Educating engineering students in Egypt: recommendations for improvement

Educating Engineering Students in Egypt:

Recommendations for Improvement

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Abstract

Egyptian schools of engineering (government faculties, private faculties and private higher engineering institutes) award degrees to 35000 graduates annually. There have been concerns from the Egyptian Engineers Syndicate, experienced engineers, local & international employers, parents and other society stakeholders about the knowledge and skills gained by engineering graduates. In this article, first the institutions were analyzed from a fresh business perspective. The analysis highlighted several constraints that hinder radical reforms. In part two of this article the aspirations of stakeholders were collected and identified. In part three, recommendations were made based on the experiences of engineering education providers worldwide.

Keywords: higher education, Egypt, engineering education, quality improvement

1. Introduction

Each year approximately 35000 engineering graduates join the Egyptian Engineers Syndicate (Deabes, 2015), yet in 2001, the number of graduates was recorded at 12213 (El-Sayed, Lucena & Downey, 2006), triple the number. Rabeae (2017) reported that governmental universities will admit 17170 students in 2017, meaning the remainder of those who which to study engineering will be enrolled in private universities or private higher engineering institutes also offering BSc. degrees in engineering. There have been concerns about the quality of education these engineering students receive and skills acquired during their studies by academics (Riad & Kamel, 2004), employers (Osman, 2011) and the Egyptian Engineers Syndicate (Elkhatary, 2017). Al-Harthi (2011) reported that Egyptian undergraduate students were aware that their education is not related to the required employment skills. International organizations also expressed concern about the skills of Egyptian graduates (Assaad, Krafft, and Isfahani, 2014; Egypt Human Development Report, 2010; Murata, 2014; OECD-World Bank, 2010). A number workshops discussed these issues over the years (as highlighted by El Araby, 2014; Deabes, 2016; and Zein, 2017).

Shann (1992) identified the chronic symptoms of the higher education system in Egypt in general. She noted severe crowding, decline in quality, out-dated curriculum, limited educational facilities and resources and reliance on private tutoring. More recently, similar observations were made by Holmes (2008), Schomaker (2015) and Habibi & El-Hamidi (2016), which showed that many years later the symptoms were still there. Loveluck (2012) added other perspectives including: over-centralized control, focus on rote learning for examination, inadequate access and funding & research capacity. Based on these issues, recipes for reform were suggested (OECD-World Bank, 2010). The Ministry of Higher Education took notice of these recommendations and established a "Center for Higher Education Reform" in the early 1990's, and later another entity was established under the name "Project Management Unit for Educational Development" in 2003. Egypt has received aid to help in the reform efforts from international organizations since the late 1980's (World Bank, 1989). Many engineering education development projects have been funded through various initiatives (Abdellah, Taher & Abdel-Rahman, 2008), however, the concerns for quality still persist (El Hooty, 2018).

Hall, Swart & Duncan (2012) pointed out that higher education institutions were being transformed into major business enterprises in the new global reality. Krouse (2018) supported this view by stating that higher education institutions: "must think creatively and adapt to meet changing economic and environmental factors and students' expectations. That means more focus on costs and expenditure, just like business. It also means exploring alternate revenue streams and creative finances, just like business". Gekeler (2018) argued that higher education institutions must distinguish themselves in a saturated marketplace by renewing the product offerings to their students. Perhaps it is time that higher education providers are studied from a business perspective in order to arrive at a deep understanding of the challenges faced by these entities.

Elsafty (2018) proposed a business anatomy model to closely study organizations before attempting to solve any noticeable problems. The model is shown in Figure 1. Government providers of engineering educations were analysed in accordance with this model as fresh perspective into the current situation. The comprehensive analysis in accordance with the model can be seen in the dissertation presented by El Sayad (2018) and was updated in the manuscript by Elsafty, El Sayad and Shaaban (2020). Only some elements from the analysis are reported here for brevity.

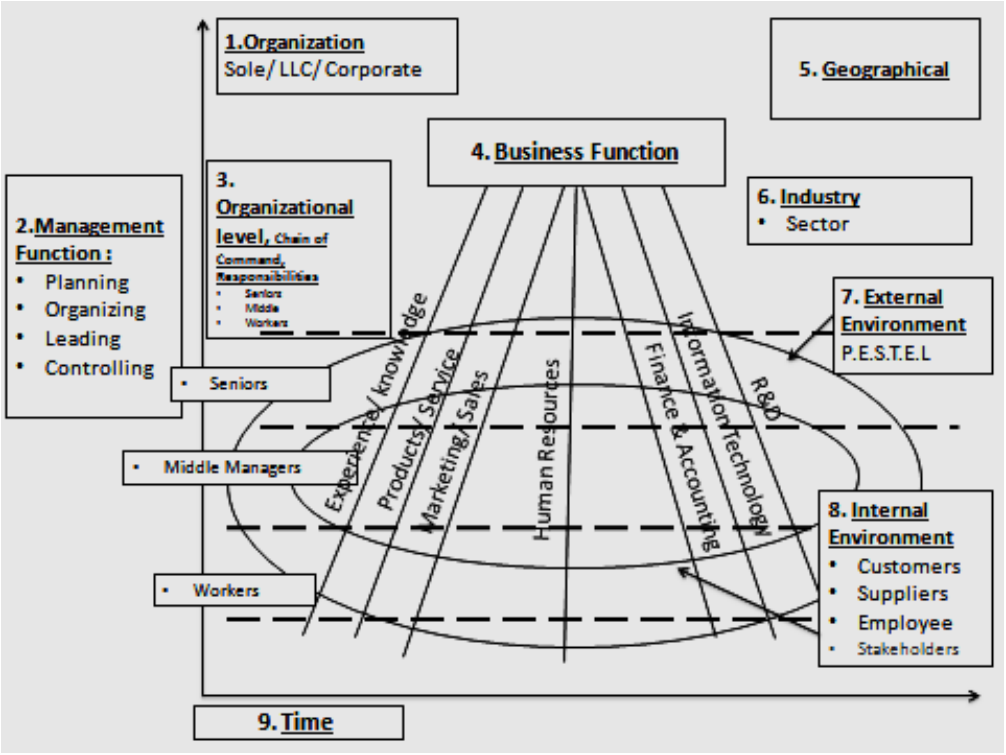

Figure 1. Full Business Anatomy Model Proposed by Elsafty (2018, p.22)

2. Selected Results from the Business Anatomy Analysis of the Government Faculties of Engineering in Egypt (The Organization)

Government Faculties of Engineering are higher education providers operating as part of government funded universities in Egypt. To establish a new faculty, a chapter or decree is added to the "Executive Regulations" of the "Higher Education Law No. 49 issued 1972". Both the Supreme Council of Universities and Engineering Sector Committee must approve the application for a new engineering faculty. Before the start of any academic year "Central Students Office" allocates a certain number of students to study in each faculty based on their secondary school GPA.

This formal process of establishing new faculties of engineering affect their mission, diversity, modernity and/or limit their ability to offer up to date education. The faculties have no say in the number or academic achievement levels of the admitted students. The faculties also have to approve their curriculums from the Engineering Sector Committee, which has a traditional outline for the courses offered in each department.

2.1 Management Functions

2.1.1 Planning

The concept of planning in faculties of engineering has been traditionally associated with tasks such as: asking the **University President** for money to buy new equipment or construct more buildings. Preparing educational schedules, exam timetables, assigning staff for various tasks (e.g. laboratory managers, student mentors …etc.). Deciding the number top graduates to hire each year in each department. Dividing students between academic departments, following the preparatory year. Similar operational plans (approving theses titles and supervisory and examining roles etc…).

The National Authority for Quality Assurance and Accreditation of Education (NAQAAE) was established by the Law No. 82 in 2006 and started operations in 2007. Its' aims were to: develop educational establishments in order to improve the educational process and its outputs using the international standards, gain the trust of society, increase competitiveness regionally and globally, and serve sustainable development in Egypt. The authority is not a regulatory body, but it grants accreditation to educational institutions upon establishing an internal quality assurance system in faculties and after conducting a "Self-Study" of each faculty by the team in the quality assurance unit (NAQAAE, 2006).

With the introduction of quality assurance in higher education, and as part of the "Self Study" requirements, Faculties of Engineering started to draft so called "Strategic Plans", following the procedures and format used to generate such plans (e.g. Strategic Plan for Shoubra 2012-2017). However, the existence of a document does not mean that it is applicable. For example, the government finances a typical faculty of engineering with L.E. 150 M annually, the strategic plan 2012-2017 needed between L.E. 189 – 260 annually for implementation. This had not materialized. Moreover, having the freedom to act autonomously in issues directly affecting the education quality such as No. of students admitted, or the type of curriculum offered is not achievable in the current time frame (see Organization section 1 above).

2.1.2 Organization Structure

The organization structure for all faculties, not only engineering, is dictated by the "Higher Education Law No. 49 issued 1972". The Dean or the faculty council has no power to alter the organization structure. Units or departments are added by changes in the law or after approval from the supreme council of universities. For example, when NAQAAE was established in 2006 clauses were added to the law to create quality assurance units in the faculties. A typical organization structure is shown in Figure 2. It is a complex structure with non-academic units each reporting to one of the three Vice Deans or the "Faculty Administrative Manager". These four key people report to the Dean. Quality assurance unit's Head and Heads of academic departments report to the Dean directly, who also manages his/her own support staff. Again, the structure is dictated by with "Higher Education Law No. 49 issued 1972", therefore, all Faculties of Engineering, regardless of their size, have the same structure.

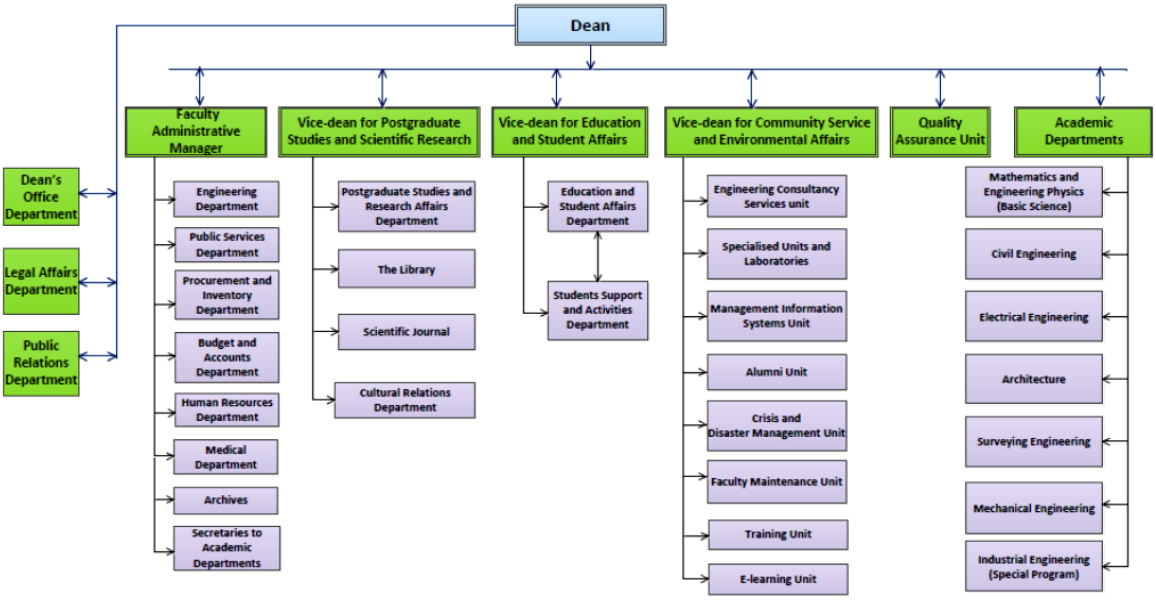

Figure 2. Typical Organization Structure for a Government Faculty of Engineering in Egypt

As seen from the structure, the quality assurance unit has no authority over any member in the faculty community: essentially, they are just advisors, and academic or administrative staff members have no obligation to comply with any of their recommendations. NAQAAE itself also has no power to address, for example, any of the outdated teaching practices. Osman (2011) argued that NAQAAE has neither an effective impression nor mandates to improve the performance of universities. Schomaker (2015) found structural shortcomings and implementation problems related to the current accreditation system introduced by NAQAAE.As a result of this situation, the aims of NAQAAE and the quality assurance units within faculties, specifically education development, are difficult to achieve.

2.1.3 Leadership

Deans, Vice Deans, and Heads of Departments are appointed in accordance with "Higher Education Law No. 49 issued 1972". The president of Egypt signs the decree appointing the dean of each faculty in all universities. Vice deans are appointed by after the University President signs a decree. The leadership style, effectiveness or success depends mainly on individual attributes. There is no formal training for leaders and the selection process does not guarantee choosing the most likely leader to succeed.

2.1.4 Performance Control

No performance appraisal system is in place for academic staff. The teaching capability, scientific competence, and cooperation with colleagues are not assessed in any formal way. Student performance is monitored through written or practical examinations. In case of violations from academic staff and students, the "Higher Education Law No. 49 issued 1972" outlines the reprimand process. Despite this, such proceedings rarely lead to any harsh measures for academic staff. For students there are serious consequences such as temporary or final dismissal or deprivation from sitting an exam for cheating or assaulting an academic staff member. Theoretically, performance appraisal of administrative staff is carried out in accordance with "Civil Government Employees Law No. 47 issued 1978, clause 28". In practice however, the Head of Administrative staff usually gives each employee more than 95% of performance score each year. Otherwise, employees become extremely unhappy and potentially hostile, as a low performance assessment disqualifies them from an annual increase in salary which they depend upon to get by.

The inadequacy of non-academic departments adversely impacts academic studies. For example, the laboratory technicians report to the "Faculty Administrative Manager", not the academic head of department that uses the laboratory. It is difficult to get them to cooperate in student learning by conducting educational experiments or keeping the equipment well maintained. Bureaucracy causes problems, like when, for example, an apparatus needs to be fixed. This requires many authorizations from budget/ procurement and there is usually a long-time lag until things get done.

The student support department overlooks the activities undertaken by student societies. This department keeps these activities running in traditional areas, like theatre, poetry, music, sports…etc. However, this department, if restructured and given new authority and mandate, can also organize engineering oriented extra-curricular or co-curricular activates that would help in student development and learning.

The reality is that department councils and faculty councils have little real powers to improve teaching practices. They cannot force any faculty staff member to change the education style or update the topics discussed in class. The roles of these councils are limited by what is permitted in "Higher Education Law No. 49 issued 1972", which is essentially running academic affairs.

2.2 Business Functions

2.2.1 Staff Selection/Training (Human Resources)

The academic staff members are appointed in accordance with "Higher Education Law No. 49 issued 1972". The law dictates certain age, qualifications and academic achievement for academic candidates to be appointed. Usually, a number of top graduate performers in an academic department are appointed annually as demonstrators, as they work their way through a master and doctorate degrees. At this point they become lecturers and continue carrying out research to be promoted to higher academic positions. Usually, a faculty member graduates from a department and keeps working there for his entire academic career. In the rare event, when there is shortage in a particular specialty, a job advert is placed asking external academics to apply for a vacant position.

Administrative staff members are appointed in accordance with the Civil Government Employees Law No. 47 issued 1978, clause 28 which prevails in Egypt. They are usually trained by older personnel on the job. Sometimes they can

adversely affect education due to their poor selection, training or motivation. For example, a laboratory assistant may be unable to operate apparatus or the departmental secretary taking too many days off work.

It should be noted that there are limited plans for hiring replacements to any of the administrative staff who retire. Recently in 2016, a replacement of Law 47 was approved under the name Civil Service Law No. 81, which introduced more strict measures on hiring employees. Egypt is seeking to reduce the number of civil servants by 50% before 2030 (El - Dada, 2017). The new Law No. 81 encourages employees to take up early retirement. It is expected that this trend will worsen the situation in academic institutions.

2.2.2 Marketing/Sales

These business functions do not exist as such. Mark (2013) and other quality assurance literature consider students as customers of the educational establishment. Hartmann (2008) in her working paper on private tutoring in Egypt argued that the students are consumers, private tutors are the suppliers and education is the commodity. However, it is difficult to apply consumer or consumer theories to Egyptian students attending governmental or even private universities. Each year students compete, by trying to get the best GPA in secondary schools, in order to be accepted in one of the governmental or private faculties. The available places in the faculties of engineering are much less than the number that would like to study engineering, whereas in a traditional business setting, firms compete with one another for customers. In addition, in governmental universities, the bench fees paid by students cannot be considered as a fair value for the education provided, regardless of its quality. Moreover, Bunce, Baird & Jones (2017) found that considering students as customers and treating them as such damages their academic performance, i.e. quality will suffer. The authors consider that students are inputs, and the education process transforms them into graduate products. This was supported by Pereira and Da Silva (2003).

Attracting industry clients to benefit from the consultation services offered by the Faculties of Engineering is carried out by individual efforts, not through any organized marketing program (Self Study 2013-2014, p. 61). Annual adverts are placed in newspapers or on the internet website of the faculty to announce the beginning of admission process for postgraduate degrees, but this cannot be considered as a marketing effort (Self Study 2013-2014, p.99).

2.2.3 Finance/Accounting

The accounting function exists and is strictly carried about in accordance to the law. It is used to calculate the salaries of staff, payoff the purchases, collect bench fees from students, collect money from industrial clients, etc.

Egypt spends 23.4% of per-captia GDP on higher education. This percentage is low if we compare it with 98.2 % in Jordan, 53% in Syria, 84% in Lebanon, 55.8% in Tunisia and 89.7% in Morocco (El Araby, 2010). Consultancy services are negotiated with the clients, depending on the size and complexity of the project. There are guidelines in the law that dictate how much to charge students to study in governmental universities, with undergraduate students paying a small flat bench fee, and post graduate students paying per credit hour studied. However, students in private universities do pay high tuition fees. All accounting and finance activities are supervised and audited by the "Accountability State Authority – Elgehaz Elmarkazi Lel-mohasaabat" and the University, (Self Study 2013-2014, p. 53).

2.2.4 Information Technology

Information technology infrastructure, such as student educational computer laboratories, desktop facilities for administrative staff to carry out day-to-day tasks, telephones and fax machines, exists in all faculties of engineering. There is usually an internet service for the Dean, Vice Deans and Heads of academic departments. Academic staff members have no desktops or internet facilities in many faculties of engineering.

2.2.5 Research /Development (R&D)

Scientific research is carried out by academic staff members and postgraduate students, but this is directed towards publishing papers in technical engineering academic journals or conferences. Academic staff should publish 6 to 9 papers in refereed journals before being promoted to a higher academic degree. Postgraduate students must also write similar publication(s) jointly with their supervisors before they are allowed to defend their theses. Although there are some publications, by Egyptian academics, dealing with quality assurance measures and accreditation criteria in Egypt, the authors cited only 1 publication related to the pedagogic research in engineering education (El Bahrawy, 2005). Moreover, the scientific research conducted in faculties is traditionally not dedicated to developing the management / business functions or the performance of a faculty (Self Study 2013-2014, p. 94-95). One of the main aims of establishing the "Quality Assurance Units" in faculties was to develop the performance of the different

departments in order to improve learning outcomes. However, the current role of the "Quality Assurance Units" is only evident in preparing the documents needed for accreditation (Self Study 2013-2014, p. 103-111).

2.3 External Environment - P.E.S.T.E.L

2.3.1 Political

The turbulent political situation in Egypt has negatively affected the staff and students in the higher education system. Since the Arab Spring in January 2011, 12 different higher education ministers have taken office. A comprehensive analysis of how the political environment in Egypt influence higher education, were covered in the Carnegie Paper (Lindsey, 2012).

2.3.2 Economic

Due to the challenging economic situation in Egypt, spending on higher education is very low compared to other countries. The last reported spending was 3.8% of the GDP. This ranks Egypt at the 110th position globally (UNDP, 2013). In governmental Egyptian higher education, students pay a token bench fee of $60. Low spending coupled with having no freedom to alter the fees paid by students, reduces the income of the faculties of engineering in governmental universities. Although the private universities are legally non-profit organizations, they charge the students relatively high fees to cover costs since fees are the main sources of income for private universities. Internationally, faculties of engineering have more freedom and income opportunities which enable them to provide a reasonable educational service.

2.3.3 Social

Egyptian society has great respect to education and people try their best to get a university degree. The demand for higher education in Egypt is growing and the sector is undergoing considerable change as new private providers joined government funded universities (Mourad, Ennew & Kortam, 2011). However, family income level has redefined the type of students that can study in various places. The poor quality of the governments' education system, lead to widespread reliance on private tutoring to supplement it (Loveluck, 2012). Those who come from higher income families usually have a better chance of getting higher GPA in secondary schools since they have access to good quality private tuition (Hartmann, 2008; Egypt Human Development Report, 2010; Buckner, 2013).

The effect of family income on the ability to score high GPA in school, is found in a study by the Information and Decision Support Center in 2009, cited in El Gerby (2012), in which sampled 4286 students from 6 government and private universities (12 Colleges), and 9 private higher institutes. The results found that those who come from high income families, continue their university education almost free.

Many students coming from middle to lower income families, who join private higher education, will need to work and study at the same time to pay the high fees demanded by private establishments. This is the case as 27.8% of the population were below the poverty line in 2015 (UNDP Human Development Report 2015), and the percentage is expected to be more today. Although, the percentage of students working and studying is unknown, evidence of this phenomenon is cited in the work of Habibi and El-Hamidi (2016), who cited students objecting to the proposal of increasing the bench fees for students attending governmental universities in Egypt.

2.3.4 Technological

Engineering is the application of technology. Yet, Egypt is not as technologically advanced as it should be. Table 1 shows a comparison of various IT indicators for 3 Middle East countries. The best indicator would be "1" and it is clear that Egypt lags behind other countries in the Middle East region. The technological infrastructure falls short of supporting e-learning programs. In addition, many students still do not have access to computer and Internet facilities (Anis, 2011). This situation definitely affects the utilization of technology in learning and hence the quality of graduates.

Table 1. Comparison of IT Indicators for 3 Middle East Countries (Data Source: https://knoema.com/GITR2015/global-information-technology-report-2016)

Index	***Oman***	***Morocco***	***Egypt***
Networked Readiness Index	52	78	96
Political and Regulatory Environment	53	70	102
Business and Innovation Environment	58	87	113
Infrastructure	46	102	94
Skills	76	110	111
Business Usage	94	105	129
Social Impact	46	59	103

2.3.5 Environmental

Egypt has diverse natural and built environments, and sometimes severe rain causes floods in Upper Egypt, Alexandria and Sinai leading to road blockages (Egypt: Flood, Oct 2016). Even without weather problems, ease of transportation to and from the faculties of engineering has a profound effect of the education. Alaa El-Din (2016) noted that: "Although transportation methods may seem affordable, the time spent commuting from one district to another is frequently stressful and time consuming." If staff and students travel using uncomfortable means or waste a long time to arrive to the education establishments, their performance as teachers or learners will be hampered. There are no programs to make educational operations more environment friendly. Environmental protection laws are directed towards protecting the Nile and safe solid waste disposal …etc. do exist in Egypt (e.g. Law 4 issued 1994). Sound and air pollution affect all people in large cities, and this has an impact on all aspects of life, not only education.

2.3.6 Legal

The law that governs higher education in Egypt is the "Higher Education Law No. 49 issued in 1972". A comprehensive review of the legal aspects of the Egyptian higher education system can be found in the Tempus (2012) report. This law has affected the education quality in a profound way, as it dictates every aspect in higher education establishments. Amendments to this law has been numerous but have always served a certain political agenda.

3. The Stakeholder s' Perspective

3.1 Methodology of Data Collection

People acquainted with the authors, either personal friends or on the social media page of a typical Faculty of Engineering, were asked two questions:

1. What do you think is deficient in the engineering student experience today?
2. Do you have any suggestions to improve Egyptian Engineering Education?

Altogether, 26 students & fresh graduates, 6 engineers with several years of experience, 10 engineers with long experience, 8 academics, 5 parents and 3 administrative staff responded to the two questions. The detailed responses are shown in the dissertation presented by El Sayad (2018) and was further analysed in the manuscript by El Sayad, Shaaban and Elsafty (2020). Note that most of the responses were in Arabic and were translated by the authors.

3.2 Summary of Stakeholders' Views on the Deficiencies in Student Experience

Input from the stakeholders gave various and valid perspectives on the deficiencies in current engineering education.

- Some instructors have poor teaching skills.
- No training for students in work setting/ practices.
- Instructor's knowledge is out of date.
- Graduates are shocked when they join work as it is not directly related to what they studied.
- Graduates not familiar with new software.
- Students copy assignments.

- Graduates recall what they studied, but unable to apply the knowledge.
- Graduates unable to make decisions.
- Graduates have no self-confidence.
- Graduates posse poor communication skills (writing, presentation….etc.)
- Graduates unable to operate simple office machines.
- Not enough open communication between students and instructors.
- Students are not asked to innovate.
- Graduates cannot persuade contractors or workers to do the job correctly.

3.3 Stakeholders' Recommendations

The stakeholders gave several recommendations. The recommendations were divided into two groups (i.e. suggestions which cannot be applied at the moment, due to constraints as discussed in the Business Anatomy above, and suggestions that are applicable).

3.3.1 Inapplicable Recommendations

There were a number of suggestions that cannot be applied as seen in Table 2 below. The authors gave reasons for their inapplicability.

Table 2. Analysis of Inapplicable recommendations by stakeholders

Valid but constrained suggestions	*Why is this not applicable?*
Update the curriculum	Only curriculum approved by the Supreme Council of Universities (SCU) and Engineering Sector (ES) can be taught. SCU and ES have strict guidelines for the curriculum.
Change the grading and/or exam system	This is part of the curriculum, cannot be changed
Improve/Evaluate the teaching ability of academic staff – no tenure for everyone	There are programmes to support teaching competencies, but these need to become more effective. This is beyond the control of individual faculties. Tenure is garneted by Higher Education Law No. 49 issued 1972.
Improve school education	This is the responsibility of the Ministry of Education, not the faculties of engineering.
Update the academic background of academic staff	Criteria for hiring academic staff is set by Higher Education Law No. 49 issued 1972.
Ethics of academic staff (selling books, private tutoring are amongst the undesirable practices)	Criteria for reprimanding academic staff is set by Higher Education Law No. 49 issued 1972.
Stop using authored academic staff study books	This is an undesirable practice. However, staff course notes, which students call books, are sometimes the only source of study since many students cannot read English sources. Some staff offer the notes for free; others ask students to pay printing price. Unfortunately, some staff sell those at a profit.
Stop private tutoring	Any service without customers will cease to exist. The students keep up the demand for tutoring since they got used to this during secondary school. The faculties have no control on this practice since it is carried out outside working hours and off campus.
Increase education fees paid by students	Many students cannot afford higher fees. Some even struggle to pay the bench fees. It is a political decision beyond the control of the faculties of engineering.

Reduce number of students	SCU decides the number to be admitted to each faculty annually as discussed in Part 1
No old academic staff	Age discrimination is not acceptable.
Close private engineering faculties	Private faculties' establishment is a political decision.
Give tax incentive to engineering firms to cooperate in training students	This cannot be controlled by the faculties of Engineering.
Change the Egyptian Codes of Practice to be the same as international codes	This cannot be controlled by the faculties of Engineering.
Open courseware	Developing E-Learning open courseware is costly and running these requires good IT facilities which are not available in man faculties.
Train students to carry out research	Students need first to gain better English language ability to be able to read research papers. Deficiency of lab facilities in some facilities may hinder practical research. Postgraduate students often conduct tests in large colleges or research centers equipped with labs. Undergraduate will not be granted access to such facilities.
Specialization, no need to study many topics. Faculties for designers and other for industry supervisors.	The undergraduate degree should give students a broad understanding of the engineering field. Only curriculum approved by the Supreme Council of Universities (SCU) and Engineering Sector (ES) can be taught. The Engineers Syndicate only allows engineers with a BSc. in Engineering to join. Industry supervisors will not find work as they are not members of the Syndicate.
Change the selection process for academics	Criteria for selecting academic staff is set by Higher Education Law No. 49 issued 1972.
Change the committees responsible for engineering education in Egypt	That refers to SCU and ES. This is a political decision.
Work and study	Study hours are set by the curriculum approved by SCU.
Keep security forces out	Security forces sometime interfere with student activities. However, they will remain on campus for political reasons.

3.3.2 Applicable Recommendations

By reviewing the responses, four requests became clearly evident:

1. The application of innovative teaching methods
2. Soft skills training, including English language abilities
3. Modern software applications training
4. Practical technical or industrial training

4. Learning from International Providers of Engineering Education

A comprehensive analysis was conducted regarding the current status of teaching methods, soft skills, software and industrial trainings in Egyptian engineering education provided in public faculties. In addition, a literature review was performed to compare the current status in Egypt with the practices of international engineering education providers. The aim was to find ways for fulfilling the aspirations of Egyptian stakeholders within the current constraints and to provide recommendations for improvements for the current status. The full analysis and review can be found in the in the dissertation presented by El Sayad (2018) and was refined in the manuscript by Shaaban, El Sayad and Elsafty (2020). Only the final recommendations are presented here.

5. Conclusions and Recommendations

1. Due to the various constraints on engineering education in Egypt, it is not possible to totally change the delivered programmes. However, some changes to the current practices can be introduced, leading to improvements in graduate skills.
2. Innovative teaching methods have been successfully applied in many countries in engineering education (Rugarcia et al. (2000); Daly, Mosyjowski, & Seifert (2014); and Lefebvre and Prakash (2018)). Egyptian faculty staff can apply these methods if they receive adequate training and support to do so. It is suggested that staff from the faculty of education mentor engineering staff to help them select and apply teaching techniques suitable for various engineering courses. This would greatly enhance students' learning outcomes and skills.
3. A new "English Language Curriculum for Engineering" suitable to Egypt should be designed to help students acquire reasonable language understanding abilities, as suggested by Pritchard and Nasr (2004). Investing in English teaching facilities and software would greatly help verbal communication. Adding report writing to assignments required from students would enhance written communication.
4. Egyptian engineering staff members can help students work on practical real-life design projects. Most engineering faculties in Egypt have an "Engineering Consultancy Service", which offer industrial consultation to clients from the local community for a fee. The consultancy service can assign its industry projects as final year capstone projects for students, similar to the practice in Kansas University (DeAgostino & Dougherty, 2018). These projects can also include teams from different departments. This will help students acquire multi-disciplinary team skills, as suggested by Dirsch-Weigand et al. (2018). There is nothing in the current Egyptian programmes structure that would prohibit multi-departmental collaboration in graduation projects.
5. Investing in computer laboratories is not going to be too costly. Students in the preparatory year should be introduced to practical hands on applications on computers. Thereafter, most courses should encourage students to use Excel applications in solving problems like suggested by Yanase (2017) and Sana (2017) or to utilize open source packages like MATLAB as recommended by Yetilmezsoy (2017) and Niazkar and Afzali (2017). The students can be simply asked to solve the assignments using the software package instead of by hand calculation. This would provide a good basis in terms of software training if the faculties are unable to purchase commercial software packages.
6. Practical training and soft skills can be cultivated through service projects. Each faculty has a community service vice dean. Most of the time, the nature of activities for community service are short term humanitarian relief events. However, for the purpose of training students, these activities can be extended to long term practical engineering projects, like those carried in Purdue University (Huff, Zoltowski, & Oakes, 2016). Students spending time and effort on such projects, dealing with various stakeholders, would gain excellent experiences. Student societies, administrative departments and academic staff can make a great difference by helping in the development of Egyptian rural areas. So even if increasing the period of practical training in the current curriculum is not a viable option, service projects can fill both the technical and soft skills training.
7. Student trips can be an opportunity for experiential learning exercises to help students gain important soft skills, leadership and problem-solving abilities instead of being just for recreation (such as the experience described by Rouvrais and Le Bris (2018)). Students can learn a lot by going, camping, mountain climbing, fishing or navigating. Such activities will be fun and beneficial to character building. The student support department available in all faculties should be restructured and its operations updated to gear trips towards cultivating much needed learning outcomes.

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