

Development of a Web-Based Curriculum in Architectural Engineering Technology

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Abstract

This paper highlights the work at Bluefield State College (BSC) to develop a web-based baccalaureate degree program option (B.S.) in Architectural Engineering Technology (ARET) that remains TAC-ABET accredited. Capitalizing on the initial success of our web-delivered courses in the School of Engineering Technology and Computer Science (SETCS) through its Center for Applied Research and Technology (CART), this work describes the research process used to measure our capability to provide an online version of our degree. Mid-career professionals interested in completing degree requirements without having to attend on-campus classes represent a new student target for our BS in ARET programs.

The program will continue to conform to our TAC-ABET requirements ensuring the quality of the on-line ARET program. The article will address the development of this new delivery method. The curriculum will be designed to operate in an interactive web-based environment for submission of coursework; concept diagrams, drawings, reports, and assorted forms. Class discussions, conferencing, forums and real-time project reviews will utilize current “chat-room” technology and newly emerging conference software applications. Testing opportunities will be devised through models similarly employed by Sylvan Learning Centers and NCARB, allowing online vignettes and projects. The research will determine the extent and volume that portfolio materials will be allowed to be used as submissions for program requirements.

The research will analyze the hardware needs required the institution for the delivery of the program and by students taking the individual courses. Cost analysis will include the cost of delivery of the program, individual courses, and impacts on faculty resources. Research will examine development of marketing strategies and propose market pricing for tuition and fees required by the program.

1. Introduction

The CART Course Management System (CMS) was developed by the Center for Applied Research & Technology, Inc. established on 28 July 1998 to enhance the competitive position of Bluefield State College for applied research opportunities in the current environment for research and development; promote the general economic development of the region; expedite and simplify the acquisition and utilization of research contracts; improve technology transfer; and link applied scientific research and technological advancements to economic development of the State of West Virginia. CART is a non-profit, non-stock corporation under the general corporation laws of the state organized exclusively for educational and scientific purposes within the meaning of section 501(c) [26 U.S.C. § 501(c) of the Internal Revenue Code of 1986, as amended, to foster and support applied research at the Bluefield State College School for Engineering Technology & Computer Science and to provide evaluation, development, patenting, management and marketing for the inventions and diverse service capabilities of its students, faculty, and staff. CART operations are subject to an independent audit.

The Architectural Engineering Technology (ARET) baccalaureate program has been TAC-ABET accredited since 1992. Students are provided the opportunity to analyze the role of architecture in the building construction industry. Course work has involved developing skills in graphic communication, CAD proficiency, building design, and the basic engineering and analysis of building structures. Graduates are provided with a wide range of employment and graduate school opportunities in architectural design, construction estimating, general contracting, government planning agencies, and building material science.

Since the inception of the ARET B.S. program, we have been concerned with increasing our enrollment while retaining program quality. This led to the interest in developing a web-based curriculum that could reach prospective students outside our traditional service area. We have had considerable success in delivering ARET 212 Applied Project Management via our own CART CMS and wanted to explore the possibility of using it more extensively throughout the curriculum. This expansion of web-based delivery presents obvious and not so obvious challenges particular to the delivery of an ARET Online curriculum. We are in the process of critically analyzing the advantages and disadvantages of such program delivery.

2. ARET Online Admission Requirements

To enter our program a student must be 21 years of age and have completed an associate degree or the equivalent from an accredited college or university. Students must be employed in an A/E/C career field position. As part of the admission requirements, credentials, transcripts and evidence of course work shall be submitted for review and a personal contact will be made to describe the evaluation process. There will be an application fee assessed each student to cover administrative costs.

If the students' first language is not English or the applicant graduated from a non English speaking institution, a TOEFL Score of 550 or other accepted proof of proficiency of English must be submitted during the application process.

ARET Online will reserve the right to reject applicants that do not successfully complete the application process. If an applicant is not accepted, admission fees will be refunded.

3. Transfer Credits

Transfer of credits from other institutions will be reviewed on an individual student basis. The student will be assigned an online advisor and the advisor will evaluate courses for content and application to the program. A maximum of 72 semester hours of credit or 108 quarter hours may be transferred from junior or community colleges accredited by a regional accrediting association. Work transferred from non-profit institutions that are approved by a state and not accredited by a regional accrediting association maybe eight separate to meet specific degree requirements up to a maximum of 64 semester hours after earning at least twelve hours of the degree credit at Bluefield State College with an institutional grade point average of at least 2.0. Students desiring transfer credits will submit catalog descriptions of course content as published in their respective college catalogs. Conditional information; course syllabi, assignments, projects and other evidence may be required if no description exists.

Over the past decade, the ARET Department has been working directly with a number of local and regional community and technical colleges to establish articulation agreements. These agreements specify how and institutions associate degree and courses transferred directly into the ARET Program. As our ARET Online program expands, the intention will be to continue to develop such agreements with institutions all over a national and international arena.

4. ARET Curriculum

The program offered by the BSC Department of Architectural Engineering Technology has been designed to provide graduates with the technical and managerial skills necessary to enter careers in the planning, design, construction, operation or maintenance of the built environment. Graduates of the associate degree programs have strengths in their knowledge of the building, testing, operation, and maintenance of building systems and possess the ability to produce and utilize basic construction documents and perform basic analysis and design of system components. The baccalaureate degree program provides graduates that are able to analyze and design systems, specify project methods and materials, perform cost estimates and analyses, and manage technical activities in support of architectural projects. The curriculum is outlined below:

ARET Core Elements

ARET Core	(12 credit hours)
CIET Requirements	(12 credit hours)
ENGR Requirements	(6 credits hours)
General Electives	(12 credit hours)
Technical Electives	(3 credit hours)

Fifth Semester

ARET 301 Institutional Design	(4 credit hours)
ARET 205 History of Architecture	(3 credit hours)
MATH 230 Calculus II	(4 credit hours)
ENGR 313 Engineering Mechanics	(3 credit hours)

Sixth Semester

ARET 313 Applied Project Management	(3 credit hours)
ARET 306 Site Planning	(3 credit hours)
SPCH 208 Fundamentals of Speech	(3 credit hours)
ARET 316 Technical Presentations	(3 credit hours)
CIET 212 Hydraulics	(3 credit hours)

Seventh Semester

CIET 207 Soil Mechanics	(3 credit hours)
CIET 401 Adv Structural Analysis	(3 credit hours)
ENGR 315 Engineering Economics	(3 credit hours)
ENGL 201 or 205 Humanistic or Modern Traditions	(3 credit hours)
Elective	(3 credit hours)

Eighth Semester

ARET 402 Senior Design Studio	(3 credit hours)
CIET 402 Structural Steel Design	(3 credit hours)
Technical Elective	(3 credit hours)
One Social or Cultural Elective	(3 credit hours)
Art, Music, or Humanities Elective	(3 credit hours)

We may not be able to develop an online version of these courses in every instance. Therefore, we will need to initially rely on the availability of some transfer coursework in the student's area, on campus residency, or other online course to round out these requirements. Common market agreements and fee structures will need to be developed.

5. Maintaining Quality

Pairing the lessons learned from past and current online delivery schemes with our overall experiences with the ARET B.S. program, we want to address our own TAC-ABET accreditation requirements without compromise, and enhance our delivery of the program without simply creating a web-based novelty. Therefore, the requirements for successful delivery of our program will remain consistent with the TAC- ABET GENERAL CRITERIA for students and graduates as follows:

- a. an appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines,
- b. an ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering and technology,

- c. an ability to conduct, analyze and interpret experiments and apply experimental results to improve processes,
- d. an ability to apply creativity in the design of systems, components or processes appropriate to program objectives,
- e. an ability to function effectively on teams,
- f. an ability to identify, analyze and solve technical problems,
- g. an ability to communicate effectively,
- h. a recognition of the need for, and an ability to engage in lifelong learning,
- i. an ability to understand professional, ethical and social responsibilities,
- j. a respect for diversity and a knowledge of contemporary professional, societal and global issues, and
- k. a commitment to quality, timeliness, and continuous improvement.

This leads to an honest assessment of ARET Online as a web-based system for meeting the requirements above.

6. Delivery Systems

A wide variety of online programs are being offered across the nation. The courses being provided by these programs provide their students with many online features such as: registration, syllabi, course materials, schedules, class notes, online testing, document submissions, and chat rooms for discussions, FAQ pages, and grade recording. Our ARET Online program requires an additional set of elements to be successfully implemented. The program will require a means of submitting additional materials in other formats including: drawings, presentations, group projects, and graphic examinations. Drawings will be submitted, marked up for modifications and corrections, and then posted for return. Presentations will be made to an online audience of faculty, guest reviewers, and the other students in the class. The program will also need the ability to organize students into workgroups that allow them to cooperate in projects as well as working independently of other groups. Graphic examinations need to be administered utilizing an online CAD format, requiring a rudimentary CAD skill level while allowing students to solve multifaceted architectural problems. These elements combined to create a unique set of requirements for the online program. These features have yet to be developed within the CART CMS suite. However, there are existing graphic testing and rudimentary CAD systems that hold promise for inclusion in our CART CMS capabilities.

Graphic Material

TAC-ABET IIB program criteria for architectural engineering technology identifies the need for the following abilities:

II.B.2.b. Technical Specialties.

II.B.2.b. (2). Baccalaureate degree curricula must include topics in architectural design; architectural graphics; architectural detailing; computer-aided drafting; contracts and specifications; construction materials and methods; building electrical/mechanical systems, elementary structures; materials testing; estimating; architectural theory;

building environmental control systems; building codes; concrete, steel, and wood structures design; planning and scheduling; and site planning.

Drawings and other graphic materials make up a major portion of the course content assigned in four of the six required ARET courses in the BS degree curriculum. Drawings will need to be created in specific formats using standard nomenclature; titles, scales, uniform sets of symbols, and text appearance criteria. As part of the requirements of these courses, drawings will be submitted for periodic reviews. Projects submitted for these scheduled reviews will be marked-up for modifications, deletions, and corrections utilizing current Tablet PC Windows features or equivalent. Drawing files will be uploaded through the CART CMS as .DXF or .DWG format files. Drawings sets will be reviewed by the faculty member and posted on the CART CMS for return and feedback. Final drawings sets will be archived by the ARET Department and maintained as hard copy portfolio evidence on the CART CMS server.

Presentations

TAC-ABET IIB program criteria for architectural engineering technology identifies the need for the following abilities

Communications The communications content must develop the ability of graduates to 2003-2004 Criteria for Accrediting Engineering Technology Programs – Technology Criteria 2000

- a. plan, organize, prepare, and deliver effective technical reports in written, oral, and other formats appropriate to the discipline and goals of the program,
- b. incorporate communications skills throughout the technical content of the program,
- c. utilize the appropriate technical literature and use it as a principal means of staying current in their chosen technology, and

The ARET Online program will require students to compose presentations in the courses involving building design and planning. Presentations will become the tool used to describe the background, intent and solutions to design problems. Presentations will be delivered to a variety of reviewers: faculty members, guests from the A/E/C fields, and the other students in the course. The audience aspect provides some technological challenges. Presentations may be prepared using PowerPoint or other presentation software and presented in real time. Other formats, such as streaming video and web-cam broadcasts are possible; however the development and transmission software needs to be available to all students. New technology may soon emerge that provides better opportunities for completing this task.

Workgroups

TAC-ABET Criteria Program for architectural engineering technology identifies the need for the following abilities:

Communications The communications content must develop the ability of graduates to

- d. utilizes the interpersonal skills required to work effectively in teams.

Course work in the ARET Online program will involve projects assigned to student groups described above. Developing and maintaining teams in online format course will pose the most problematic set of challenges. Program courses will use existing CART CMS “chat rooms” and forum technology and newly emerging conferencing software to allow collaboration between group members. Software features will establish communications parameters between members of individual groups, while providing security via password from viewing by other nonmember students.

Online graphic testing

The ARET Online program poses a situation that will require an innovative solution to the online testing challenge. The design courses in the program will require a series of real-time graphic examinations to measure skills and knowledge of course materials. The graphic exams will use a vignette format, solving limited scope design problems in a set amount of time. The graphic exams will be posted on the CART CMS specific to ARET Online. Each student will generate a solution to the vignette utilizing an internal, limited scope CAD program. No additional software will be required. AutoDesk, Inc. and Educational Testing Services (ETS) have devised such a CAD system and the program is working on acquiring a licensed version for use within our CMS. The exam solutions will be stored on site for retrieval and grading by the instructor. Graded exam results are then posted for student review.

7. System Resource Requirements

In order to successfully run the CART CMS the student will need Windows® 2000, XP or Tablet PC XP and for best performance we recommend:

- Pentium III processor or greater equivalent
- Windows 2000® or XP
- Microsoft Office 2000®
- Microsoft Word®
- PowerPoint®
- Microsoft Excel® (for selected courses)
- Microsoft Access® (for selected courses)
- Microsoft Project 98 ® or 2000® (for selected courses)
- Microsoft Visio 5.0 ® or later (for selected courses)
- A current anti-virus application
- 512 MB RAM or greater
- 20 GB hard drive or larger
- DSL or cable modem
- 1024x768 or greater monitor and video card
- Sound card with speakers

- CD ROM
- Inkjet or laser printer
- E-mail address
- Internet service provider (ISP) account
- Microsoft Internet Explorer Version 6.0 or later

8. Tuition and Fee Structure

The anticipated fee structure for online courses will be \$110 per credit hour. An additional \$10 per credit hour fee will be imposed as a web-based instruction fee for ARET courses will be assessed a \$35 electronic access fee. These costs will defray the cost of instruction; instructor salaries, and benefits, courseware development, server security and system maintenance. These cost figures were established through a combination of informal market research of other online programs across the country and are consistent with current BSC tuition and fees. The table below summarizes these costs and fees:

Type of Fee	Amount	Payment Due
Application Fee	\$100	At time of application.
Undergraduate	\$110 per credit hour	At time of course registration
Web-based Instruction	\$10 per credit hour	At time of course registration
Electronic Access Fee	\$35	At time of course registration
Late Payment Fee	\$30	Upon notification.
Graduation Audit Fee	\$100	When an application for graduation is submitted.

9. Conclusion

We have learned through our experiences with other CMS's that controlling the organization of the site and updating the material without becoming HTML programmers is the most important concept in creating a living and lasting online curriculum. Therefore, we needed to develop our own CMS through CART to take advantage of an open architecture PEARL-based system that could be customized to perform consistent to our own requirements. The website at www.cartlink.org is continually evolving to respond to the increasing requirements as they arise. The basic philosophy is that no one can simply put an instructor's course on the web for them, then stand back and watch it perform. Conversely, instructors will be more than reluctant to use a CMS that requires that person to become a programmer. Therefore, CART CMS was designed to require a limited set of instructor proficiencies used in the current office setting.

For example, instructors upload course materials that were created in familiar software rather than learning in a one-time, single point-of-use environment that is, all too often, subsequently replaced by still another unique software. Working within the standard Office suites encourages faculty to continue developing course materials consistent with existing resources. If we are able to complete the development of a graphic testing module, and enhancements to our drawing file exchange, then we should be able to both maintain an acceptable comfort level, while creating

the “red line” markup capabilities vital to graphic communication in any architectural engineering technology program. Tablet PC operating systems could provide a universal grading by markup capability without the need for additional software. The instructor would markup the student posted assignment on screen, then repost for student review of grades. The graphic testing module will essentially operate as a simplified CAD template populated by symbols limited to the appropriate subject.

In a general sense, recent results of student satisfaction surveys have highlighted both the strengths and weaknesses of their online experiences. We will have to overcome several conditions in order to better provide an online curriculum.

- Students sometimes enroll in online courses as a “catch all” solution because of scheduling conflicts with other courses, work, etc. They may lack web experience, computer skills, or the even the self-motivation required for success. We do not want students to take these courses because nothing else would fit.
- The quality of previous online experiences may lead the student to believe the myth that these courses do not require as much of their time or lack rigor. We are developing a “Student Responsiveness Policy” to replace our “Attendance Policy” in response to this wide variance in quality of experience. We want both the expectations of the students and the faculty to match.
- The development of a well-designed and tested web course orientation, mini-training program, and a *CART CMS 2.0 Student Guide* for first time online student could become a key factor in their success and satisfaction with the program.
- The web-based curriculum will require a full-time web technician to provide trouble shooting assistance to the students, faculty, and the CART CMS web master, and requires release time to faculty members for design, development and testing. We want the program to continue running smoothly while experiencing growth and development.
- We envision our web-based program serving 100 ARET students in a national and international setting within the near future. A targeted web-based marketing plan must be devised to attract the proper number of students with the proper background for success. We should partner with a variety of other institutions and organizations where common student serving interests exists.

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