

2006-1519: DEVELOPMENT AND DELIVERY OF NUCLEAR ENGINEERING TECHNOLOGY ON-LINE COURSES: THE EXCELSIOR COLLEGE EXPERIENCE

Altaf Memon, Excelsior College

Interim Dean, School of Business and Technology, Excelsior College, 7 Columbia Circle, Albany, NY 12203-5159

Li-Fang Shih, Excelsior College

Director, Online Course Management, School of Business and Technology, Excelsior College, 7 Columbia Circle, Albany, NY 12203-5159

Byron Thinger, Diablo Canyon Power Plant

Senior Nuclear Generation Engineer, Pacific Gas and Electric Company, Diablo Canyon Power Plant, Avila Beach, CA 93424

“Development and Delivery of Nuclear Engineering Technology On-line Courses: The Excelsior College Experience”

Abstract

Excelsior College, located in Albany, New York, has been a pioneer institution in the distance learning. Numerous online courses have been recently developed by Excelsior College to serve the educational needs of its students. These courses cover a wide range of academic disciplines and can be delivered by a course management system known as WebCT, CD-ROM, or directly through the Web.

This manuscript provides a detailed description of the WebCT-based courses in Nuclear Engineering Technology recently developed by the School of Business and Technology at the Excelsior College to fulfill the academic needs of students enrolled in ABET accredited baccalaureate Nuclear Engineering Technology degree program. The manuscript also provides information regarding the methods used in these courses to assess students' learning and presents a comprehensive review of the development, implementation, and evaluation of the online courses. Feedback from the students on teaching and learning in the online environment is also analyzed and discussed. Finally, this paper explores successful strategies and the best practices for online education.

Introduction

Excelsior College in Albany, New York, was founded in 1971 by the New York State Board of Regents, and was originally known as Regents College. In 1998, it was granted a charter to operate as a private, independent college and changed its name to Excelsior College in 2001. Currently, it has approximately 27,000 enrolled students and is one of the most respected distance learning institutions in higher education.

Recognizing that college-level knowledge can be obtained in many ways, Excelsior provide access to many different avenues for earning college credit, focusing on what students know, rather on where and how they learned it. Undergraduate credits are earned through a variety of accredited sources including for-credits exams, traditional campus-based courses, military and corporate training and distance learning and online courses offered by Excelsior and other institutions. Through these means, the college makes associate, baccalaureate, and master's degree more accessible to busy working adults.

Excelsior College has been continuously accredited by the Commission on Higher Education of the Middle State Associate of Colleges and Schools since 1977. Excelsior's associate, bachelors and master's degree programs in nursing are accredited by the National League for Nursing Accrediting Commission. Its Bachelor of Science degrees in Electronics Engineering Technology and Nuclear Engineering Technology are accredited by the Technology Accreditation Commission of the Accrediting Board for Engineering and Technology (TAC of ABET). The American Council on Education (ACE) recognizes all Excelsior College Examinations for the award of college-level credit.

Excelsior made its first venture into instruction at-a-distance with the introduction of its Master of Arts in Liberal Studies (1998) and piloted Business and Technology undergraduate online courses in 2003. Using the experience gained in these, the college has recently made a successful transition into the delivery of instruction in its undergraduate and graduate programs and now offers more than 125 courses.

Online Nuclear Engineering Technology Program

BS in Nuclear Engineering Technology program is one of the undergraduate programs offered by the School of Business and Technology (B&T) at Excelsior College. Before September 2004, students enrolled in the Nuclear Engineering Technology program could only earn their credits by demonstrating their college-level knowledge and competencies in the academic fields through the submission of transcripts from regionally accredited colleges/universities or through written/performance examinations.

Anticipating the growing demand for online instruction in higher education and to provide the students with an additional avenue for degree completion, B&T launched the online courses in September 2004 starting with the capstone course NUC 495.

In Spring 06, a total of 4 upper division online Nuclear Engineering Technology core courses including the capstone course were launched; they are:

1. NUC 320 Materials (3 credit hours)
2. NUC 330 Reactor Core Fundamentals (3 credit hours)
3. NUC 350 Plant System Overview (3 credit hours)
4. NUC 495 Intergrated Technology Assessment or ITA (3 credit hours capstone course)

The Nuclear Engineering Technology courses offered and registrations in by academic terms are presented in Table I. The course registration has increased over a period of 16 months by about six times.

Table I - Number of Courses Developed and Enrollment by Terms

Academic Term	Courses	Registrations
September 04 (Fall 04)	1	8
January 05 (Spring 05)	2	17
May 05 (Summer 05)	3	37
September 05 (Fall 05)	4	49
January 06 (Spring 06)	4	49

It may be noted that the development and offering of the Nuclear Engineering Technology courses are based on the prioritization of the student needs with in the context of Excelsior College transfer credit policy and procedures. In future, more online courses will be added to allow students to meet their needs.

A strong laboratory component is part of the Nuclear Engineering Technology program curriculum; however, there are no laboratory courses available at Excelsior at this time. Almost all of the students enrolled in this program are able to transfer the required laboratory credits from approved sources. Therefore, at present there does not appear to be a strong demand for such courses. B&T has; however, included development of the laboratory courses in its online course development plan to assist students interested in taking these courses from Excelsior to complete their degree requirements.

Format of Online Courses

All of the online courses in B&T use a standard course template to ensure consistent look and feel of the courses. The online courses are delivered through WebCT, a password protected course management software. Upon entering the course, the students will get access to the “Homepage” of the course, the controller for the course that students will use. To provide the students with more control of the learning process, WebCT enables the students to navigate the online courses in the following three ways:

1. Open specific areas in courses by clicking on the name from the Homepage or other organizer page,
2. Use breadcrumbs to trace their way back through the course, and
3. Use the course navigation tools on the course toolbar to navigate through the course.

The course homepage is organized into three sections. At the top is the title of the course and an area for any introductory or welcoming remarks underneath the Title. The middle section consists of five course icons that link to five main areas of the course. Such consistent look and feel makes the navigation process easier and more intuitive. The five icons that are made available on the course homepage and link to specific course areas are as follows:

- Course Information & Syllabus
- Course Content Modules
- Using WebCT Vista
- Virtual Library
- Tech Support Information

Under the course information and syllabus, following items are included:

- General Course Information(Course title, number, prerequisites, brief description, start and end dates, and required materials)
- Welcome
- Instructor Bio
- Course Syllabus
- Excelsior College Policies (Grading Policy, Academic Honesty, ADA Compliances, and Electronic Use, etc.)

Under the syllabus, following items are addressed:

- About the instructor (instructor name, contact info, and office hour)

- Course Overview
- Course objectives/outcomes
- Relationship between Course Objectives and Program Objectives
- Required and recommended Course Materials
- Library and Reserve readings
- Academic Integrity Policy
- Course Requirement (Exams, projects, discussions, quizzes, etc)
- Course Outline with due date schedule
- Grading Policy (weights and Excelsior grading scale)

Generally, in the B& T's online courses, the course content is divided by weekly modules in which the students' access is limited to the previous taught content modules and the current module. In this way, the students can re-visit the previous taught content modules to refresh what they have learned and associate what they have learned with current obtained concepts, while focusing students' access to the current module. This enables the students to concentrate on the concepts presented in the current module, foster collaborative learning, and generate active interactions among the students.

The course content page is the “heart and soul” of the course. Here the student should find everything they need to successfully complete the course. The content modules and syllabus should be considered as partners. Typically, a content module includes:

- Module Learning Guidelines – module overview, learning objectives, required reading assignment, information on the support learning materials, assignments, and assessments.
- Support Learning Material - Instructor lecture notes, PowerPoint presentation, multimedia demonstration, and/or simulation, etc.
- Module Assessment and Assignments -- Module practice quizzes/exercises, homework assignments, and projects, and assessments such as quizzes and exams, etc.

Online Course Management

The rapid growth of internet-based or online distance learning in higher education has brought the attention of higher education accreditation bodies, especially as it relates to the quality of online education. The importance of ensuring the quality of online education is clearly stated in the report of the Council for Higher Education Accreditation. It is suggested that accreditors should “establish reliable and valid performance measurements, require evidence of contact between faculty and students, mandate evidence of effective instructional techniques, prompt systematic efforts to select and train faculty, staff and administrators receive adequate training to use electronic resources.”¹

Since the early 1990s, various groups and organizations have developed principles, guidelines, or benchmarks to ensure quality distance education.² These guidelines were initially developed for all types of distance learning and contained broad statements. To develop benchmarks that specifically suit for the online distance learning environment, the Institution for Higher Education Policy (IHEP) has proposed 24 essential benchmarks for measuring quality online instruction. These benchmarks were further grouped into 7 categories: (1) institutional support,

(2), course development, (3) teaching/learning, (4) course structure, (5) student support, (6) faculty support and (7) evaluation and assessment.³

Online course management policies of the School of Business and Technology at the Excelsior College have evolved from synthesizing the benchmarks developed by various associations, the characteristics of Excelsior College, and the authors' experience in online education. The school has since developed an online course management system. Different aspects of the management system are discussed below.

Administrative Support

This refers to the activities implemented by the Excelsior College as an institution in order to ensure an environment conducive to maintaining quality online education. The College continues to improve the online education administrative support system as a part of its continuous improvement efforts. In particular, three support services are identified as essential to establish quality online learning environment. They are technical support, student support, and faculty support. These are described as follows:

1. **Technical support:** Excelsior College uses WebCT VISTA, a password protected course management system, to deliver all of the online courses. WebCT VISTA has been regarded as one of the most reliable and easy to use course management software and is used by a majority of the online institutions. In addition, the Office of Information Technology Service (OITS) at Excelsior College is a centralized unit, which maintains technology aspects of the system and provides technical support to the faculty, students and staff of the college.
2. **Student support:** Administratively, Excelsior College has established a comprehensive virtual student service site. Through this site the students upon enrolling in the program can get access to various student services. These services include online registration, academic profile development, and access to the virtual library, etc. Academically, upon entering the program, students are directed to their academic advisors who review their profiles, provide one-to-one consultation, and work with each student to develop a personalized degree completion plan. Once the student registers in an online course, he/she will be directed to a self-paced online student orientation and an online training course to familiarize themselves with the institution as well as the online learning environment. The school's online course management staff is also available to assist the students with respect to any academic issues related to the online courses. Additionally, throughout the duration of course/program the student can get access to the technical assistance via e-mail or telephone 24/7.
3. **Faculty support:** Upon signing the contract, the new faculty are provided with a series of written guidelines addressing various issues related to online education including syllabus writing, online course design and instruction, and facilitating class discussions, etc. An online faculty success guide for online teaching is available to all teaching faculty as well. The new faculty will also be assigned to a well experienced online instructor as a mentor through the progression of the online course. In addition, every faculty member

can also get access to the B&T faculty cyber common room, a virtual community for B&T faculty, in which the faculty member can get access to the most up to date information and resources about online instruction and learning and communicate with his/her colleagues. In addition to a self-paced technical training site, one-to-one technical consultation is also provided to assist the faculty with the development and delivery of the online courses. In order to ensure quality, B&T faculty program chair or designee review courses from their inception to end and guide the faculty along the way to make changes as needed.

Course Development

School of Business and Technology applies a team approach to develop each online course to ensure quality of online instruction. The course development team consists of an instructional designer, technical support personnel, a content expert, an instructor, a mentor (depending on online teaching experience of the instructor), and program chair or designee. The salient features of the process are mentioned as follows:

- Minimum requirements for instructional activities: In order to ensure the consistency and quality of online education, the school has developed specific guidelines regarding minimum standards for course development, design, and delivery.
- Learning Outcomes: The design of the instructional activities (i.e., the use of technology/multimedia) is dictated by desired learning outcomes rather than the availability of existing technology.
- All of the instructional materials are reviewed by the program chair(s) to ensure they meet the program standards and objectives.
- All of the courses are required to be designed to provide pedagogy that requires students to engage themselves in high level of critical thinking skills including analysis, synthesis, and evaluation.

Course Instruction

There are array of policies and activities that support and relate to pedagogy and the art of teaching. These include guidelines involving interactivity, collaboration, and modular learning as explained below.

- Multiple channels for student-instructor communication: In addition to facilitating online class discussions, the students can communicate with their instructors through weekly virtual “Office Hour” and internal e-mail. In case of emergency or private personal issues, the students also can reach their instructor through the instructors’ private e-mail address and telephone number.
- Instructor clarity: Instructions and information regarding the instructional activities and subject content are required to be presented in a clearly written and, straightforward format.
- Specific expectations: During the first week of the semester, online faculty are expected to communicate and orient their students with information about their teaching

philosophy, their expectation about students' performance, and the role and responsibilities for an online learner

- Standardized syllabi: A standardized syllabus template has been applied to all of the B&T online courses. In the syllabus, students are provided with specific course information that outlines course objectives, concepts, and ideas, outline with schedule, and learning outcomes, etc.
- Timely response from the instructor: Feedback to student assignments and questions should be constructive and provided in a timely manner.

Program Evaluation and Revision

The institution reviews the effectiveness of the distance delivery programs to assure alignment with educational objectives and institutional priorities. The improvement of online programs is driven by the data gathered from various scientific measurements. Necessary revisions and modifications are made based on the data gathered from the following measurements:

- Academic Success: information on the student academic success is gathered from the evaluation of student performance within each course, student work and archive of student activities in the annual program review, and evaluation of alumni success.
- Quality Instruction: information on the quality of the online instruction is gathered from the end of course evaluation, faculty surveys, peer review of programs, reviews by course designers, and curriculum reviews by outside panelists.
- Student Service: information on the performance of student service is gathered from student surveys of satisfaction with library service, the peer-to-peer network, advisement services, and software used to support online course instruction.

Perceptions of the Online Programs

Student satisfaction has been regarded as an indicator of the effectiveness of online instruction.⁴ To understand students' perceptions of the online instruction and to improve and ensure the quality of the online programs; the school regularly surveys student satisfaction with their online learning experience. The results of the course evaluations conducted in August 2005 and December 2005 is presented in the following description.

Subjects for this study were drawn from students enrolled in the online NUC courses in the May 2005 term and Spetember 2005 term. 25 (out of 86 enrolled students) that volunteered to fill out an end of course evaluation online survey. The survey consists of 27 questions. Twenty four of these questions employ a rating scale ranging from 1 to 7. A rating of 1 denotes "strongly disagree" while a rating of 7 represents "strongly agree". These questions asked respondents to rank their perceptions of online instruction including course objectives, Global evaluation, perception of faculty, perception of reading and test, and pre-course information and quality interaction. The remaining 3 questions are open-ended questions which solicit a subjective response from students.

Table 2 depicts the results of end of course evaluation of the NUC courses and the school of Business and Technology. As shown in Table 2, all variables yielded an average score above the

Excelsior College standard of 5 except the quality interaction. These findings were also found to correspond with the results of the students' subjective responses.

The qualitative data collected from the open-ended questions reinforced the findings of the quantitative data. The open-ended questions queried students about perceptions of their

TABLE 2 Average Score by Variables

Variables	NUC Courses	School Average
Course Objectives	5.63	5.97
Global Evaluation	5.32	5.76
Perception of Assignment	5.44	5.66
Perception of Faculty	5.37	5.66
Perception of Reading and Test	5.05	5.68
Pre-course Information	5.02	5.76
Quality Interaction	4.20	4.53
Overall	5.15	5.58

online learning experience. In summary, the results indicated that four types of interactions are factors that contribute to overall student satisfactions. They are interaction with the instructor, interaction with the students, interaction with the content, and interaction with the interface. Table 3 depicts the frequencies and percentages collected from the open-ended questions with students' (n=25) indications of factors influencing their satisfaction with the online courses.

Table 3 - Student Responses to Open-ended Questions

Factor	Frequency	Percentage
Interaction with the students	4	16
Interaction with the instructor	8	32
Interaction with the content	8	40
Interaction with the interface	5	12
Totals	25	100

Discussion of the factors shown in Table 3 is provided in the following:

- Interaction with the instructor: Some of the students (4 responses) indicated that interaction with their fellow classmates was beneficial to their learning. Below is the extracted comment from one of the responses:

“More interaction between the students is necessary. If not then it becomes completely take the course independent of the teacher.”

The above statement indicates the importance of student-student interaction to students’ perceptions of online learning. Limited student-student interaction might contribute to a sense of isolation and lack of sense of connection to the course. The results suggest that it is important to integrate student-student interaction into the instructional activities to foster interactions and cooperative learning among the students.

- Interaction with the students: The results of the student subjective responses (8 responses) indicated that the perceptions of instructor-student interaction contribute to students’ satisfaction of online learning. The following extracted student remarks provided good examples:

“The layout of the course was confusing at the beginning, but the instructor was very flexible to answer questions.”

“I wished that we had better communication between the teacher and student. This would have improved the course a lot.”

“The instructor should answer e-mail questions more often. It was left up to the students to figure it out”

The results depict the importance of timely instructor response. The timely response from the instructor will help students ease the confusions at the beginning of the course and contribute to positive online learning experience while limited instructor-student communication might result in student frustration and dissatisfactory online learning experience.

- Interaction with the content: The results of the student subjective responses (10 responses) indicated that the perceptions of course content/course design contribute to students’ satisfaction of online learning. For example,

“In my opinion the professor, X, did an excellent service for the students by completely laying out the course from day one. We were provided with all homework assignments at the very beginning as well as detailed power point presentations for each chapter. X also provided sample problems for each chapter which I found very useful. I have completed several classroom based science courses that were not as well conducted as this online course.”

One of the student commented on the merit of flexibility that the course provided,

“Good course. I liked the format and the method of completing assignments, quizzes, and exams. I never felt pressured by time limits and was able to focus on learning the materials.”

The above remarks depict that clearly presented course materials is vital to students' satisfaction with their online courses. Additionally, the results also indicate students' appreciation toward the flexibility of the instructional activities. It is suggested that the online instructor/course designer need to take into account the flexibility in the online learning format and design the instructional activities accordingly.

- Interaction with the Interface: The results of the students' subjective responses indicated that students' proficiency in the course management system, WebCT, might influence their online experience, especially in the beginning of the semester. Specifically, the students reported to have difficulties in submitting the assignment (1 response), navigating through the system (3 responses), and gaining access to the course (1 response). The results suggest that technical problems might interfere with student learning. The students need to possess the required skills and facility for learning online before the course begins so that the students can concentrate on their learning in the subject matter instead of trying to learn the course management system simultaneously. It is recommended that the students may be provided with an online orientation in the course management system upfront to enable them to use their online experience effectively for learning.

Conclusion

Online programs seem to be growing exponentially among institutions of higher education, yet the quality of the online instruction has been questioned by members of the higher education community.² The extraordinary growth of online programs calls for careful examination of aspects constituting a successful online learning experience.⁴ Taken together and based on the Excelsior College Nuclear Engineering Technology online courses, the paper suggested the following implications regarding the preparation of the institution, faculty and students to ensure quality online instruction:

- The institution needs to establish a solid administrative infrastructure to ensure an environment conducive to maintaining quality distance education.
- The online faculty should possess the skills and temperament for online instruction.
- Students who are interested in taking online courses should have or be provided with the required skills and facility for learning online.
- Course design and interaction are the key components to student satisfaction.

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