

EXIT EXAM AS ACADEMIC PERFORMANCE INDICATOR

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ABSTRACT

This paper focuses on the impact of exit exams on different elements of the educational process, namely: curriculum development, students and instructors. A 50-question multiple-choice Exit Exam was prepared by Electrical Engineering (EE) faculty members covering a poll of questions from EE core courses. A copy of the Exit Exam applied during each semester will be available as exhibit material. The exam was administered by the Graduation Project and Industrial Training Unit to graduating students taking Graduation Project II during their last semester before graduation. Results indicate that the student average grade was around 52% and 60% for Fall 2013 and Spring 2013, respectively. The students felt that the exam was difficult and that some problems needed more time. The exam results suggest that we concentrate the exam on general basic questions from the different basic core courses of the program. Thus, it is recommended that focus groups and program assessment committee review the Exit Exam questions and make sure that questions are of the general and principle type and do not require any formula or any memorization. We feel that the response is expected in relation to the exam difficulty. In fact, the EIT exam results in the US range between 50-60%. The Exit exam for Fall 2013 showed weaker results than previous semesters due to the fact that it included more definition-based questions. Also, the average GPA of the graduating students was lower than previous years which could partly justify the weaker performance. Some questions were also seen confusing by students and this suggests that the EE Department needs to draft the questions more carefully. It is worthy to add that in any program development cycle, evaluation is ongoing and one should not wait for the completion of the program or the course to introduce changes.

INTRODUCTION

Exit examinations are common for high school graduates who wish to enter the university. Such exams result in positive effects on student achievement because of incentives for both teachers and students (*Jürges 2012, Costrell 1997, Effinger 1999, and Jürges2005a*). On the other hand some studies have shown that negative impact of exit exams on students' motivational and emotional experience leading to increased stress, anxiety, or fatigue (*Meyer 2009, Pedulla 2003 and Ryan 2005*). Researchers have related these negative effects to the increased pressure on students exerted by teachers (*Jürges 2005b*). There is still very little known about the impacts of the exams on students' learning (*Merki 2011 and Zimmermann 2001*). According to theoretical models (*Bishop 1997 and Wossmann 2003*) the goal for implementing exit exams is to encourage students to put effort into their learning.

Although examinations for professional licensing are common for different disciplines (*Young 2013, Macale 2013, Seibold 2005, Kleiner 2000 and Pagliero 2011*), exit exams for students who are completing their bachelor degree are not very common. Therefore, this study investigates the impact of the implementation of exit exams on educational and learning process, to assess the importance of exit exams as a quality indicator for academic program reviews and for benchmarking. Though online exist exams are new in engineering, they have been used for many years in medicine.

The exit exam as an assessment tool for engineering programs was introduced and began receiving attention from 1990. Besides basic engineering aptitude, several factors have been recognized to contribute to performance, with "motivation to pass" as one of the most significant factors (*Mazurek 1995*). The subsequent analysis by Watson concluded that the exit examination generated significant amounts of useful assessment data that was not being utilized by engineering programs (*Watson 1998*), and indeed there should be urgent use of such data to be used in academic performance indicator. Several notations and conclusions have been drawn, however, the examinee's motivation to pass contributed to the viability of the results obtained. Several studies recommended that engineering institutions should be providing performance data to institutions' policy makers to allow the use of these results in program assessment. Since that time, many methodologies for applying exit exam results in program assessment have been published (*Watson 1999, Page 1994, Nirmalakhandan 2000,*

Nirmalakhandan 2004, Lawson 2007, Koehn 2008, and Schimmel 2003). Most of these methodologies rely on the use of historic exit exam performance data to assess the overall program, topics within a program, as well as individual course content within a program.

All degree seeking graduates are required to take the exit exam at the United Arab Emirates University (UAEU). The College of Engineering (COE), in accordance with standards established by the Accreditation Board for Engineering and Technology (ABET), has established assurances of learning /educational standards and specific performance indicators that evaluate how well any college of engineering fulfills its educational objectives. In order to implement this initiative, the COE has introduced an exit exam requirement for all its running programs. The purpose of this exam is to ensure that it demonstrates accountability (through the ABET accreditation) and to assist its faculty members to improve programs and courses. Graduates of the Bachelor of Science degree programs are expected to demonstrate certain student learning outcomes and this exam partially assesses these competencies.

At COE, the exit exam is given a credit of 5% of the grade in the final graduation or final year project. In each semester the exit exam is attended by approximately 200 students from the COE's five different departments namely Department of Architectural Engineering; Department of Chemical and Petroleum Engineering; Department of Civil and Environmental Engineering; Department of Electrical Engineering and Department of Mechanical Engineering. These departments follow several procedures to prepare students for the exit exam. Most faculty members contribute to the exam by suggesting helpful questions. Generally speaking, the exit exam is made up of a balance of questions usually collated from the past years courses of study at the specific department. The problems allocated to each department naturally will be relevant to their area of expertise.

The engineering profession is moving dynamically as we start the twenty first century. Technological innovations are changing the way engineers conduct their business as the analysis, trouble shooting, and design tools have evolved allowing for multiple scenarios to be simulated before choosing the most appropriate one, while most industrial operations are automated and monitored throughout allowing for more reliable and safer operations. The role of engineers has also changed as they are often part of technical teams, and in addition to the technical proficiency and professional skills they bring, they are expected to demonstrate managerial and team building skills and have a wider knowledge and appreciation of the societal, economic, and environmental, health, and safety issues related to their industries and profession. These developments have led the College to adopt an engineering curriculum that fosters innovation and better prepare graduates to effectively meet current and future professional needs as well as rapid technological advances encountered worldwide. The UAEU engineering curriculum focuses on a balance of knowledge and skills that prepare graduates to analyze and design engineering systems and become technical leaders in their fields, and provides students multiple opportunities to demonstrate these skills through laboratory hands-on experience, project based learning relevant to their disciplines, design challenges, and professional activities. The engineering applications are founded on a solid core of scientific and engineering knowledge that instills the "engineering sense", and the teaching philosophy emphasizes cooperative and collaborative teaching and learning with emphasis on individual and group activities, effective communication, professional responsibility, self-learning & lifelong learning, and teamwork.

The Departments of Electrical Engineering in the College of Engineering at UAE University has embraced the general philosophy of outcome-based educational methodology, and has engaged in an ongoing assessment process to evaluate the offered programs. Both the programs educational objectives and outcomes are used as a long and short term objectives, respectively, by utilizing a set of tools for indirect and direct measurements of program assessment components. Within the Electrical Engineering (EE) programs, establishing and reviewing educational objectives is part of the assessment and continuous improvement cycle for the programs. This paper describes a process for the establishment and assessment of the educational objectives set by the EE Department at the United Arab Emirates University. This process is initiated by defining the EE programs outcomes to match the ABET (A-K) EC2000 criteria (Fredericks (2004) and from these outcomes the program educational objectives are derived.

PROGRAM ASSESSMENT PROCEDURE

The philosophy of EC2000 is to allow institutions and engineering programs to uniquely define their mission and objectives to meet the needs of their constituents. In addition, the new ABET system focuses on continuous improvement of program based on the results of the assessment process for program objectives and outcomes and on the input of constituents (Whiteman, 2003). The EE programs at the United Arab Emirates University were established in 1980. The mission of these programs is to meet the educational, research, and service needs of UAE society by providing programs and services of the highest quality. Also it contributes to the expansion of

knowledge by conducting quality research and by developing and applying modern engineering tools and techniques that could play a significant role in the technical and economic development of the country. The EE programs' educational objectives were designed to meet the UAEU mission and to fulfill the ABET requirements. These objectives were intended to serve new graduates by providing them with:

- Adequate skills including, understanding of scientific and engineering concepts, effective oral and written communication, ability to participate in life-long learning, diverse and global professional careers, project management and decision making.
- Strong foundation in engineering principles and practices, based on the learning of fundamentals of engineering, ability to use advanced techniques, and participation in relevant engineering interactions.
- Enhanced problem-solving skills that involve designing and conducting experiments, analyzing and interpreting laboratory as well as field data, innovation and conceptual thinking, and applying engineering through research and/or industrially oriented projects.
- Ability to understand important issues, such as knowledge and appreciation of the codes of ethics, awareness and appreciation for health, safety and environmental issues, integrating ethical, social, health, safety, and environmental issues into practical projects, economic evaluation and risk assessment, awareness of international standards and specifications.
- Working skills in multi-disciplinary teams; functioning with peers from other disciplines, integrating information and data from multiple sources, participating in technical seminars and industrial/professional functions and events, and adaptability to different working environments.

The program outcomes that have been established as goals of the EE program follow closely the ABET required outcomes. Achievement of these outcomes in the context of EE program would meet the requirements and outcomes. The Exit Exam is administered to measure student competence in areas identified as critical to the EE Program, thus it is considered as one of the assessment tools used by the EE department to verify students' achievements. The exam consists of 50 multiple choice questions with five questions for each representative course. It is anticipated to use a nationally normed assessment tool currently under development by Electrical Engineering Department and supported by The Institute of Electrical and Electronics Engineers (IEEE), when it becomes available. The ABET program outcomes are defined as:

- a. an ability to apply knowledge of mathematics, science and engineering
- b. an ability to design and conduct experiments, as well as to analyze and interpret data
- c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- d. an ability to function on multidisciplinary teams
- e. an ability to identify, formulate, and solve engineering problems
- f. an understanding of professional and ethical responsibility
- g. an ability to communicate effectively (3g1 orally, 3g2 written)
- h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- i. a recognition of the need for, and an ability to engage in life-long learning
- j. a knowledge of contemporary issues
- k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Moreover; the worldwide trend is now on computer-based and online exams. This is because:

1. Multiple versions of the exam can be distribute without having to manually monitor which students got which tests.
2. Quickly evaluation of the performance of the group is possible.
3. Less time and effort is needed.
4. Question styles on exams, including graphics can be mixed and made more interactive than paper-based exams.
5. Human errors in grading can be eliminated.
6. Save paper.

The use of computer based exam or online exams goes under this trend of the e-learning and e-education systems.

THE STUDY

The primary purpose of the exit exams is to assess students' educational achievement in the courses in their major area of program study. The exam is supposed to measures the learning outputs of the program as a whole not the individual courses. Naturally the students have already shown a certain level of proficiency through earning passing grades in these courses. Organizations that accredit college and universities such as ABET, often

require an additional demonstration of achievement through passing scores on objective examinations. Such objective examinations should assess the knowledge that one must have from the study of these subjects regardless of who teaches the course and where the course is taught.

An exit examination tests students at the end of their program of study for attainment of the program's intended learning outcomes. They cover one or more program-level outcomes, not course-level outcomes. Because the test is used to determine whether COE has met the ABET accountability standards, students still would be required to take the exam. A set of questions is normally identified covering the fundamentals and highlighting key concepts in engineering in the past year course. These questions stress the basic and fundamental knowledge that any engineer should possess before starting practicing. By default, fewer advanced questions are introduced to distinguish between the smart and the average students. The number of questions varies from department to department, but is normally kept identical among all years. Moreover, some exams are the same as in the past taking into consideration that even no single question will be known or revealed for the next student batch (The exams are similar to past year exams). In the last 3 years, the exams were held online. There was no significant difference in the grades whether it is computer based or paper based. The exam is conducted on the same day and same questions are given to everyone on campus in the presence of proctors.

The score on this exam should reflect the student performance. This exam tests the student on knowledge, skills and attitudes gained throughout the study of the courses of a specific program. It is expected that students do not study for the exam, but they put a good faith effort into doing their best.

The graduate exit exam is a requirement for degree completion. The exit exam is a mandatory exam, which is administered on campus. It is offered twice a year: fall and spring terms and is normally scheduled at least three weeks before the graduation deadline. The online exam has been conducted with the following conditions:

- 1) The exam can only be taken once.
- 2) All exiting students take the exam simultaneously.
- 3) The total number of questions is ranging from 50 to 100, depending on the program.
- 4) Once started, this test must be completed in one sitting.
- 5) Time is set for 2 hours.
- 6) There is a required password to access this test.
- 7) One question is normally presented at a time.
- 8) Changing the answer to a question that has already been submitted is not allowed.
- 9) Questions are randomized.
- 10) No smart phones or electronic devices are allowed in the examination hall.

FINDINGS

Figure 1 shows exit exam results at one of the engineering departments at *UAEU* for the year 2012. The total number of admitted students was 36 over the two semesters. The represented data reveals that 22% of the students scored "A", 0% "B+", 11% "B", 20% "C+", 14% "C", 17% "D+", 8% "D" and 8% "F". Therefore, 92% of the students passed the exam from the first attempt.

Immediately after the exit exam, student's feedback about the exam and their reflections were collected. Many students do not see any benefit for the exam since it only weighs 5% of their final grade in the final graduation project course. Some students believe that this exam has to be taken first by the instructors themselves to see how many of them can pass. Others believe that this exam is a good chance to remind them of what they have studied in the last four years of their study (many students spend 5 years).

The exam is computer based and has been designed and integrated in the blackboard-*UAEU* online education system for students. The build- in grade system offers the opportunity to display each question with its multiple choice options along with the percentage weight of each multiple choice option. This helps in detecting how many students have chosen the right answer and how many have chosen each of the other choices, as depicted in Figure 2.

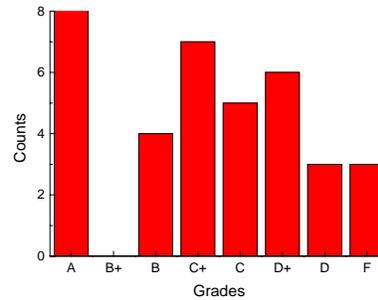


Figure 1: Exam grade distribution at one of the engineering departments at UAEU for the year 2012. A: above 90, B+ from 85 to 89, B from 80 to 84, C+ from 75 to 79, C from 70 to 74, D+ from 65 to 69, D from 60 to 64 and F below 60.

Question (45)	The resistance in a conductor depends on	
Correct		% Answered
X	1) Conductor length	50%
	2) Conductor cross sectional area	0%
	3) The materials of the conductor	0%
	4) All of the above	50%
	5) Unanswered	0%

Figure 2: A statistical portion from the blackboard shows the percentage weight of the answers. 50% of the students choose the wrong answer while the other 50% have chosen the right answer.

Table 1 summarizes the average grade obtained in both semesters along with student data. It is clear that the overall spring semester results show some improvement over that of the fall semester, and it shows a noticeable improvement when considering a 50% as a passing grade.

Table 1- Summary of Exit Exam results for Fall and Spring Semester of AY 2012-2013

Semester	AY	# Students	% Students Grades $\geq 60\%$	% Students Grades $\geq 50\%$	Total Average Grade	Average Std. Dev.	Average Student GPA
Fall	2012-13	29	27.6 %	69.0 %	51.9 %	5.88	3.06
Spring	2012-13	19	42.1 %	89.5 %	59.6 %	5.61	2.93
Fall	2013-14	24	2.9 %	20.6 %	39.6 %	4.68	2.75
Spring	2013-14	21	57.1 %	76.2 %	59 %	6.31	-

Tables 2 (a-c) shows the overall average grade mapped to each program outcome for the Fall and Spring semesters of AY 2012-2013 and AY 2013-2014. The same exit exam was applied for fall 2012 and spring 2013. Different exit exams were applied during fall 2013 and spring 2014 semesters. **Table 3** shows the conversion criteria used from percentage grade (%) to a performance value on a scale 1-5. It should be mentioned that students were not given any prior exam samples to practice on or any material related to the exam. Our expectation is that an average grade for a particular program outcome above 50 % is considered satisfactory and any average below this requires further analysis of the exam topics where students scored the lowest grades.

Table 2(a)- Average Exam Grade for Each Program Outcome for both Fall and Spring semesters of AY 2012-2013

Program Outcomes	Mapped Exam Questions	Total Number of Mapped Questions	Fall 2012		Spring 2013	
			Average Grade (%)	Equivalent Performance Level (1-5)	Average Grade (%)	Equivalent Performance Level (1-5)
A	1-43, 45-50	49	51	3	59	3

B	-	-	-	-	-	-
C	5,9,11,12,16-27, 42, 44	18	56	2.5	65	3.5
D	-	-	-	-	-	-
E	13-15, 37, 39-42, 48	9	43	2.5	60	3.5
F	-	-	-	-	-	-
G	-	-	-	-	-	-
H	-	-	-	-	-	-
I	13-15	3	70	4	74	4
J	8, 10-12	4	42	2.5	57	3
K	-	-	-	-	-	-

Results indicate that the student average grade was around 52% and 60% for Fall 2012 and Spring 2013, respectively. The students felt that the exam was difficult and that some problems needed more time. The results suggest that the program concentrates the exam on general basic questions from the different basic core courses of the program. Thus, it is recommended that focus groups and program assessment committee review the Exit Exam questions and make sure that questions should be of the general and principle type and do not require any formula or any memorization. We feel that the response is expected in relation to the exam difficulty. In fact, the EIT exam results in the US range between 50-60 %.

The Exit exam for Fall 2013 showed weaker results than previous semesters due to the fact that it included more definition-based questions. Also, the average GPA of the graduating students was lower than previous years which could partly justify the weaker performance. Some questions were also seen confusing by students and this suggests that the EE Department needs to draft the questions more carefully.

Results for Spring 2014 were improved and comparable to those of AY 2012-2013, indicating an average group performance of 59 % which is comparable to typical EIT exam results in the US universities. The suggestion is to make questions more conceptual and dependent on basic skills required from graduates. Otherwise, formulas must be made available to students. It is also believed that the Exit Exam must assess basic engineering application skills including the knowledge of basic math and science, technical skills, engineering standards, and communication skills.

Table 2(b)- Average Exam Grade for Each Program Outcome for Fall semester of AY 2013-2014

Program Outcomes	Mapped Exam Questions	Total Number of Mapped Questions	Fall 2013	
			Average Grade (%)	Equivalent Performance Level (1-5)
A	1-2, 5-6, 8, 10-12, 23-24, 26-43, 48, 50	39	42	2.5
B	3, 7, 10-11, 14-16	7	28	1
C	3, 6-7, 9, 13-18, 33-38, 40-44, 46-47, 49	24	44	2.5
D	-	-	-	-
E	2, 4, 14-16, 23-24, 27, 33-38, 40-47, 49	23	37	1
F	27, 37	2	16	1
G	-	-	-	-
H	-	-	-	-
I	1, 8, 28-30, 37, 40, 42, 48, 50	10	39	1
J	-	-	-	-
K	4, 6, 20-25, 45-47	11	36	1

Table 2(c)- Average Exam Grade for Each Program Outcome for Spring semester of AY 2013-2014

Program Outcomes	Mapped Exam Questions	Total Number of Mapped Questions	Spring 2014	
			Average Grade (%)	Equivalent Performance Level (1-5)
A	1-27, 30-44, 47-50	46	59	3
B	27-28	2	50	3
C	1, 15, 22-25, 39-40, 45	9	74	4
D	-	-	-	-
E	29, 32-34, 38-40, 43-48	13	45	2.5
F	-	-	-	-
G	-	-	-	-
H	-	-	-	-
I	-	-	-	-
J	-	-	-	-
K	-	-	-	-

Table 3- Mapping of Average Exit Exam grade to an equivalent performance level

Average Value	Equivalent Performance Level (1-5)	Action to be taken
$90 \% \leq g$	5	No action
$70 \% \leq g < 90 \%$	4	No action
$60\% \leq g < 70 \%$	3.5	No action. However, improvements may be suggested
$50\% \leq g < 60 \%$	3	No action. However, improvements may be suggested to some topics
$40\% \leq g < 50 \%$	2.5	Improvement needed. The Exit Exam requires major revision and action to improve student abilities
$g < 40 \%$	1	Failure—Need to look for weaknesses and seek ways to strengthen student skills in particular topics

Such analysis on exit exam results draws our attention to some questions which can be classified as fundamental and should not be missed or wrongly answered. The question that is presented in Figure 2 is considered as fundamental and can easily be mapped to the specific course where this topic is supposedly covered.

It is worthy to add that in any program development cycle, evaluation is an ongoing process and one should not wait for the completion of the program or the course to introduce changes. Other elements such as the teaching skills of faculty members may be related to the success of students in the test. Personal worries and anxieties that students have at the end of the course may also be factors that should be taken into account given their psychological impacts.

In general, the curriculum development process includes several stages that are ordered as follows: the design, development, implementation and evaluation of curricula, as depicted in Figure 3. The exit exam could be used as a monitoring tool whose outcomes could be used for feedback, evaluation and reviewing processes, as depicted in Figure 4. Moreover, the monitoring can be seen as part of the implementation process of the curriculum. It is at this stage that departments have responsibility to verify that student performance is consistent with the established goals and objectives of the university curriculum. As stated previously, the data and information are gathered to inform university policy and decision makers about the curriculum. At the evaluation stage, academic representatives are engaged in analyzing the collected data to measure the effectiveness of the curriculum design and its implementation.

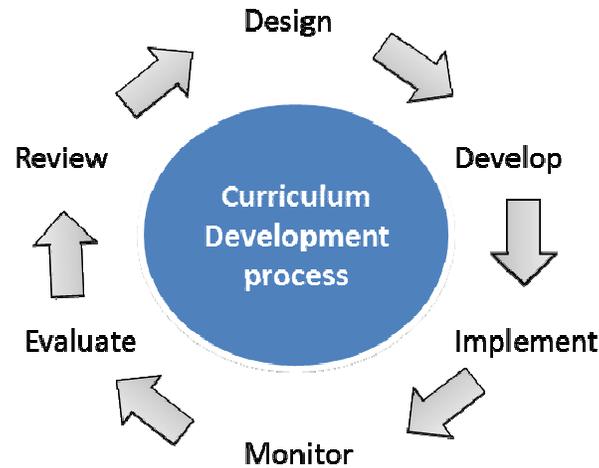


Figure 3: Conventional curriculum development process.

The exam serves to provide the departments, colleges and universities with detailed up-to-date feedback, which helps develop the program and its courses. Once the students take the exam, the results are analyzed, examined and discussed extensively to identify points of strengths as well as weaknesses and pinpoint any areas for development in the academic programs or even the introduction of new programs and courses. Thus as a consequence, those detailed results will allow colleges and departments to identify domains where the students excel and those which need improvement and better assessment.

The expansion of exit exams can be attributed mostly to standard based reform, and college administrators are the main drivers. Standards have provided solid reliable foundations and backgrounds to the concept of exit exams by setting what students should know and be able to do by the time they graduate from engineering schools. College administrators have an ongoing responsibility to closely monitor the implementation of exit exams. They must understand the effects of these tests, including any negative or unexpected consequences, so they can address problems or adjust state policies.

Results of the exit exams could be used by universities in the evaluation of their instructors and faculty member during one batch. This evaluation may impact the academic promotion of faculty members. This action would force instructors to do their best to explain the content of the course well, which will impact significantly on the students' performance and proficiency. Questions of the exit exam are mapped with their corresponding courses, within which the information has been covered. Needless to say that a good instructor is the one who helps students to retain the necessary and basic knowledge as long as possible.

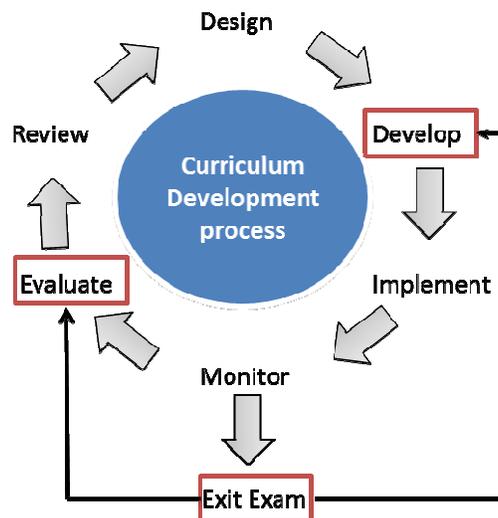


Figure 4: Curriculum development process and exit exam feedback.

The exit exam aims at measuring the students' attainment of the program learning outcomes as well as their performance in the individual courses/domains relevant to their specialization. This is highly important in higher education as it serves as a point of reference for program enhancement. The students taking the exam realize the importance of the exam when it is seriously taken. These types of exams will motivate students to work harder and help teachers identify and address students' weaknesses.

The ABET accreditation now requires students at engineering school to pass an exit exam before graduating; a key element of standards-based accountability reforms. The objectives of this test are as follows:

- 1) To make sure that all courses are expeditiously completed and that they are taken before other courses that may have them as prerequisites. If the time limit is not met, the student may be dis-enrolled.
- 2) To use the exit exam results to introduce necessary adjustments to teaching and learning processes.
- 3) To assess functions to improve student learning, to discover course-embedded assessment models and contemporary approaches to curriculum design, teaching methods, and assessment
- 4) To benchmark measure of excellence this will help to improve the department services and operations by tracking several measureable parameters over the years.
- 5) *To measure* the quality of the engineering programs.
- 6) *To provide data and information for decision* making process.
- 7) To learn how assessment strategies can form the groundwork for an improved "assessment"
- 8) To map and to provide "backwards" feedback for curriculum design and development

To improve the exit exam results, the following are suggested:

- 1) The contribution percentage of the exit exam should be increased from 5 to 10%.
- 2) Students must repeat the exit exam until they pass.
- 3) A minimum score level for passing the exit exam should be defined.
- 4) After the exam, a statistical analysis of the results should be used to compare the new test to the benchmark set.
- 5) It is necessary to rewrite the exam periodically to maintain security.
- 6) The exam score of the students should appear on their transcripts.

CONCLUSIONS

Exit exams can be vital to the improvement of academic programs quality and effectiveness. These benefits can help improve the quality of programs across colleges at the UAEU as well as other institutions within the UAE. Moreover, this creates a good area for cooperation between academic departments since they can compare results and work jointly to improve the quality of higher education as a whole. Coaching or preparing students for the test is a problem and should be avoided. At the end, ABET and degree-accreditation agencies have strong reasons to keep track of the impacts of exit exams. It is worthy to add that in any program development cycle, evaluation is ongoing and one should not wait for the completion of the program or the course to introduce changes. Other elements such as the teaching skills of faculty members may need to be considered as part of the success of the test. The personal worries and anxieties that students may have at the end of the course are also factors that should be taken into account.

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