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Challenges of Changing Engineering Education

Abstract- Due to the combination of the current conditions of globalization and digitization, the social and economic horizons of the world, and the mixing of technical, economic and societal cultures, many challenges appeared and force referred to modifying the syllabuses and methods of introducing engineering education as a response to changes in student attitudes and low student performance as well as the spread of computers and information technology. In this research we are showing a number of these challenges and some it details to put some of the imbalances with some of the recommendations that would contribute even if it formed a part of the solution, treatment and evaluation.

Keywords- Engineering education, Engineering education syllabuses, Engineering education challenges, ABET2000.

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1. Introduction

Engineering is the most important specialties, it is the one who provided the necessary for all aspects of human material progress and is one of the topics that uphold the standards of humanity. History has recorded many examples where the decline of civilizations is paralleled by the lack of importance given to the engineering. The Greeks, Romans, Chinese and others have built their civilizations to a great extent on the basis of engineering efficiency and progress. Their strength, status and level of living soon declined as soon as they failed to conserve their outstanding engineering efficiency and development. It has been said in ancient times "The only thing that is permanent in engineering education is change", so this statement reflects the impact of science and technology on our society and the academic community's as a response to new societal needs." The essence of the debate here is the modifications to engineering syllabus in response to changes in student attitudes and each of these phenomena is closely related to societal changes, as well as the spread of computers and IT. As a result, we must propose changes involving more practical learning, rather than workshops and laboratories. The best textbooks that contain several real examples, and a way to communicate with students through that deals with their conceptual framework and rational abilities. There are two

main types of social challenges that have been treated by many engineering institutions, the first is the skills of employing graduates and the second the need for a sustainability approach to engineering. The ways in which engineering organizations have responded are a constant pattern, regardless of the specific nature of change, and three types of strategies have been taken: addition; integrating, and the rebuilding. The last strategy involving redesign the basic syllabuses. Addition strategy and integrating strategy are the most widely used, while the reconstruction strategy is at an emerging stage in most engineering education communities. Most engineering education institutions find it very difficult to reconstruct a whole syllabus, so smaller changes are generally recommended. Under the influence of globalization and the advent of the information age, a paradigm shift occurs in the engineering syllabus and academic structure. A part from the creation of new programs for emerging fields in engineering, approaches and guidance have also been transformed from input-based education to education-based outcomes. Quality standards have been greatly expanded for the new generation of engineering graduates. The syllabus of learning, teaching, evaluation and reorganization are reviewed not only to graduates to update their professional knowledge, but also to have acquired different thinking and communication skills, a sense of social

responsibility, learning how to learn and learn lifelong learning, foreign language and other cultures, Authentic in conducting research. As engineering education is internationalized, the government can meet international standards by joining regional and international cooperation initiatives in the field of engineering education. The change in the educational institutions is slow according to the prevailing educational traditions is the centralization of the teacher and not the centralization of the learner. Challenges Facing Change in Engineering Education Worldwide, a series of reports from the Royal Academy of Engineering [8] have demonstrated the urgent need for change in university engineering education to ensure that graduates are ready for the new and complex challenges of the 21st century. It is then across the higher education sector. There is increasing appreciation of the slow pace of change that reflects the difficulties of motivation and the maintenance of educational reform within engineering departments and institutions. Everyone recognizes the need for change, but the challenge is to achieve this. The persistent issue of engineering education is not whether it is but how it will change [8]. At the level of a huge country such as China, many challenges have also emerged and several strategies have been developed to address them. Among these strategies, the researcher proposed [3]:

- Close cooperation with industry
- Public awareness of engineering education
- Multidisciplinary education
- Innovation as a basic skill for students
- College development

At the level of Iraq, many Iraqi engineering faculties have adopted a program to rehabilitate the higher education and scientific research system in Iraq, including engineering education. The main objective of this program is to achieve quality assurance and system reliability according to international standard specifications. Ministry of Higher Education and Scientific Research, and follow-up and review of the review group (RG), which includes the Bureau of UNESCO - Iraq and the Network of Iraqi scientists abroad (NISA) [10].

2. Challenges Facing Engineering Education in Iraq

The talking about students' weaknesses level of students are sensitive and precise and are closely related to the future of our students, their practiced and social life, as well as psychological stability in their different stages of life. The problem of weak academic achievement in

general is one of the most difficult problems of global education, which hardly any society to be devoid of it, there is word for one of the scientists who were the first to study this problem, which came after several studies in depth, (Among the 100 students, 20 students have a low academic achievement. The researchers attributed the low level of educational achievement to many of the reasons that impede the achievement of students such as the teacher, the student's family and the economic and social environment, as well as the student's psychological and mental state. It is very important that the student progress from a study stage to another. Here we must have a clear, objective and clear understanding that requires us to prioritize the study of all aspects surrounding the student, especially the whole educational process, and to analyze them fully in order to identify the actual causes of this delay and to treat these reasons which are for the student such as indifference and lack of Focus with the teacher during the explanation or the student's feeling of boredom of the material or lack of skill in the student mainly to the other reasons), as well as in relation to the teacher, such as not to use modern education strategies in the teaching of mathematics or not to use modern methods and techniques, there are two important reasons, not relate study material with real life (To exceed the level of the book and the book to realistic examples complete with the perception and understanding of the student) as well as lack or weakness of cooperation between home and school, as the home and the family a great role in follow-up And to push towards the arrival of the student to the levels of excellence, so that the social compliance is distinct so that the lack of lack of a link between the home and school on the one hand and the lack of care of the family and the interest of its students and we do not deny that this requires a large education adopted by the State and its social institutions And for a long period of time to establish such a thing, but it is not impossible and the journey of a thousand miles begins with one step. Before we discussed the challenges, it was necessary for us to review some important things and start with the basic elements of successful engineering education:

First: the efficient teacher

The presence of an efficient teacher that drives the process of education to achieve the desired objectives of the syllabus developed away from the conservation and indoctrination in the performance through the technical and educational role, seeking positive growth in trends and the basic skills that contribute to

building a scientific personality characterized by critical thinking and creative, The teacher is ready to produce intellectual in all areas of his life, based in his dealings on the appreciation and respect of students, motivating them and encouraging them to creativity and thinking through the enjoyment of aspects of human personality educational.

Second: Interested student

The presence of students interested in the curriculum, following all his subjects and lessons with passion, motivation and motivation to learn, are characterized by a healthy body structure to a large extent, characterized by a sound mind capable of thinking, aware of their role in the educational process seeking to achieve that role and have a great desire to create and prepare a personality Scientific aware able to think and creativity.

Third: Educational Environment

The existence of an integrated educational environment, equipped with many educational means and tools that achieve the objectives of the syllabuses.

3. Requirements to be achieved in the graduate according to (ABET2000) [11]:

1. Ability to apply knowledge in mathematics, science and engineering.
2. Ability to design, test and process data.
3. Ability to design systems (or units or processes) to meet specific requirements.
4. Ability to work with a multidisciplinary team.
5. Ability to identify, configure and solve engineering problems.
6. Understanding professional and ethical responsibilities.
7. Ability to communicate effectively.
8. Desire and ability to engage in lifelong learning.
9. Knowledge of contemporary issues.
10. Ability to use the techniques, skills and modern engineering tools required to practice engineering.

4. The qualities that should be available in modern engineering education [11]:

1. Active learning based on a project-based approach.
2. Integration of the development of concepts of mathematics and science within the applied content.
3. Great interaction with the industry.
4. Wide use of information technology.

5. Devoting the efforts of faculty members towards the development of the engineering profession as mentors and mentors from more than one source to provide information.

5. The Challenges Facing Engineering Education in Iraq Can be summed up as Follows:

I. Financial support

The conditions that the country has been going through for quite some time from the 1980s to the present day have been and still are a major obstacle and a great challenge to engineering education. It has prevented the implementation and application of many research projects. The student should rely on himself and his material resources in completing his research. Especially the graduate students, where educational institutions suffer from the scarcity or lack of laboratory equipment, materials and techniques, including licensed engineering programs, as well as weak cooperation and communication in order to ensure the availability of these possibilities. There is a major obstacle: the lack of optimal investment for finance, albeit weak, as there is weakness in prioritizing and finding alternative sources of funding.

II. Engineering syllabus

There is an urgent need to make changes in the syllabus and methods of providing engineering education to meet the needs of the labor market in the country. This requires an in-depth study to understand the actual need for general specialization and then the specific disciplines. The speed of knowledge development and the emergence of information, According to a serious timetable and is being updated in line with developments. Here, too, the modernization should be subject to quality requirements in general as a basic entry point for higher education with its impact, advantages and disadvantages. It is very important at this stage that there is merit in modern teaching methods (active learning, collaborative learning, self-learning, etc.) in improving the level of higher educational and professional higher education outputs. There is a distinction between long-term engineering education and professional engineering education, with practical skills that meet the needs of the immediate industry.

III. Ability to use modern information technology and knowledge of foreign languages and civilizations

Most of the sources are mainly in English. This is also the language of technology. Therefore, the weakness of language among students and

teachers has become an obstacle to easy communication with these sources and techniques, since there may be an understanding by The student or the professor but at a slow time or a level of moral fragility has become in some cases what is given from the English language in the curriculum a burden on students rather than be helpful to them and the development of their language skills and here is an invitation to review and search for a foreign language curriculum results are reflected in the results of knowing the engineering and integrated with him in building a student can graduate from the conversation, discussion and review of sources and lectures needed in the fields.

IV. Optimal use of resources, environmental protection, technical, social, economic and other impacts and obligation to ethics.

One of the important things that must be instilled in the mind of the student of engineering sciences that there is optimization in the decision-making and the optimal solution produced by the study and analysis of the existing data of any project involved since the beginning of the start of the project activities or during the implementation period as it cannot be the easiest or cheapest way cost Is the right decision, the matter is wrapped up in some complexity and taking into account all the surrounding circumstances and exceptions. The neglect of this aspect may lead to the worker in the engineering field of engineers and others a source of pollution or destruction of economic and social effects or inciting sectarian or ethnic tendencies without even knowing not to take into account or neglect the specifics of the project from place and time.

V. Keeping pace with the requirements of the labor market

Since the eighties of the last century to the present day there are increasing appeals for the labor market to balance teach a new engineering the strong technical background with other skills such as communication skills where bachelor's degree alone has become not enough to qualify for the labor market has to be other qualifications and depending on the nature of the project that offers the opportunity to work qualifications can be obtained through courses held in educational centers or organizations or even in the universities themselves with financial amounts that a student cannot attend or the student may obtain these qualifications through training in the projects and here again we do not get all the alumni's on these opportunities of training and for all of the above and starting from the

responsibility of institutions of higher education in the development of students' skills for lifelong learning and the qualification of engineers who are on the job must put universities and in their syllabus to give courses for students in the periods that include summer training Or ensure the training of students by engineers or technicians experts in the workplace to get everyone and fairly qualified to enter the labor market. The role of the economy and its dependence on the labor force in the engineering fields and the major role of the engineering unions in securing the rights of this sector should be mentioned. The other segments that were not related to the engineering work were not mentioned. In recent periods, the leaders of engineering projects or activities within the engineering projects, All the dimension of the engineering specialization may be a humanitarian competencies Here not only negatives on the quality of work, but on the reputation of the owners of science and engineering disciplines also and undermine the confidence of the community engineering staff thinking that the total negatives belong to the professions O or technicians, this is contrary to the truth. There is an important aspect worthy of attention by higher management in higher education in general and in engineering education in particular, which is suitable to meet the needs of the labor market. It is not logical that the number of graduates of engineering education from engineers and technicians will weaken the actual need for the labor market. The first is the reputation of engineering education. The fit between the actual need for the labor market and the engineering specialization will raise the level of interest and interest among the target group of outstanding students and thus the reputation of engineering education and graduates in general.

VI. Refrain from joining engineering departments by outstanding students.

The spread of the worths of the engineering professions and the incentives and benefits associated with these professions is necessary, since many of the public have little knowledge of the engineering professions and importance and may think that some of the future of some of these specialties is not guaranteed, while some countries give some of the terms of reference and take priority attention peer. In order to achieve the above, we must define, publish and educate the engineering disciplines in the secondary stages in order to win the largest possible number of outstanding students to ensure a successful engineering education and excellence.

VII. Negative impression of the engineering job

Because of the flood of information provided by the Web through documentary films or networking sites and instead of leaving a positive impression and enthusiasm of the student of engineering science leaves a negative impression of some of them as the student sees himself a point in the sea than see and hear the greatness of the giant projects and accuracy in its completion and amazing technology. In his implementation, he became unable to keep up with this information race. It was hidden from him that what he saw did not come overnight, but as a result of a complex and deep collective effort and accumulated experience. It is not impossible or remote. The conditions and will have escaped and there are many evidences on the creative engineers of the country's people in the world and they are graduates of the same universities that exist now and this requires the awareness and guidance of the most diligent teachers and owners of human development organizations and the most influential of the cadres that have been successful and excellence to find out the real details of things and reveal the understandings. Also from the other negative images that I personally experienced in many students while urging them to follow up and adhere to lectures and examinations. It is no use of this fatigue and diligence and that the achievement of the degree of success is sufficient because there is no job opportunity after graduation where the media is established in all its forms audio and visual in the student this is not true. Although we do not deny the difficult circumstances facing the country, there are opportunities in small percentages, especially in the private sector, on the one hand, and on the other hand, the graduate of engineering sciences will be M And this is what makes his chances of working more than his peers from the rest of some specialties and here I refer to the follow-up of a number of meals graduates in recent years has been received a number of them by A job opportunity in terms of specialization or what is included in the competence and for the above must be sent a positive signal to the students to send their spirit of optimism and to stimulate enthusiasm in the superiority of success and early access to these opportunities, although few.

VIII. Education technique

For some time now, the educational specialists have been monitoring the disadvantages of traditional education and setting up what they do

in modern education through the following comparison [11]:

Table 1: comparison between classic and modern education

Classic Education	Modern Education
The teacher is the focus of the educational process	The student's is the focus of educational process
Transfer of knowledge from teacher to student.	Students develop knowledge by assembling, synthesizing, and integrating information into general skills in fact-finding, communication, critical thinking, and problem solving.
Students receive information negatively.	Students actively participate.
Focus on acquiring knowledge outside the context in which it will be used.	Focus on the effective use and transfer of knowledge to address permanent and emergency issues within the context of real life.
The professor is the main source to provide the student with information, which is the main focus.	The teacher conducts the training process and the student walks the course. The teacher and the students have a role in evaluating the learning process.
Calendar and teaching are two separate processes.	Teaching and evaluation are two overlapping processes.
The calendar is used to monitor the learning process and focus only on the correct answers to the student.	The calendar is used to encourage learning and to diagnose its situation and focus here on better questions and on learning from mistakes
Indirect evaluation through tests in which the marks are objectively determined.	Direct evaluation through research papers, projects, performance, achievements files and the like.
Focus on one knowledge branch.	Expanding and accessing several knowledge branches.
The prevailing culture is a competitive culture based on individual spirit.	Culture is a cooperative culture based on participation and support.
Only students are involved in the learning process.	Professor and students learn together.

This is where the greatest challenge is the faculty members. Joining the faculty should be based on qualifications that do not stop at the limits of obtaining the postgraduate certificate and passing the course of teaching techniques, but extends to a number of details, including the charisma possessed by teacher and teaching ability in general, That some of the faculty members may be have excellent ability in the field of scientific research, but fails to deliver the material to students and here begins the suffering of the

student and then the educational institution as the outputs of the educational process of this article may not be acceptable and for the previous reasons the need to give faculty members interested in the direction of creating the conditions necessary for the transition to this modern style and the potential of being the first and most important step in the update process.

IX. Work as a team

Teamwork is the secret behind the multiple successes of individuals and institutions through which they draw plans and share ideas and experiences in order to achieve one goal agreed upon by all and satiated by it, and to work within the team skills and requirements, the first is the distribution of the tasks and dedication of members in the service of the goal and the implementation of roles and access to the best means to achieve objectives, as well as the continuous evaluation of the roles of members through the purposeful discussion, in addition to the integration of roles distributed well, and the head of the team other tasks is the selection of good members working with him, and make sure the readiness of the team member to play his role and Oz One of the weak points that employers are registering today for engineering graduates is the lack of experience of working as a team and a situation of negative technical arrogance that casts a shadow over the results of the work and this requires that it includes The syllabus of engineering education which qualifies students to work as a team after graduation by assigning them, for example, to completing duties in the form of groups or attending field teams through hosting to explain the mechanisms of working as a team to other means.

5. Conclusions

By reviewing the above-mentioned global requirements to ensure modern and productive engineering education and the obstacles and challenges that countering, conclude the following:

1. The need for an efficient teacher, an interested student and an integrated educational environment that invites us to review a lot of details and develop serious programs to address what is existing and to overcome the failures in what is coming and it takes a period of time not a few for the purpose of achievement and establish it as a culture in the minds of those who manage engineering education institutions.
2. The fortune of engineering knowledge is no less important than the other fortunes in the country. Therefore, it is essential that the

concepts of investment in this field be firmly established as an economic project with a strategic dimension in the sense that spending according to priorities and in a deliberate and professional manner by the state to improve and develop engineering education facilities is not a consuming of money like other services, but is an investment that the state expects and in the long term to profit or at least reduce the expenses spent on external expertise.

3. There is an urgent need to reconsider seriously and equitably the circumstances in the following matters

- a) Engineering education syllabus
- b) Methods of produce engineering education
- c) Developing the capacity of engineering students to deal with modern technologies and early establishment of the values of the engineering profession and the preservation of the environment and the effects and the peculiarities of society
- d) Educating students of engineering sciences to work as a team and make it axiomatic to start work
- e) Keeping abreast of the real need for the current and future labor market
- f) Real student experience of engineering work and communication with leading teams in this area
- g) Ensuring job opportunities for graduates of engineering education for the purpose of competition and hopeful a promising future for engineering graduates

6. Recommendations

1. Invitation for greater attention to individual skills, personnel and leadership departments, as well as integrating corporate and community activities, and preparing students for continuous learning or lifelong learning.
2. Reconsidering, from now, all programs and policies for the preparation of teachers in different educational stages and to develop extended plans for the training and rehabilitation of existing teachers who have received traditional education and have exercised their functions under traditional educational systems that are no longer relevant to the present and the future.
3. Apply a new philosophy based on student learning assessment and principles of continuous improvement accordance to accumulated experience in "Engineering Change", by developing engineering programs and relying on faculty in reengineering syllabus, teaching methods, professional development practices, program evaluation, decision making, and to

some extent recruitment, promotion and length of service standards.

4. The essential aim is that graduates are significantly better prepared than their peers in a decade in all areas of learning that have been assessed and have the ability to understand social and global issues, the ability to apply engineering skills, teamwork, and the appreciation of ethics and professional issues.

5. To continue in spread the culture of quality assurance and to make it a permanent application and practice in the institutions of engineering education and analytical and constructive review of the engineering education programs and degrees and qualifications granted by these institutions.

References

- [1] Aldert Kamp and June, "Engineering Education in a Rapidly Changing World," Delft University of Technology, Faculty of Aerospace Engineering, 2016.
- [2] Anette Kolmos, Roger G. Hadgraft, and Jette Egelund Holgaard, "Response Strategies for Curriculum Change in Engineering," International Journal of Technology and Design Education, August 2016,
- [3] Chung Chak, "Changing Engineering Curriculum in the Globalizing World," New Horizons in Education, Vol.59, No.3. December 2011,
- [4] H. Baruh, "A Need for Change in Engineering Education," 2019.
- [5] Jennever M., Case and Gregory, "Emerging Methodologies in Engineering Education Research," Journal of Engineering Education, Vol. 100, No. 1, pp. 186–210, January 2011
- [6] Lisa R. Lattuca, Patrick T. Terenzini, J. Fredericks Volkwein, and George D. Peterson, "The Changing Face of Engineering Education," National Academy of Engineering, 2008.
- [7] Shan-Dong Tu, "Total Engineering Education: the Way to Shape our Future Leadership," Global J. of Engng. Educ., Vol.10, No.2, 2006.
- [8] The Royal Academy of Engineering, "Achieving excellence in engineering education: the ingredients of successful change," March 2012.
- [9] Salem Suleiman and Salah Al-Hadithi, "Higher Education in Iraq Analytical Study," www.nazaha.iq/conf7/conf7-adm2.
- [10] Hassan Yahya Hussein, "Ensuring the Quality of Engineering Education in Iraq, Objective and Means," September Ministry of Higher Education and Scientific Research, 2015.
- [11] Khalid bin Saleh Al-Sultan, "Engineering Education Challenges and Opportunities," Qassim University.
- [12] Quality Assurance and Academic Accreditation Guide for Iraqi Universities / Ministry of Higher Education and Scientific Research in accordance with the standards of the Union of Arab Universities, 2009.
- [13] Alaeddin Abdel Rahman, Wissam William Slim, and Ibtisam Faeq Nasser, "Determining Quality Standards in Engineering Technical Education Outputs," 2011.