

Academic Quality Management

C. R. Sekhar, O. Farook and Jai. P. Agrawal, E.Bouktache
Department of Electrical and Computer Engineering Technology
Purdue University Calumet

Abstract

This Paper describes the implementation and outcome results of an Academic Quality Management (AQM) program and one of the tools used in three of the courses taught in the Electrical and Computer Engineering Technology (ECET) program at Purdue University Calumet, Hammond, IN. A number of papers have been presented at the ASEE and other professional society meetings on the subject of academic quality under various titles such as TQM, CQI, and TQI etc. Continuous improvement is the buzz word that is used by ABET. We will describe a process that has worked for us to improve the learning and retention of knowledge by the students.

I. Introduction

Classroom assessment techniques are widely used to measure students' acquired knowledge. These techniques include assigning home work problems, quizzes, tests, term papers and others.

Minute papers, Muddiest point, one sentence summary and what is the principle techniques are well described in literature^[1]. At the macro level assessment activities include: 1) Student learning as evaluated by test scores, grades, project presentations etc. 2) Curriculum and course objectives evaluated by an external body such as an Industrial Advisory Committee, and 3) The quality of the graduates judged by the placement data and employer survey. Continuous improvement to the curriculum is implemented using graduate exit survey, employer feed back survey and alumni survey. Number of articles has appeared in the past ASEE conferences and assessment related meetings on continuous improvement, most of them implemented at the macro level, this paper address the issue at the micro level.

Technology criteria 2000 (TC2K)^[2] requires that TAC/ABET accredited institutions implement Programs that will address educational objectives based on the mission of the institution, a process to measure the outcome of the established objectives and a continuous improvement program that will enable the graduate to achieve their educational objectives. Schools are developing volumes of document addressing the above requirements along with statistical data to show continuous improvement in their programs, indeed a time consuming process for the faculty!!

II. AQM at Purdue University Calumet

At Purdue University Calumet AQM was started in 1994. We realized that having the college level algebra as a prerequisite rather than pre/co requisite for Electrical Circuit I (this is case for many technology programs) will benefit the students. The students take College Algebra-I in first semester before they take Electrical Circuits-I (dc circuit analysis) in the second semester and Algebra-II (college trigonometry) in second semester before they take Electrical Circuit-II (ac circuit analysis) in the third semester. The students now have the necessary mathematical background for problem solving in the circuit courses. This process alone produced improved retention in the program.

III. Revamping of ECET 100 as a Freshman Experience Course

The department went through a name change in spring 2003, from Electrical Engineering Technology to Electrical and Computer Engineering Technology. EET-100 was a seminar course with 1 credit hour introducing the in coming students to the field of electrical engineering. Wiring, soldering, fabrication techniques were discussed in this course. This approach did not produce the desired outcome of increasing student's interest in the subject area and in retention. With the change in the department's name the EET-100 with a new designation of ECET-100(3 credit hours) was targeted to address the issues that surround student retention. The course was revamped with the intent to introducing the students to the discipline and at the same time prepares the students with a laundry list of proven educational learning methodologies that would prepare the student to engage in the life long learning process as an active participant. The following methodologies were incorporated into the pedagogy of the course curriculum which has shifted the element of competition from the equation of learning and has replaced it with cooperation.

a) Active Listening and Notes Taking

Students were positively rewarded to participate and inculcate in the active listening and notes taking process. This activity has integrated the students in the classroom engagement. Students were positively rewarded for further elaborating the notes and subject matter on their own (synthesizing).

b) Maintaining of Portfolio that reflect the student work in totem

Student were required to maintain their total work, this was evaluated at the end of the semester as the log and meter to fathom the student's learning. Student in maintaining the portfolio participated in taking over the process of learning and became responsible for their work, the log book is the proof!

c) Interactive Learning

Subject matter was introduced in a logical sequential manner by interactively posing relevant questions, and then building a class consensus in arriving at the answers through the process of problem solving. Thus the whole class participated (active learning) rather than instructor lecturing (passive process). Open ended questions were assigned, where the answers were sought through the use of Internet / library research (independent research).

d) Approaching the subject matter through Project implementation

Through project based learning approach the students were exposed to the fundamentals of various fields of electrical engineering. A robot was used to design, build and program to perform various tasks. Students through this integrated activity saw the use of mathematics in computing and problem solving. They understood how circuit analysis and digital electronics interact in the design process. Software design provided a very important skill set in the design implementation of different functionalities and their implementation through the use of programming. Students were thrilled to see their program executed by the robot performing different tasks (immediate feed back).

e) Cooperative and collaborative learning through the Student Teams^[3]

Through out the semester students were to perform in a three member team. This team interaction provided the student a base in which they could communicate professionally. This provided a forum for support and a platform on which cooperative learning (horizontal learning) took place.

f) Empowering the students, to take learning in their own hands

The implementation of these methodologies in the pedagogy of the course delivery has really prepared the student to take on learning and to engage in it (total emersion). The semester long activity has not really terminated with ending of the semester but served as a catalyst, that has started and triggered a process of life long learning engagement that would carry on for the rest of student's professional life.

IV. Assessment of student learning at the micro level

It is imperative that students' learning is a continuous process for success. The learning and retention process should be continuously assessed and corrective action taken to improve overall learning process. Freshmen students' characteristics vary from semester to semester. The students' background such as the school district from which they graduated, their math back- ground and the mix of full-time and part-time students in the class has to be taken into account to achieve the curriculum objectives. The incoming students' SAT mathematics scores ranges from 310 to 720 and verbal from 240 to 640. The students should be motivated every which way to achieve their set goals. To help the learning process and have continuous

improvement the student's comprehension of the concepts should be assessed at the micro level and corrective action implemented.

The faculty at PUC strongly believes that good reading habits set at the early stages of the program will help the students to achieve their educational goals and personal achievements. With this in mind in fall 2000, three courses were identified to implement a testing sequence we called the "**ten minute quiz**". The courses are

ECET-100 ECET seminar

ECET-102 Electrical Circuit-1

ECET-152 Electrical Circuit-II.

All the three courses are required for the program.

Concept based objectives were written for all the courses and is used by the faculty who teaches the courses. The grading criteria included the following.

Homework 5%

10 Minute Quiz 25%

Tests (3) 30%

Final (Comprehensive) 15%

And the Laboratory 25%

At the beginning of every class a ten minutes quiz was given to the students based on the concepts that was taught in the previous class hour. 25% of the grade was assigned to the ten minute quiz; this large percentage is to motivate the students to study on a regular basis.

A benchmark of 95% of the students score at least 80% in every quiz was established as the base. Based on this benchmark the instructor either will review the concepts for the entire class or proceed with the next item in learning objective. Through this process the students are kept on a continuous learning mode and any weakness in learning is assessed and corrective action implemented immediately.

ECET-102 is given as an example on the effectiveness of the ten minutes quiz on the learning and retaining of the concepts by the students.

Table-1 shows the course the course objectives and the corresponding quizzes associated with the objectives.

Table-2 shows the test scores after the implementation of the ten minute quiz.

Table-3 shows the assessment results for ECET-102 fall 2003

The using of ten minutes for a quiz every class (the class meets twice a week for 90 minutes each) was an issue raised by some faculty members who thought that there may not be enough time to cover the syllabus material, a very genuine concern. However after trying this method of putting the students in to a constant studying mode the progressive retention of the concepts by the students showed improvement and the coverage time for the syllabus was not an issue.

V. Conclusions

The test scores for fall 2001 and spring 2002 were much lower in comparison to the scores in the semesters when the ten minutes quiz was given. These results show that there is merit in implementing the ten minute quiz. The quiz provides a self assessment for the student on their progress and retention of the concepts. Every test is a comprehensive one and this enhances the retention of knowledge. The ten minutes quiz is a time consuming process for the faculty. Students' response was normally negative in the first two weeks of the semester, however it turned highly positive later. The students' understood the benefits of the quiz and were appreciative of the process expressed during the course evaluation process (exit survey).

Table-1. Course objective for ECET-102. Circuit Analysis-1

Objectives	Ten minutes quiz numbers.
1. Atomic theory, electric charge, voltage, current, resistance, conductance, color code, measurement of voltage, current and resistance.	1, 2
2. Ohms law, power, energy, efficiency	3
3. Series circuit, KVL, series equivalent circuit, VDR circuit ground and reference points.	4, 5
4. Parallel circuits, KCL, CDR	6, 7
5. Series-parallel circuits, analysis and application of Series-parallel circuit.	8, 9
TEST-1	
6. Constant current sources, source conversion, branch circuit analysis, mesh and nodal analysis, delta-wye conversion	10,11,12,13
7. Network theorems	
TEST-2	14,15,16,17
8. Capacitors and application of capacitors in dc.	
TEST-3	18, 19, 20
9. Magnetism and magnetic circuits	21, 22
10. Inductance and application of inductors in dc.	23, 24
Final Examination.	

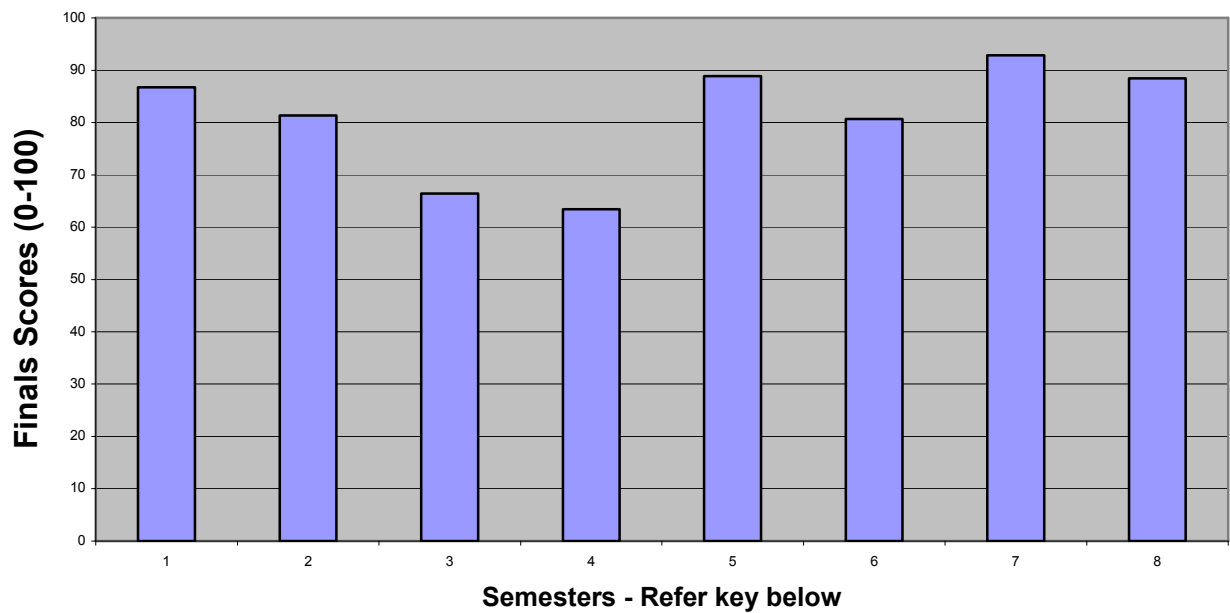


Table – 2. Final Test Scores Reflecting the Impact of “Ten Minute Quiz”

X - AXIS KEY

- 1: Fall 2001-51, Ten Minute Quiz
- 2: Spring 2001, Ten Minute Quiz
- 3: **Fall 2001-01, NO Ten Minute Quiz**
- 4: **Sp 2002-01, NO Ten Minute Quiz**
- 5: Sp 2002-51, Ten Minute Quiz
- 6: Fall-2002, Ten Minute Quiz
- 7: Sp-2003, Ten Minute Quiz
- 8: Fall-2003, Ten Minute Quiz

College Algebra I is a pre requisite for ECET-102.

Table-3. Course Assessment ECET-102 Fall 2003

ECET-102 Electrical Circuits I Course Assessment Tool														
Semester: FALL 2003					Instructor: Chandra R.Sekhar									
Course Objective	Supported Related Outcome	Course Embedded Assessment of Student Performance						Student Evaluation (%)						
		Assessment Tool 1	Score (%)	Assessment Tool 2	Score (%)	Assessment Tool 3	Score (%)	E	G	A	P	NA	Composite	
Atomic theory, current,voltage,measurement of resistance, voltage and current	1.1 Technical Proficiency a,b,c,d,f	Quiz 1,2	78					11	1	0	0	0	4.9	
Ohms law,power,energy,efficiency	1.1 Technical Proficiency a,b,c,d,f,g	Quiz 3	90					10	2	0	0	0	4.8	
Series, parallel and series parallel circuit analysis ,KVL,KCL	1.1 Technical Proficiency a,b,c,d,f 1.2 Math & Science b,c,f	Quiz 4,5,6,7,8,9	81	Test-1	80.5	FINAL EXAM Q-1	84.44	10	1	1	0	0	4.8	
Mesh and Nodal analysis	1.1 Technical Proficiency a,b,c,d,f 1.2 Math & Science b,c,f	Quiz 10,11,12,13	78**			FINAL EXAM Q-4,5,	52.96	4	6	2	0	0	4.2	
Network Theorems	1.1 Technical Proficiency a,b,c,d,f 1.2 Math & Science b,c,f	Quiz 14,15,16,17	81	Test-2	81.7	FINAL EXAM Q-6		2	4	3	3	0	3.7	
Capacitors and inductors in dc circuits	1.1 Technical Proficiency a,b,c,d,f 1.2 Math & Science b,c,f	Quiz 18-24	82	Test-3,Test-4	83.79	FINAL EXAM	80.1	7	3	2	0	0	4.4	
Instructor Comments for needed changes:** Will increase instruction time by 3 hours.								Number of responses:				12		

References

- [1] Assessment Forum: 9 principles of good practice for assessing student learning. American Association for Higher Education.
- [2] "Criteria for Accrediting Technology Programs" TAC/ABET.
- [3] A Model for Engineering Technician Education: Teaching What the Marketplace Needs. Regional Conference, Las Vegas, NV-2003. NJCATE.

Biography

CHANDRA R. SEKHAR is a member of the faculty of the Electrical and Computer Engineering Technology at Purdue University Calumet. Professor Sekhar earned a Bachelor's Degree in Chemistry from the University of Madras (India), a Diploma in Instrumentation from Madras Institute of Technology and Master's Degree in Electrical Engineering from University of Pennsylvania. Professor Sekhar's primary teaching and research focus is in the areas of Biomedical and Process Control Instrumentation and Clinical Engineering.

OMER FAROOK is a member of the faculty of the Electrical and Computer Engineering Technology Department at Purdue University Calumet. Professor Farook received the Diploma of Licentiate in Mechanical Engineering and BSME in 1970 and 1972 respectively. He further received BSEE and MSEE in 1978 and 1983 respectively from Illinois Institute of Technology. Professor Farook's current interests are in the areas of Embedded System Design, Hardware – Software Interfacing, Digital Communication, Networking, C⁺⁺ and Java Languages.

JAI AGRAWAL is a Professor with joint assignment in Electrical and Computer Engineering Technology and Electrical & Computer Engineering. He received his PH.D. in Electrical Engineering from University of Illinois, Chicago, in 1991, M.S. and B.S. also in Electrical Engineering from I.I.T. Kanpur, India in 1970 and 1968 respectively. Professor Agrawal has worked recently for two years in optical networking industry in the Silicon Valley in California. Professor Agrawal is the Founder Advisor to Agni Networks Inc., San Jose, California. His expertise includes optical networking at Physical and Data link layers, optical and WDM interface, SONET and Gigabit Ethernet and analog electronic systems. He is the author of a Textbook in Power Electronics, published by Prentice-Hall. His professional career is equally divided in academia and industry. He has authored several research papers in IEEE journals and conferences.

ESSAID BOUKTACHE is a member of the faculty of the Electrical Engineering Technology Department at Purdue University Calumet. Dr. Bouktache received his MS and Ph. D in Electrical Engineering from the Ohio State University in 1980 and 1985, respectively. His research and teaching interests include Digital Signal Processing, Computer Networks, and Digital Communications. Professor Bouktache has been with Purdue since 1992 and is a member of IEEE and ASEE. He has several publications to his credit.