AC 2007-1399: A FRAMEWORK FOR THE ASSESSMENT OF ONLINE ENGINEERING TECHNOLOGY COURSES: A CASE STUDY

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1.0 BACKGROUND AND INTRODUCTION

Globalization of the economy has impacted the workforce education and training needs in most of the major industrial nations. In the United States, there has been a steady transition from a predominately production/manufacturing based economy to an economy in which services account for more than 50% of the GDP. The World Factbook- United States Economy, states that in 2004, nearly 80% of the GDP in the U.S. was generated by services related industries[1] . This shift has made the acquisition of a university degree (Associate or Bachelor) by former and current employees of the manufacturing and agricultural sectors more desirable, and financially attractive. Along with the growing demand for higher education by working adults in the civilian sector, military personnel preparing to enter the civilian employment sector, have created a rapidly growing market for education of non-traditional students.

Since most of the non-traditional students are generally unable to take classes on the campus of an educational institution, the providers of higher education for this segment of the student population have to utilize distance learning systems. Although the initial stimulus for the development of distance learning systems was provided by non-traditional students, the recent growth in the demand for distance education has been augmented by a significantly large number of regular students who take some classes online, concurrent with enrollment in face-to face classes.

In 2003, Allen and Seaman[2] estimated that there were nearly 2 million students in completely on-line courses. The corresponding figure for 2006 is estimated to be 3 million. These researchers also estimated that in 2003, more than 80% of all institutes of higher education offered at least one on-line class, and one third of these entities conducted completely on-line degree programs.

The rapid advance in the adoption and acceptance of on-line distance education systems has been facilitated by the spectacular progress made in the availability and affordability of broad-band telecommunications systems during the last 2 decades. Additionally, Human Computer Interaction (HCI) designs are becoming increasingly user-centered, and the design of asynchronous on-line class delivery systems is a very representative example of learner-centered approach to design of HCI associated with distance learning systems. Recent advances in the design of sophisticated on-line courses, incorporating multi-media, have enhanced the effectiveness and acceptability of web-based on-line distance learning systems.

Excelsior College (EC) has been a pioneer in the service of non-traditional students since 1971. This institution was quick to adopt web-based asynchronous distance learning systems as the primary mode of instruction for the predominantly non-traditional adult student population of the college. During the last 5 years, the Schools of Liberal Arts, Nursing, Health Science, and Business and Technology have developed several hundred web-based on-line courses for management and delivery through the Web CT Distance Learning System. To ensure that all of

the EC students enrolled in these on- line classes are receiving quality instruction, the administration of this college has been rigorously assessing the quality of instruction through student surveys, faculty surveys, and in-class course evaluations by students.

In this paper, the authors present an overview of the online Bachelor of Electronic Engineering Technology (BEET), and Bachelor of Nuclear Engineering Technology (BNET) degree programs at EC, with the primary focus on the process for assessing the quality of the courses, quality of instruction, and user (student) satisfaction with the online courses in BEET and BNET programs. A summary of the methodology used for data collection surveys, and the results of the quality assessment of a selected set of courses are presented. Finally, conclusions concerning the results are provided, along with some references to the outcomes of similar studies conducted at other institutions.

2.0 DISTANCE LEARNING AND QUALITY OF INSTRUCTION AT EXCELSIOR COLLEGE

2.1 Overview of Engineering Technology Programs

In the school of Business and Technology, the core of the technology degree learning sector consists of five B.S. degree programs: B.S. (Technology), B.S. (Computer Science), B.S. (Information Technology), B.S. (Electronic Engineering Technology), and B.S. (Nuclear Engineering Technology). The last 2 degree programs mentioned above are ABET accredited. In these technology programs, the courses taught on-line at EC include a combination of engineering, science, computer science, information systems, project management, telecommunications, electronics, and quality assurance topics. Every degree program requires a course in Integrated Technology Assessment, which is equivalent to a "CAPSTONE" course. Where necessary, students are provided access to a "Virtual Laboratory" for gaining laboratory experience.

Anwar et.al.[3] provided an overview of the engineering technology programs at EC, in a paper presented at the 2005 ASEE Annual Conference and Exposition. Anwar[4] presents details of the BEET program at EC in an article to be published in the Journal of Pennsylvania Academy of Science.

2.2 Characteristics of EC Students

As stated in Section 1.0, Excelsior College was the first institution of higher learning, created 35 years ago, to primarily serve the community of non-traditional adult students in pursuit of B.S./B.A. degrees. Since the start of its operations, EC has continuously transitioned from the role of a facilitator of degree acquisition, to the role of a higher education instruction provider. Currently, EC is offering several hundred on-line classes for the 28,000 students at this college. The School of Business and Technology at EC is presently offering 72 on-line courses to nearly 4,500 students. These courses are delivered through web-based asynchronous classes, so that the students can have access to "any time, any place" mode of distance learning.

2.3 Quality of Instruction Considerations

Although distance learning systems have become a universally accepted mode of instruction delivery throughout the world, asynchronous distance learning systems still have to deal with questions about technical viability and quality of instruction. As is the case with any successful innovation, the traditionalists have doubts about the efficacy of on-line distance learning systems. In a report published by the Institute for Higher Education Policy [5] in 2000, the authors stated: "Proponents ooze with blind adoration, declaring that online learning can resolve all the problems confronting traditional education. Opponents insist that courses taught on the net are incapable of living up to the standard of the traditional bricks and mortar classroom."

Recognizing the importance of the "quality of education" as an indicator of the effectiveness of its academic programs, the administration of EC has regularly conducted "quality of service" surveys, in which the quality of instruction is the focus of a significant number of survey questions. The feedback provided by the participants in these surveys

(students, alumni, faculty, and staff) is the basis for assessing the current status of the quality and effectiveness of the academic programs, and the survey results provide stimulus for corrective and proactive actions for effecting "continuous improvement" of these programs.

3.0 METHODOLOGY FOR ON-LINE QUALITY OF INSTRUCTION ASSESSMENT.

3.1 On-line Instruction Process

In the On-line distance learning environment, the instructor, the technology, and the course content are the key components of the learning process for the student. The technology based instruction delivery system is generally fixed once the institution selects the distance learning technology.

In the case of EC, the instruction delivery is achieved through the WebCT distance learning system. The course content and the instructor's flexibility in the utilization of multi-media features in the class is influenced by the design and capability of the instruction delivery system. It is also a well known fact that the mind set of the instructor, as well as the student must be conditioned to get the best out of the on-line instruction process.

3.2 Methodology for Evaluation the Effectiveness and Quality of Instruction

Nearly 20 years ago, Chickering and Gamson [6] identified seven principles, which were later highlighted in a technology focused study sponsored jointly by the Education Commission of the States, the American Association of Higher Education (AAHE), and the Johnson Foundation[7]. These researches stressed that good practice in learning must.

- Encourage student-faculty contact,
- Encourage cooperation among students,
- Encourage active learning,
- Give prompt feedback,
- Emphasize time on task,
- Communicate high expectations, and
- Respect diverse talents and ways of learning.

These seven principles have been the focus of several other studies, many of them dealing with on-line instruction systems [8,9,10]. In the AAHE sponsored study report released in 2000, Chickering and Ehrmann[7] stated that instructional technology must be utilized in ways consistent with seven principles for good practices in undergraduate education to take full advantage of the power of new technology. A number of other studies also concentrated on the relevance of the seven principles to the effectiveness/ quality of on-line instruction systems [11,12,13,14].

The above-mentioned studies provide the foundation for the evaluation of the quality of on-line instruction. In this methodology, various evaluation tools/ techniques are utilized to evaluate the (i) Access, (ii) Student Learning (iii) Student Satisfaction, and (iv) Instruction Satisfaction elements that determine the effectiveness and quality of the on-line instruction process at an institution.

4.0 EVALUATION OF QUALITY OF ON-LINE INSTRUCTION AT EXCELSIOR COLLEGE

4.1 Data Collection and Evaluation Tools/ Techniques.

As shown in Figure 4-1, the four key elements of the quality/ effectiveness of on-line instruction are Access, Student Learning, Student Satisfaction, and Instructor Satisfaction. The collection of data pertaining to each of these elements was accomplished through surveys involving the students, staff and instructors. Table 4-1 show the tool/techniques used for evaluation of each element. So far, instructor satisfaction has not been evaluated explicitly in the quality of instruction assessment at EC.

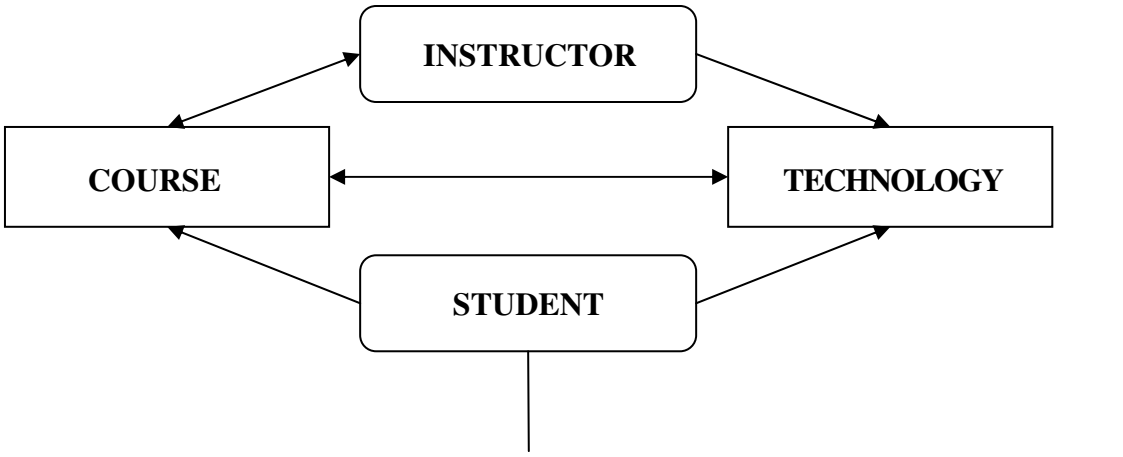

Figure 4-1

Elements of Effectiveness/Quality in an On-line Distance Learning Process

Table 4-1
Quality of Instruction Elements and Evaluation Tools/Techniques

Quality of Instruction Element	Evaluation Tool/ Technique
Access	-Course Rubric -In class course evaluation survey -Quality of service survey -Course activity logs
Student Learning	-Course Rubric -Learning outcomes Assessment -Longitudinal tracking of graduates
Student Satisfaction	-In class course evaluation survey -Quality of service survey -Informal feedback

4.2 Methodology for Quality of Education Assessment

The methodology for assessing the quality of education at EC has three distinct components. These are:

(i) Assessment of the Quality of the Course Content;
(ii) In-Class Course Evaluation by students; and
(iii) Learner/ Instructor Satisfaction with the learning experience and resources.

Presented next are some details of the methodology used in each segment of the process for assessing the quality of education for the BEET and BNET programs at EC.

4.2.1 Assessment of Quality of Course Content

For assessing the quality of subject matter content of each on-line course offered in the BEET and BNET programs, the School of Business and Technology (SBT) utilizes the "Quality Matters" Rubric developed by the Quality Matters Organization. There are several other "Quality of Course" rubrics available (e.g., California State University-Chico, Troy State University) and most of them are equally effective in relating the "Seven Principles of Good Practice" to the evaluation of the course content. The Quality Matters rubric appears to be somewhat easier to implement compared with other rubrics. Table 4-2 displays the quality elements used in this rubric to determine whether the course content and the student/learner support infrastructure possess the attributes that meet the standards for an "acceptable" on-line course. As shown in this table, course attributes such as the clarity of course Overview/Introduction and Learning Objectives, quality of course Resources and Materials, the availability of adequate technology for the delivery of instruction, the infrastructure for learner support, the potential of the course for facilitating learner engagement in class activities, and the accessibility features of the course are scored to decide whether the course being evaluated meets the "Quality Matters" standards.

In this process, the Subject Matter Expert responsible for determining the adequacy of subject matter content and recommended class activities, the Project Manager for the Creation of the On-line course, and the Managers for On-line Instruction Delivery at SBT are jointly

involved. The assignment of point values for various components of the Quality Matters Rubric is a very intense, objective, and time consuming process. Every new on-line course introduced by SBT must score enough points to meet the Quality Matters standard.

Table 4-2

All Quality Matters Rubric Standards with Assigned Point Values

	Standard		Points
Course Overview and Introduction	I.1	Navigational instructions make the organization of the course easy to understand	3
	I.2	A statement introduces the student to the course and to the structure of the student learning and, in the case of a hybrid course, clarifies the relationship between the face-to-face and online components.	3
	I.3	Etiquette expectations with regard to discussions, email, and other forms of communication are stated clearly	2
	I.4	The self-introduction by the instructor is appropriate and available online	1
	I.5	Students are requested to introduce themselves to the class	1
	I.6	Minimum technology requirements, minimum student skills, and, if applicable, prerequisite knowledge in the discipline are clearly stated	1
Learning Objectives	II.1	The course learning objectives describe outcomes that are measurable	3
	II.2	The module/unit learning objectives describe outcomes that are measurable and consistent with the course-level objectives	3
	II.3	The learning objectives are stated clearly and written from the students' perspective	2
	II.4	Instructions to students on how to meet the learning objectives are adequate and stated clearly	2
	II.5	The learning objectives address content mastery, critical thinking skills, and core learning skills	2
Assessment and Measurement	III.1	The types of assessments selected measure the stated learning objectives and are consistent with course activities and resources	3
	III.2	The course grading policy is stated clearly	3
	III.3	Specific and descriptive criteria are provided for the evaluation of students' work and participation	3
	III.4	The assessment instruments selected are sequenced, varied, and appropriate to the content being assessed	2
	III.5	"Self-check" or practice types of assignments are provided for timely student feedback	1
Resources and Materials	IV. 1	The instructional materials support the stated learning objectives	3
	IV.2	The instructional materials have sufficient breadth, depth, and currency for the student to learn the subject	3
	IV.3	The purpose of each course element is explained	2
	IV.4	The instructional materials are logically sequenced and integrated	1
	IV.5	All resources and materials used in the course are appropriately cited	1
Learner Engagement	V.1	The learning activities promote the achievement of stated learning objectives	3
	V.2	Learning activities foster instructor-student, content-student, and if appropriate to this course, student-student interaction	3
	V.3	Clear standards are set for instructor response and availability (turn-around time for email, grade posting, etc.)	3
	V.4	The requirements for course interaction are clearly articulated	2
	V.5	The course design prompts the instructor to be active and engaged with the students	2
Course Technology	VI. 1	The tools and media support the learning objectives, and are appropriately chosen to deliver the content of the course	3
	VI.2	The tools and media enhance student interactivity and guide the student to become a more active learner	2
	VI.3	Technologies required for this course are either provided or easily downloadable	2
	VI.4	The course components are compatible with existing standards of delivery modes	1
	VI.5	Instructions on how to access resources at a distance are sufficient and easy to understand	1
	VI.6	The course design takes full advantage of available tools and media	1
Learner Support	VII. 1	The course instructions articulate or link to a clear description of the technical support offered	2
	VII.2	Course instructions articulate or link to an explanation of how the institution's academic support system can assist the student in effectively using the resources provided	2
	VII.3	Course instructions articulate or link to an explanation of how the institution's student support services can assist the student in effectively using the resources provided	1
	VII.4	Course instructions articulate or link to tutorials and resources that answer basic questions related to research, writing, technology, etc.	1
Accessibility	VIII.1	The course acknowledges the importance of ADA requirements	3
	VIII.2	Course pages and course materials provide equivalent alternatives to auditory and visual content	1
	VIII.3	Course pages have links that are self-describing and meaningful	1
	VIII.4	The course demonstrates sensitivity to readability issues	1

To meet Quality Matters review expectations a course must: Answer 'Yes' to all 3-point Essential Standards: I.1, I.2, II.1, II.2, III.1, III.2, III.3, IV.1, IV.2, V.1, V.2, V.3, VI.1, VIII.1 ***A N D*** Earn 68 or more points

Source: QualityMatters.org (Quality Matters/Maryland Online)

4.2.2 In-Class Course Evaluation by Students

It is a common practice for students to complete a questionnaire concerning course evaluation in face-to-face classes, prior to the end of a class. A similar activity takes place in on-line classes, where the student responses to the question concerning the quality of the course and instruction are submitted electronically. At EC, the course evaluation data collection system is designed to guarantee the anonymity of the responses provided by the students.

The course evaluation instrument used at EC consists of 26 questions, addressing various important outcomes, instructor-learner interaction, adequacy of technology and support infrastructure, and responsiveness and capability of the faculty, staff and support personnel. Table 4-3, shows the 24 statements for which the responses are recorded on a scale going from 1 (strongly disagree) to 7 (strongly agree). A high average score (near 7) indicates that the respondents (students) agree with the statement presented to them. In the Table 4-3, the average scores based on actual responses from students in a BEET course are shown.

SBT management utilizes the results of these evaluations for making modifications/improvements in the course content, method of delivery, and technical and student support infrastructure for the particular course, and also for the degree program in which the course is being evaluated. The student inputs submitted in response to the course evaluation questionnaire are utilized for evaluating the effectiveness of the instructor, and for providing any guidance/counseling, if called for.

In addition to 24 statements in Table 4-3, the in-class course evaluation template includes the following two questions soliciting open-ended responses from students:

Q.No.25
WebCT is the name of the software system used to administer this course. Did you have any problems using WebCT that you would like to share? If yes, what were they?
Q.No.26
If you felt this course fared poorly in any of the above listed dimensions (or any that were not included above), what could we change to improve the course?

The results of in-class course evaluation surveys indicate that the BEET and BNET students have a high level of satisfaction with the quality of the courses, and the quality and effectiveness of instruction and delivery system.

Table 4-3

In-Class Course Evaluation Questionnaire

Questions	Rating
1. The grading policy was made clear at the beginning of the course.	6.2
2. Initial instructions clarified the course objectives and content at the beginning of the course.	6.0
3. Interacting with other students helped me meet the learning objectives of this course.	3.3
4. Engaging with other students in course related activities made me feel like I was part of a learning community.	3.7
5. The instructor did an excellent job interacting with students using available technology.	6.0
6. I understood what I needed to do to complete my assignments.	6.5
7. Graded assignments were not related to the course objectives.	6.9
8. Assignments stimulated my interest in the topics covered in this course.	6.4
9. Graded assignments for this course were returned quickly.	6.4
10. The time given to complete assignments allowed me to do my best work.	6.1
11. The discussion questions helped me learn the content of the course.	5.9
12. The feedback I received on my assignments from this course helped me perform better on subsequent assignments.	5.6
13. The readings for this course were presented in a logical order.	6.5
14. The readings for this course stimulated new thinking about course content.	5.9
15. The readings for this course helped me meet the learning objectives of the course.	6.5
16. The instructor conducted this course in a way that accomplished the stated objectives.	6.5
17. The instructor for this course responded to questions in a timely manner.	6.2
18. The instructor for this course was interested in helping me learn the material.	6.3
19. The instructor's feedback helped me learn.	6.0
20. The course schedule was flexible enough to meet my needs.	5.5
21. I would recommend this course to others.	6.2
22. Overall I was very satisfied with this course.	5.7
23. Before starting my online course(s) I received sufficient information about registration requirements and prerequisites.	5.2
24. Before starting my online course(s) I received sufficient information about student support services.	5.7

4.2.3 Quality of Service Survey

Once every three years, Excelsior College conducts a comprehensive assessment of the "Quality of Service" (QOS) provided to the students at this institution. This assessment is based on surveys consisting of quantitative questions for which the responses are scored on a scale going from 1 (strongly disagree) to 7 (strongly agree), and a number of qualitative questions soliciting open-ended responses. The latest QOS survey, conducted in 2006, was web-based and generated 1,734 usable responses. There were 1,356 responses from undergraduate students, 239 responses from graduate students, and 139 responses from staff members at EC.

Since the focus of the QOS is very broad, the discussion concerning the results of this survey is confined to the quality of education, and cost of education data representing the responses from students in the Bachelor of Technology (BT), BEET, and BNET programs participating in the survey, pertaining to the quality of education, and cost of education.

Table 4-4 shows the aggregated results for the student assessment of the academic rigor of the curriculum in the engineering technology area. These results indicate that the academic rigor of the courses may need some elevation. At the same time, the respondents seem to suggest that in terms of the difficulty of courses, the EC offerings are comparable to those offered by competing institutions.

Table 4-4

Student Assessment of Academic Rigor

Online	BT	BNET	BEET
Have you taken any online courses from Excelsior College? (% yes)	74.4%	73.6%	76.9%
Compared to other courses I have taken, online courses at Excelsior have less academic rigor. [mean (standard deviation)]	2.99 (1.86)	2.66 (1.73)	3.00 (1.84)
Compared to other courses I have taken, Excelsior College online courses are more difficult. [mean (standard deviation)]	4.38 (1.63)	4.34 (1.47)	4.25 (1.65)

In the Table 4-5, the results for the assessment of the Value, Cost and Quality of Engineering Technology courses are presented. The results of this assessment are generally quite positive and indicate that EC students in the engineering technology academic areas believe that the value, cost and quality attributes of EC academic programs are quite attractive.

Table 4-5

Student Assessment of Value, Cost and Quality of Engineering Technology Courses

Value, Cost, & Quality	BT	BNET	BEET
Considering the cost of the services provided by Excelsior College, the benefits I am receiving are worth it. [mean (standard deviation)]	5.38 (1.51)	5.58 (1.34)	5.23 (1.56)
Thinking of what I paid at Excelsior College, I am getting my money's worth. [mean (standard deviation)]	5.32 (1.62)	5.58 (1.40)	5.20 (1.50)
Overall, the quality of my academic program at Excelsior College is excellent. [mean (standard deviation)]	5.57 (1.46)	5.85 (1.19)	5.60 (1.26)
Overall, the quality of my Excelsior College courses is excellent. [mean (standard deviation)]	5.85 (0.97)	5.93 (1.38)	7 (N/A)
Overall, the quality of Excelsior College examinations is excellent (please answer this question only if you have taken any examinations from Excelsior College). [mean (standard deviation)]	5.42 (1.54)	5.41 (1.18)	5.50 (1.64)

It is appropriate to mention that the standard deviations for most of computed mean scores are quite high. This is attributable to small sample sizes in most cases.

Overall, the results for the assessed quality of academic programs in the engineering technology area, generated by the QOS study, are either neutral or positive.

5.0 CONCLUSION

The management of the academic programs at the School of Business and Technology, and the administration of Excelsior College have made the maintenance of the quality of courses, quality of students support, and the adequacy of the infrastructure for successful delivery of on-line courses, a high priority. In addition to the regular evaluation of specific degree programs, EC has implemented a rigorous process for the assessment of the quality of individual courses, and the performance of instructors for these courses.

Two of the fastest growing B.S. degree programs at EC, Electronic Engineering Technology, and Nuclear Engineering Technology, are ABET accredited, and the academic program quality assessment is an integral part of the "Continuous Improvement" (CI) projects for these programs. At EC, the program outcomes, based on student success in the real world, are the drivers of the actions taken in the CI project.

As documented in this presentation, the academic programs in the engineering technology learning area are competitive with similar offerings at other institutions in terms of academic rigor, student satisfaction, and cost of education. The positive assessment of these academic programs is attributed to an effective procedure of preparing course content, development of on-line courses by experienced and innovative IT professionals, delivery of programs through a user-friendly distance learning system (Web-CT), and responsive student and faculty support infrastructure.

The results of the quality of instruction assessment for two online engineering technology courses at EC, are similar to the results provided by evaluations at a number of other institutions of higher education (e.g., University of Georgia, Indiana University).

The management of SBT places a high premium on regular monitoring of the quality, acceptability, and effectiveness of its on-line academic programs. Therefore, all members of the faculty and staff involved in delivering engineering technology education are constantly reminded about the need for maintaining the quality and currency of their programs. The results of the recent surveys/assessments presented in this paper indicate that SBT has been successful in this endeavor so far.

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