ii) a practical hands-on “pre-college” training period; and,(iii) fostering a “proper learning environment” to help students acquire desirable attributes such as: analytical skills, curiosity and desire to learn, creative thinking, leadership skills, and the importance of team work.<sup>(13,14)</sup>

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

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

During the last four decades, thousands of native Arabs (citizens of the Arab Gulf Region) have completed their engineering education at one of Region's eight public colleges (Table 1), and have occupied government positions or joined the private sector, side by side with expatriates. Some have established their own business, and many have moved up the ladder into responsible managerial positions. Many graduates, particularly those that have practiced engineering, do provide valuable insights relevant to today's deliberations on engineering education reform. Some feel the urge to express their views in the open, and many prefer to relate their concerns privately through formal channels. The views that have been expressed point towards the need to restructure programs, revise current educational methods, provide for professional development of faculty and students, and to graduate "well-rounded" engineers who could address variety of challenges represented by a highly competitive global market place, and be able to adapt to the ups and downs of business cycles. The views of the graduates have, by and large, been similar to those of the author and to views of some faculty members in Region's colleges; and are consonant with developing a more responsive educational environment.

It is interesting to note that the evolution of engineering education in the Region has passed through three consecutive stages. **Stage one:** the stage of ***founding and establishment***, lasted nearly a decade, and characterized mainly by adopting and transferring a North American model of engineering education to the Region. Expats, at the time, were entrusted with the tasks of the transfer, and were guided primarily by agreed-upon guidelines. **Stage two:** is the ***search for an identity*** stage. This is the period when nationals, who finished their graduate work abroad and have returned to serve their home institutions as young faculty, began to assert their presence and assume their role as a new addition to the faculty. Cultural issues, and conflicting views on how to move forward without adversely affecting earlier gains, characterized stage two. **Stage three:** the stage of ***pondering and deliberations***,

which has lingered on for a long time, is characterized by calls from industries, engineering graduates, and invited experts, for more rounded engineers with the skills and abilities to function in a modern business climate. Unfortunately, the response to these calls has been slow. The “piece meal” approach and/or periodic adjustments to an already over-burdened curriculum, in an attempt to meet a broad set of demands, have not been effective in meeting objectives, and have convinced many stakeholders that the time has come for a radical departure from the traditional layered and sequential structure that has prevailed for decades. There are clearly significant challenges ahead. Decision makers should not lose sight of the fact that students and their learning should be the focus of the educational process. i.e., to reframe the roles of faculty and rethink the current “mental model” of teaching and learning.

### **Relevant Cognitive Processes for Faculty Development**

The primary focus in this paper is on the development of young engineering faculty members in the Arab Gulf Region and the cognitive processes that faculty should follow as “they get immersed” in teaching and other related academic functions. In this regard, they most likely find their way and progress through seven incremental stages of development. An awareness that there is a lot to be learned can be both exciting and daunting. While the amount of information available can be overwhelming to any young instructor, the path forward is traversable with the advice and assistance of experienced academics and colleagues available to help with their journey.

***I. Emulate a Role Model:*** At their very start, young engineering faculty begin to remember the teachers they have had throughout their journey as students; and if their memories do not fail them, they sketch out the dominant positive characteristics of those they wish to emulate, and attempt to follow their way of teaching as they recall from their students’ days. Following the footsteps of their role model is often reflected in young faculties’ classroom disposition, attitudes, teaching activities, and may, in some instances, overshadow their true personality leading to some undesirable consequences. Eventually, however, they do come to grips with the fact that imitating their previous teachers is no solution, and do begin their sole-search by redirecting their efforts and energies towards self realization and fulfillment, moving in the direction of improving their teaching skills, and redefining their role in the teaching/learning arena.

***II. Enhance Teaching Skills:*** When young faculty members begin to get some negative feedback from students on their class performance, coupled with a “gut feeling” that their handling of the teaching material is not up to desirable standards; they begin to ponder the question of how to select appropriate strategies to improve their teaching, i.e., to learn about the “nuts and bolts” of teaching. At this stage young faculty may ask how they can make their lectures more interesting, how they can engage students, how can they prepare more suitable exams, and how best to use available teaching methods and in- class delivery techniques to enhance their teaching effectiveness. There is much to learn about teaching techniques. However, at

some point, young faculty will realize that they need to be selective in what they chose as a preferred strategy and may need guidance from a senior faculty member who has the knowledge and experience. Invariably, and in due course, young faculty members will realize that a gap exists between students' performance and their expectations as teachers. To narrow the gap, young faculty members need to move to the next level: examine closely what constitutes effective teaching, what defines deep-level learning, and what characterizes appropriate faculty and student roles in the teaching/learning process. <sup>(18, 19).</sup>

**III. Comprehend the Principles of Teaching and Learning:** While learning about teaching techniques helps instructors to become more effective in course delivery and related protocols, understanding the *basic principles* of learning and how they impact teaching in general would help them create new and more powerful forms of learning. <sup>(11)</sup> In other words, the problem may not be that the instructor lacks the experience or is a poor lecturer, but rather that lecturing may not be the most appropriate way of engaging students in the learning process. The principles of learning focus on fundamental issues such as: how people learn, how students process information, how prior knowledge impacts learning, and the varied ways different individuals learn. Because students have different *learning styles*, some teaching (and learning) methods are effective for some students but ineffective for others. Various models of learning styles preferences have been described <sup>(4, 20)</sup>. The following statements, based on the work of Rita Dunn <sup>(4, 21)</sup> and recast by Finelli, et al, <sup>(22)</sup> provide explanations and add meanings to the concept of learning style from different perspectives.

- Each student is unique, able to learn, and has an individual learning style.
- Individual learning styles should be acknowledged and respected.
- Learning style is a function of heredity and experience, and develops individually over one's life span.
- Learning style is a combination of affective, cognitive, environmental, developmental, and physiological responses that characterizes how a person learns.
- Individual information processing, fundamental to learning style, could be improved over time with practice.
- Learning style is a complex "construct" for which comprehensive understanding evolves.
- Learners are empowered by knowledge of their own and others' learning styles.
- Effective teaching implies continuous monitoring to ensure compatibility of instruction with each individual's learning style.
- Teaching individuals through their learning style strengths, improves their achievement, self-esteem, and attitude toward learning.
- Every person is entitled to counseling and instruction that is compatible with his/her style of learning.
- Applicable curriculum and teaching methods should ultimately become learning-style based and personalized to address and respect diversity.



To incorporate some or all of the elements listed above in an “engineering” course in which one is already faced with the problem of too much material in too short a time is daunting to experienced teachers, let alone young and inexperienced faculty members. Nevertheless, the challenge is exciting to any instructor who wishes to “humanize” the teaching (and learning) process, and reconcile within himself/herself that: he/she is teaching students rather than “unloading” teaching material in accordance with a time schedule.

**IV. Focus on Active Learning Strategies:** Here we proceed onward from general issues of learning to more specific questions about learning goals, including the different kinds of knowledge that would constitute significant learning for students. Researchers have categorized knowledge under different headings: *declarative knowledge* (define and describe), *procedurals knowledge* (how may learners use/ apply declarative knowledge), *structural knowledge* (how concepts in a domain are interrelated), and *contextual knowledge* (when to access selected principles/concepts and when to use certain procedures<sup>(23)</sup>). Different taxonomies of learning are in the literature that could help faculty define measurable goals that can guide the design of courses<sup>(24)</sup>. Articulating and defining goals inevitably leads to the discussion of how to achieve those goals, and how to measure whether students have met those goals. A related and a very important question is: what *active learning* really means and why research supports the notion that the more active the students are the deeper their understanding will be<sup>(25, 26)</sup>. The core elements of active learning are student activity and engagement in the learning process. Active learning is often contrasted to the traditional lecture where students passively receive information from the instructor. In short, active learning requires students to do meaningful learning activities and think about what they are doing<sup>(25, 26)</sup>. The activities must be designed around important learning outcomes and promote thoughtful engagement on the part of the students.

There are some pitfalls for young engineering faculty, in particular, those who pick up an article or two to learn how active learning works, and how they would be applying it to enhance their teaching. They should be advised to look at a broad range of learning methods and do their level best in scrutinizing information and published statistics, move into active learning gradually and cautiously, and seek the assistance and guidance of well-informed people, prior to embarking seriously on a specific strategy. No matter how data on a selected strategy and/or teaching method is presented, young faculty adopting an instructional practice with the expectation of seeing results similar to those reported in the literature should be aware of the practical limitations of such studies. Educational studies, by and large, relate what worked, for the population examined and the prevailing conditions at the time of the study. However, claiming that faculty who will adopt a selected method will see similar results in their own classrooms is simply unrealistic. Even if faculty members master the new instructional method, they will not be able to control all other variables that affect learning.

Despite these problems, young engineering faculty should be strongly encouraged to examine the literature on active learning. Some of the documented material on active

learning is compelling, to say the least, and should stimulate young faculty to think about teaching and learning in nontraditional ways, leading, in due course, to their adoption of an active learning strategy.

***V. Align Activities with Assessment and Integrate Course Components:*** To optimize on course resources, learning activities should be aligned with assessment by developing activities that support declared goals and student learning, often referred to as *educative assessment* <sup>(8, 27)</sup>. This would include decisions on how to provide information on students' strengths and their mastery of course material, as well as guidance on how to proceed with learning activities to insure compliance with defined goals and how to improve students' performance and their grasp of new material. Students will eventually need reliable feedback on their performance that allows them to move forward as learners and deepens their understanding of the subject matter. This feedback could come from the instructor, their classmates, their own self-reflection, or a combination of the three. <sup>(27, 28)</sup>

Another important factor in the optimization process is to integrate the different course components (learning goals, teaching/learning activities, feedback, and assessment), in such a way that the course becomes well-knit while the various components support and complement each other in a coherent manner, i.e., the sequencing of learning activities, feedback, and assessment should build energy, engage students, and allow learning to develop as the course proceeds. The process would invariably reach optimum conditions after several iterations, and as the young instructor becomes more knowledgeable about the learning process.

***VI. Affirm the Human Dimension of Education:*** At its core, teaching is an action with a profound human dimension. Teaching is about making some kind of dent in the world so that the world is somehow different than it was before you practiced your craft<sup>(11)</sup>. Knowing the kind of dent you want to make means that you, as a teacher, want to ask yourself the fundamental question: What effect am I having on students and on their learning? Asking this question helps when one is faced with the need to make choices, and the choices one makes, connect to the overall aims one is pursuing in his/her endeavor as a teacher. At times of uncertainty, students will draw strength from teacher's passion, understanding and conviction. Therefore we do need to understand our own- and our students'- passions, motivations, and life experiences.

There is more to teaching than "unloading teaching material"; meaning that instructors have to teach in an inspired and an inspiring way. Instructors must ask how they can more fully understand and relate to students as human beings. Instructors should demonstrate that they are thoughtful people, and possess a carefully developed and deeply felt conviction about teaching in general and their specific role in the process, in particular. Demonstrating that they know where they are going, and why they believe it is important to take students there with them, imbues the students with a sense of confidence. Students would then realize that they are under the guidance of someone who is experienced, insightful, and above all, committed and does care! Having a clear sense of where the journey is leading and a

deeply held belief in the importance of embarking on it are attributes that come strongly into play when students feel lost, afraid, and confused along the way. In her monograph, *they're Not Dumb, They're Different: Stalking the Second Tier* <sup>(29)</sup>, Sheila Tobias echoes some of these concerns. Her work addresses some specific classroom characteristics that, if paid attention to, might help calm down the second tier students (i.e., those high achievers who are serious about their learning and career goals but who, for some reason, chose to opt out of engineering). Tobias asserts that many traditional science courses suffer from lack of community( both between the instructor and the students and among the students themselves) and that many students desire this relationship and become more successful learners when it prevails in the classroom. She further states that many students would respond better to science if interactive and cooperative modes of learning replace the competitive environment that is sometimes present in science and engineering classes. <sup>(29)</sup> Also nonengineering required courses taken at the onset of an engineering degree may provide students with a foundation for engineering coursework. Those who perform poorly in these foundational courses, typically have limited success in engineering <sup>(30)</sup>.

**VII. Build Trust with Students:** Underlying all significant learning is the element of trust. Trust between teachers and their students is the affective glue that binds the educational relationships together. Not trusting teachers has grave consequences for students. They are unwilling to submit themselves to the perilous uncertainties that of new learning. The more profound and meaningful the learning experience is to students, the more they need to be able to trust their teachers <sup>(11)</sup>. At the center of the many desirable characteristics that make teachers more trustworthy in students' eyes are two components: teacher **credibility** and teacher **authenticity**. Teacher credibility refers to teachers' ability to present themselves as ordinary people with something to offer to students. Teachers who have credibility are perceived by students as possessing depth and breadth of knowledge that far exceeds the students' own. It is the competence that students do expect of their teachers, to help them come to grips with complexities, contradictions, and uncertainties that many do experience when exposed to unfamiliar territory. <sup>(11)</sup>

**Authentic** teachers are, essentially, those that the students feel they could trust. They are real human beings with passion, frailties, and emotions. They are perceived as whole persons, say what they feel and do what their conscience directs them to do. Not people who hide behind a made up façade that camouflages their true self. In more specific terms, students see four types of behavior as evidence of **authenticity**: (i) teachers' words and deeds are congruent; (ii) teachers admit having made a mistake publicly when they do so, acknowledge fallibility, and refrain from bragging and self praise; (iii) teachers allow aspects of their personality, outside their role as teachers, to be revealed to students; and (iv) teachers encourage learners to express their views openly, and are willing to change their practices as a result of students' suggestions. <sup>(11)</sup>

Research has shown that various dimensions of students' personal growth and related change does occur during students' college experience, and research also shows that

college educators impact this growth and development, positively or negatively, often without being aware of their actions and related consequences<sup>(31,32)</sup>. Educators should realize, from the very beginning and at the very start of their academic journey, that students would be influenced by teachers' actions, dispositions, and attitudes. Students may also be concerned that the learning methods that the instructor favors are entirely inappropriate or that the criteria applied to judging their efforts are unfair. In response to these legitimate concerns, the instructor should demonstrate to students that he/she knows what he/she is doing. Even though many students may not agree with his/her explanations and justifications, they would feel reassured that the instructor has chartered a clear path forward, sure of his/her actions, and sure also that what is happening is valuable and in the interest of the students and their learning goals.

### **Professional Engineering Experience and its Role in Faculty Development**

Concurrent with equipping the young engineering faculty with pedagogical knowledge and related skills in the teaching/learning arena; attention ought to be paid to young instructors' growth, interaction, and development in their engineering field, i.e., their declared area of expertise. It has been said that "engineering instructors are engineers first and instructors second", which implies that keeping pace with new development in their fields enhances their abilities as engineers, and at the same time, bolster their role in the teaching/learning domain (i.e., they become better teachers as a result of gaining practical experience and participating in solving real problems). The experience they gain as practitioners is invaluable, and would eventually find its way to the classroom - where instructors share their experience with the students, exposing them to the practical dimension of engineering, not usually found in textbooks and reference material, and supplementing it with experience-based judgment.

No one would dream of building a medical school without an explicit mechanism to encourage teaching staff to keep up with their practice of medicine. If engineering is also a real-world profession, its teachers, particularly the young, should be encouraged to practice engineering through design, development, manufacturing, and testing of real products and services. The one-day per week consulting rule does encourage this, but the reality is that these activities are, unfortunately, frowned upon, largely because they tend to distract instructors from their main functions, i.e., their teaching, research and service to the department and the college. On-campus facilities and institutional arrangements such as consulting and enterprise incubators should be investigated by appealing to other professional models, i.e., medicine, law, veterinary medicine, etc. Some of these activities are at the very least self-supporting, but could, if properly planned, shed funds that could be used to support other academic endeavors.

I believe there are feasible action plans that should be adopted to pave the way for potential collaboration between industry and academe. These would include:

*i) First*, seeding and propagating the idea, that gaining practical experience enhances young instructors' teaching competence without adversely affecting his/her research capability. A faculty member should strive to do both! (be a good teacher and a researcher at the same time). Simply stated, the prevailing perception that time and effort should be spent mostly pursuing research and research funds, and that time and effort spent enhancing one's teaching competence does not count toward promotion and tenure, need to be changed! The relatively high value currently placed by colleges on the research experience and research-oriented expectations of new faculty needs to be reexamined. The positive relationship between having practical experience and faculty's performance, commitment, and positive attitude toward the classroom environment, requires college and university administrators to "rethink" their current hiring, promotion and tenure policies<sup>(32,33)</sup>. To insure a fair and equitable system, it is important that sufficient weight be allocated to practical experience (past and present), and also, to begin a change in cultural norms that have favored research over teaching for decades.

*ii) Second*, initiating and supporting efforts to educate graduate students about the benefits of acquiring industrial experience, and its relevance to their future careers as faculty members, and becoming engineering educators. Encourage them to get in touch with industry, have a connection with someone on the inside, and plan to get involved with the practice when they do graduate. This notion of reaching out to industry at an early stage is foreign to the halls of the engineering academy in the Region, and likely to meet cultural resistance. Nonetheless, if we are pragmatic and desire to do a better job in equipping our students with the "tools of the trade" then we need to alert our graduate students (the future engineering teachers) to the need of developing proper and enduring connections with industries in their locale, and eventually have a mutually beneficial relations with the industrial sector; not so much to supplement their income; but, principally, to be able to reach the broader goal, i.e., to gain valuable experience and be truly involved in real engineering.

*iii) Third*, reaching out to the industrial sector and engineering services in the Region, and striving to form symbiotic partnerships between local industry and academia through: capstone projects, theses work with practical overtones, and applied research projects in selected domains, is extremely desirable and beneficial. Today, with the engineering profession undergoing dramatic changes on many fronts - there is real need for faculty and students, to become involved with practical problems and to share in providing solutions. We owe it to our students to prepare them to meet the challenges ahead by focusing on real issues derived from tangible situations. The surest road to having a working college-industry relation is to come to a mutual understanding that both parties would gain from such a relationship. The discussion noted above may remain academic, difficult to implement, and not feasible unless preceded by a number of specific steps borrowed largely from the world of business. These steps include:

- "Rethink" students-faculty future roles beyond the egocentric model building with the precept that the ideal educational output and the ideal student is one just

like me! Widen the discussion and seek feed back from past and present students, research sponsors, and/or industrial clients.

- Identify customers' needs on two fronts, their future manpower needs, and the support services that they are likely to require (e.g. technical consultation, applied research, testing, monitoring, setting standards, etc.), now and in the future.
- Reorganize internally in order to streamline external operations and redirect efforts to integrate with external clients, particularly local industry that hires graduates and uses institution's services. Start with the integration of the relevant parts of the curriculum, students' placement, and industrial problem solving.
- Privatize portions of the College- if at all feasible- to eliminate red tape, reduce waste, and allow industrial partners to make more effective use of college resources. Contracting or transaction costs are often a major barrier to cooperation between different parties, and many university-industrial activities run aground on the shoals of intellectual property rights. In efforts that are educational in nature it would do the universities well to remember that industries are the *sine qua non* of real engineering activities<sup>(34)</sup>. Be broad minded and think long range.

In this vein, the major engineering problems of local industries along with their potential solutions should be focused on, properly framed, and clearly identified in open forums (e.g. through technical seminars, capstone courses and projects, theses work, etc.). This would help to set the stage by: disseminating relevant information, generating technical debate, and examining potential solutions from different perspectives. To come to grip with the needs of the industry and develop the potential to tackle industries' main problems and concerns, universities have to reach out, market their services, and do a better job understanding and articulating what customers do require long range. Invariably, it has to be a team approach, and among the major players are young engineering instructors and graduate students. If we are to preach teamwork to our students, we had better train young faculty in teamwork, and leadership skills necessary for success. Although we would continue to witness faculty who can research and publish on their own; but, at the very least the lone wolves will have to learn to travel in more collaborative packs. Having more trained faculty in team-based, collaborative research will bolster the pool of potential group leaders, department heads, and future administrators, when the need arises.

### **Institutional Role**

Colleges of engineering would excel at teaching and learning when the majority of their faculty develop and achieve a reasonable level of pedagogical knowledge, and at the same time, are able to enrich the learning process by bringing in their own engineering experience into the classroom. Achieving a relatively high standard of teaching competence requires individual faculty commitment and dedication to the process, clear vision of the path forward, self-discipline, and time and effort to acquire the desired skills and the relevant practical experience. Irrespective of individual faculty member own initiative and commitment to the process, institutional support and faculty leadership is absolutely necessary for achieving success and reaching the desired level of teaching competence. There are several action items that institutions of the Arab Gulf Region need to adopt with the aim of impacting young

faculty development, their teaching/learning activities, and their classroom performance, i.e., to see faculty grow as professional educators, over time.

***Correct Misconceptions:*** To start, the institution should strive to change the mind set that has gripped academe in the Region for years. First of all, the prevailing antiquated model of good teaching and proper learning needs to redefine the roles of faculty and students in the educational process. There is every reason to believe that the institutions of the Arab Gulf Region could, by introducing a higher level of professionalism, make both: what the students are doing and what faculty members are doing with their students substantially more effective. Also, the institution should try to rectify views and dispositions of many, inside and outside academe, who are of the opinion that young faculty, upon graduation with their PhD's, have learned it all! i.e., acquired all that it takes to embark on the job, and their competence need not be challenged or questioned. Therefore, (from their perspective) the professional development of faculty members is self-generated and self-propelled; and the institution needs not interfere or help unless unusual circumstances demand stepping in.

***Provide the Necessary Environment and Support Services:*** Faculty, and in particular the "beginners", may feel good about themselves, their class performance, and their handling of the subject matter they are entrusted with, but are not prompted to explore alternative perspectives, to venture into new skill areas, or to scrutinize critically those habitual assumptions underlying their thoughts and actions. To live in a *cul-de-sac* may be comfortable, for some time, but could be self-defeating long range. Faculty are sometimes so enclosed within their narrow frames of reference that they are the last to recognize that these may be misleading or even harmful. The most important thing that could be done to lift the faculty member out of the "rut" is to challenge him/her with alternative perspectives, fresh ideas, new activities, and critical reflection. At this juncture, the viable role of the institution in providing the proper environment for professional growth and development of its faculty is key to achieving success and fostering a positive change.

***Instigate a Constructive Dialogue:*** In order to provide the necessary support services and learning opportunities for faculty in general and the young ones in particular, a constructive dialogue between faculty and administrators (planners, decision makers, and financial officers) should precede any scenario and/or action plan under consideration. Faculty should rightfully identify current barriers, including time and resources needed for new activities (what can be unloaded to make room for new things?), the need for opportunities to learn (having access to seminars and workshops on campus or at a professional conference), approval and support to try novel ways of teaching without risking low evaluations at the start, and access to instructional consultants and experienced teachers to serve as advisors and mentors. Consultants help faculty examine what they want students to learn, and explore what materials, media, and teaching strategies will most effectively support their learning goals.

**Reward Good Teaching:** Administrators should strive to make effective teaching and instructional development higher institutional priorities. Many faculty would participate in professional educational development when the institution begins to reward good teaching or learning about good teaching. It is difficult to buck the trend that has continued to reward faculty for writing grant proposals, doing research, and writing for publication. To counter this tendency, provosts, deans and chairs should reexamine the institution's infrastructure (especially the faculty incentive and reward structure) as it affects faculty attitudes and behavior. Using incentives to encourage young faculty to increase their commitment to teaching may help, but continuing to hire new faculty whose primary emphasis and interests is in research, inevitably does reinforce existing cultural norms that favor research over teaching.

**Facilitate and Support Faculty in Acquiring Relevant Practical Experience:** Encourage faculty members, particularly the young, to get involved with the practice in their locale, and devise equitable system(s) that allow faculty to gain the engineering experience they desperately need, in order to keep up with new developments in their areas of specialization. Thus asserting the view that engineering faculty "with practical experience under their belt" would, in general, make better teachers. Administrators (deans, chairs, and decision makers in general) should investigate ways for helping new faculty members gain industrial experience by spending a semester on-site at a cooperating industry, using summer release time to work within industry, or allow for a dual appointment, say fifty-fifty, i.e., fifty percent of faculty time at the College and the other fifty percent at an industry nearby. Perhaps the legal and organizational details of these schemes deserve closer benchmarking.

The above noted action items do require a change in prevailing culture accompanied by firm conviction and commitment on the part of academic leaders and decision makers, including senior faculty, department heads and deans. Attention must be paid to initiating and managing change. **Four processes** are key to attaining success: (i) arrival at plans/scenarios that have been scrutinized and received wide acceptance, preferably from the bottom up, (ii) alignment of relevant procedures and decision-making groups, (iii) learning how to initiate and sustain significant change efforts, and, (iv) devise effective means of assessing the impact of change on the new culture.

There are today many change models and a robust literature that academic leaders can draw upon. Also, an increasing number of faculty development programs, in terms of seminars and workshops, are readily available for senior faculty, department heads and deans, to review and select from. This literature includes: models of change<sup>(34,36)</sup>, recommendation on "culture-embedding" processes<sup>(37)</sup>, factors that may help in changing people's minds<sup>(38)</sup>, and advice on how leaders could make culture more explicit<sup>(37)</sup>. However, any significant change in the *status quo* can only be brought about through the leadership of visionary administrators, appropriate support, adequate resources, and faculty members' willingness to learn. All four could come as a result of a new culture in the college that values the future role of young faculty in the educational process, i.e., to enhance the effectiveness of teaching and learning of engineering students in Region's colleges. Many reports, world-wide, present a



vision of what engineering education should look like, but most do not get into the required steps needed to engage faculty, chairs, and deans in discussion of change in engineering education anywhere, world-wide.<sup>(39)</sup>

## Conclusions

The engineering profession in the Arab Gulf Region is currently facing many challenges that need to be addressed to insure that future engineers have the required capabilities they need to perform well in a world driven by rapid technological advancements, environmental issues brought about by population growth and diminishing resources, and the creation of new disciplines at the interfaces between engineering and sciences. Addressing some or all of these challenges requires new and better kinds of teaching, which in turn requires Region's engineering faculty and decision makers to think about teaching and learning in more scholarly ways.

At the center of it all, is the engineering educator who is the major player, the instigator, the facilitator of learning, and the care taker. If engineering colleges want to introduce meaningful change in how engineering education should be practiced, faculty members, and the young ones in particular, will need a new perspective that: i) validates why learning about teaching is important; ii) provides them with the opportunities to engage in what and how to learn about teaching, e.g., a systematic way for continued educational development; iii) enables young faculty to gain the practical engineering experience that faculty members require to become better teachers of engineering subjects; and, iv) propagates a positive and dynamic culture that values good teaching and introduces meaningful change in how engineering education is to be practiced throughout the Region.

The paper offers a new way to think about the potential development of the professional engineering educator. In this regard, it focuses on the cognitive processes that faculty most likely follow as they get immersed in teaching. They progress as they work their way, through seven consecutive stages of development. These stages are noted in Table 2.

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| <ul style="list-style-type: none"><li>• Emulate a Role Model</li><li>• Enhance Teaching Skills</li><li>• Comprehend the Principles of Teaching and Learning</li><li>• Focus on Active Learning Strategies</li><li>• Align Activities with Assessment and Begin to Integrate Course Components</li><li>• Affirm the Human Dimension of Engineering Education</li><li>• Build Trust with Students.</li></ul> |
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*Table 2. The Seven Cognitive Stages that Faculty Members are Likely to Follow.*

Achieving high level of professional pedagogical knowledge and competence is essential but hardly sufficient for an engineering faculty member to assert his/her role as a facilitator of an engineering subject matter. To teach certain engineering subjects you need the depth and breadth that comes only through the practice of engineering. There is much that the “practice” could add to one’s repertoire as a teacher. However, at some point, many members realize that being an academician severely limits your chances of gaining the practical experience that they desperately need to bring industrially relevant design, and many other aspects of the practice, to the classroom. In this context, it is imperative that engineering faculty be encouraged to reach out to the industrial sector in order to arrive at a workable and equitable circumstance that allows the faculty member to gain the practical experience he/she requires to enhance their role as engineering teachers. Some of the action plans that may help facilitate developing proper ties with the industrial sector in their locale, and at the same time encourage young faculty to add practical experience to their repertoire, are listed in Table 3.

- Propagate the idea - on and off campus - that gaining practical experience enhances teaching competence
- Allocate sufficient weight to industrial experience when hiring new faculty
- Initiate and support efforts to educate graduate students(the future faculty members) about the benefits of acquiring industrial experience and its relevance to their future teaching career
- Search for proper ways to connect with the industrial sector in the Region with the aim of forming symbiotic partnerships through: capstone projects, theses work with practical overtones, and applied research projects in selected domains
- Allow the industrial partners to make use of College facilities and its human resources in tackling technical and managerial issues of concern to the industrial sector, locally and regionally.

*Table.3. Action Plans to Instigate and Facilitate Industry–Academe Relations in the Region*

Although Region’s colleges of engineering have some degree of freedom, however, changing their trajectories is often difficult. To change the “mind set” of those who are entrusted with decision-making is complex and may require long time to happen. For the reforms in engineering education advocated in this article to be enacted, I believe the culture of engineering colleges needs to evolve to the point where the changes referred to will be reinforced by an explicit set of expectations, a support structure, and a compatible faculty reward system that values good teaching. Leaving change up to individual faculty members without a supportive culture, e.g., without reward systems that value teaching as a scholarly task on par with research, does not work.

Piecemeal efforts- an initiative here a workshop there- may result in pockets of improvements but would fall short of changing the prevailing norms, values, and behavior within the institution as a whole. What is necessary to bring about a change in culture is for the institution, i.e., department, college, or section, to have a comprehensive and integrated set of components: clearly articulated expectations, a reward system compatible with those expectations, supportive leadership, and opportunities for the professional development to occur.

When the institutions of the Region mount these strategic important initiatives, thus leading to effective professional development of the engineering educator, then future generations of engineering students would have a better and more relevant education. An education that provides them with the knowledge, skills, and attitudes they need to tackle the complex engineering problems that the Arab Gulf Region is likely to face in the future.

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