An Electronic Web-based Assessment System

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Abstract

In keeping with the outcome-based assessment outlined by ABET's Education Criteria 2000, the School of Engineering at the University of Bridgeport has defined fifteen general student outcomes for its computer engineering program. These outcomes form the basis of its instructional program and assessment activities. In assessing and monitoring the attainment of these outcomes, formal assessment tools such as test and quizzes as well as assignment and project reports prove to be major indicators. This study is an attempt to perform the assessment process using the Internet and its capabilities. At the heart of the assessment process lies the assurance of a quality educational experience and the commitment to continued program improvement on part of the faculty and administration. Presented in the paper is a new technique for presentation of relevant materials for accreditation under ABET criteria for Engineering program. The course materials from all courses offered in Fall 2002 and Spring 2003 are gathered and organized into separate course websites. Our electronic assessment (e-assessment) system (http://assesseng.bridgeport.edu/) is designed and implemented such that it streamlines program improvement and allows the assessment evaluator to browse in a logical and convenient manner starting from the program objectives and outcomes to specific course materials where they are implemented. Program constituents such as the students, faculty, industry advisory board and alumni are also involved in the process. The achievement of the program outcomes and objectives is the underlying goal of the assessment process. The process also proves to be a tool to identify areas of weaknesses in the program. In this paper, the focus is on the program outcomes and how they are achieved at the course level.

1. Introduction

The Accreditation Board for Engineering and Technology (ABET) is a professional accrediting organization that accredits applied science, computing, engineering, and technology educational programs [4]. The entire process of assessment revolves around program improvement with accreditation signifying the commitment of an institution towards this ultimate goal. ABET promotes quality and innovation in education, assures quality and stimulates innovation in applied science, computing, engineering, and technology education [4].

The awarding of accreditation signifies that the accredited program of education has met Commission standards and is willing to both maintain those standards and improve its educational program by implementing the recommendations in the accreditation report. The accreditation is valuable not only to the institution and its faculty but also to the students [4]. The value of the accreditation for faculty members is the enjoyment and professional pride of teaching courses of an accredited program. Accreditation provides both a personal and professional opportunity to work towards educational improvement. The evaluation experience affords the opportunity for the administration and faculty to conduct and to receive a rigorous analysis of present conditions so that needed changes may be carefully planned.

Students are most affected by accreditation since they are the central focus of the educational process. Accreditation assures them that their needs are being met through a quality educational program and that their preparation reaches high levels. It also assures them that prestigious institutions will more likely accept their transfer credits and their degree will be a tool for finding a good job and for personal development. The accreditation also increases their confidence in their educational program and teachers, and their attitude toward academic work. The CpE program accreditation indicates that the program prepares students for entry into the profession. The ABET accreditation criteria [Appendix A] are developed by engineering professionals from both industry and education which allows the education to truly meet the demands of the engineering profession, ultimately preparing students for greater success [4].

In the United States, the Accreditation Board for Engineering and Technology (ABET) is responsible for accrediting over 2300 engineering, engineering technology and engineering-related programs at some 500 institutions. Engineering programs accredited by ABET prepare students for a profession in which a knowledge of mathematical and natural sciences gained by study and practice is applied to the materials and forces of nature to benefit mankind. Engineering technology programs prepare students for a technologist or technician position that requires the application of scientific and engineering knowledge combined with technical skills that support engineering activities [4].

The Computer Engineering Program of the School of Engineering of the University of Bridgeport is one of the programs accredited by ABET since 1989. A new goal of the School of Engineering is to obtain CSAB accreditation for the first time for the Computer Science Program of the school and continue the ABET accreditation that it already has.

The School of Engineering had requested evaluation of its CpE and CS programs and had completed the internal review of each one of them, which entailed examining the program's students, curriculum, faculty, administration, facilities and institutional support. In this paper, we focus on the CpE program. To meet the requirements of the outcome-based assessment outlined by ABET's EC2000, the School of Engineering of the University of Bridgeport has defined its objectives and fifteen related general student outcomes [Appendix B]. Formal assessment tools such as tests and quizzes as well as assignment and project reports demonstrate the level at which the criteria and educational objectives are being met. At the time of the revision of this paper, the successful outcome of the ABET visit had been received and the requested interim report submitted.

2. School of Engineering Goals

One of the strengths of the American educational system is the diversity of educational programs. Such a large selection of educational offerings makes quality a vital issue. Accreditation is the quality assurance that education is meeting minimum standards. In the United States, accreditation is a non-governmental, peer review process that ensures educational quality. Educational programs volunteer to periodically undergo this review to determine if minimum criteria are being met. Accreditation verifies that a program meets the criteria, ensuring a quality educational experience. The School of Engineering at the University of Bridgeport, in line with its commitment towards continuous program improvement to ensure quality education, has regularly volunteered to undergo the review since 1989. In keeping with the EC 2000 criteria, the school defined its mission and objectives. Below are some of the goals of the School of Engineering, which guided the preparation for the accreditation process in Fall 2003.

- The prepared educational objectives should be comprehensive, measurable and flexible, and clearly tied to the mission. The objectives have to be systematically reviewed and updated.
- Outcomes assessment requires definition of all outcomes, systematic evaluation and process improvement and involvement of all support areas. The common sources of problems should be understood and eliminated.
- Assessment constituents have to show a high degree of involvement in defining the objectives and desired outcomes. They should present sustained evidence of strategic partnerships with all key components.
- Processes should assure not only continuous quality improvement but also that minimum standards are met for all elements of the criteria. The processes have to be clearly understood and controlled. They should be tied to the mission, the program objectives, and the constituents' needs. The processes should be generally viewed as benchmarks by other institutions.
- Results of the course work should cover world-class outcomes. They should be clearly caused by a systematic approach.
- The assessment presentation system should be highly integrated and deployed throughout the program, school, and institution. It has to be driven by mission and objectives. [5]

3. Methodology

3.1 Components Collection

The ABET accreditation process of School of Engineering of the University of Bridgeport was started with the evaluation request of its Computer Engineering program. An internal review was completed for the program that examined the program's students, curriculum, faculty, administration, facilities and institutional support. The assessment process followed by the department can be outlined by the following

major steps:

I. Develop a mission statement and program objectives for our undergraduate program in computer engineering that defines our purpose for existing as a program. The mission statement and educational objectives are developed in concert with our core constituents of students, faculty, industrial representatives and alumni.
II. Develop educational outcomes that are consistent with the achievement of our objectives and the fulfillment of our mission.
III. Devise quantitative metrics and processes for measuring our outcomes and ensure that we are succeeding in our mission.
IV. Use the processes we have put in place to gather quantitative assessment data relating to our metrics at regular intervals.
V. Based on the assessment data, modify our curriculum with the goal of better fulfilling our mission and objectives.
VI. Identify the strengths and weaknesses of our curriculum, processes, metrics, and objectives. Start again at step IV, or at step III if we feel that the metrics or processes need to be improved, or, even at step I if the fundamental mission or objectives of our program need to change.

The required components (fig.1) consist of a Mission Statement, program objectives and outcomes defined to match the ABET criteria, courses vs. outcomes matrix that illustrates where in the curriculum the outcomes are being met and at what level, course grids and representative student work samples from assignments, projects, exams and quizzes that reflect the collected data. The outcomes versus ABET criteria grids further map the outcomes to the ABET criteria and assist in closing the assessment loop.

3.1.1. Mission Statement

One of the most general but also most important components is the institution Mission Statement. In a few paragraphs it generally describes the goals and mission of the institution and the value it can bring to potential students. Below is the mission statement of the School of Engineering of the University of Bridgeport:

"The School of Engineering of the University of Bridgeport provides educational opportunities and serves as a knowledge resource in the sciences, engineering and technology. Our clients are students, the companies that hire them, and various other institutions in Bridgeport and the surrounding region, the United States, and all parts of the world.

Our Programs are designed with attention to the institutions we serve. The education we offer features acquisition of fundamental knowledge in a wide range of fields and an application oriented approach to issues that are progressively more interdisciplinary.

Graduates of our program possess broad knowledge, professional training, and learning skills that enable their success in an evolving global economy and allow for the betterment of the communities in which they live."

Dr. Tarek Sobh,
Dean of the School of Engineering

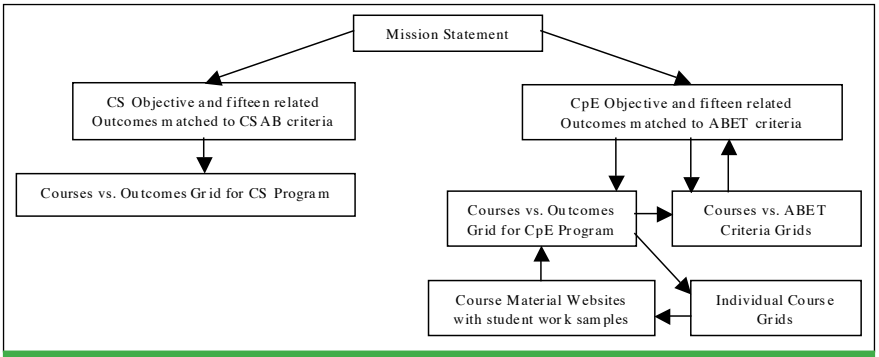


Fig. 1 - Required components for Accreditation process

3.1.2. Student Oriented Objectives

Program objectives are a more concrete definition of the School goals and mission. While the Mission statement is valid for the institution, the Student Oriented Objectives are defined for each of the programs within this institution. Below you can see the four objectives of the Computer Engineering Program of the School of Engineering:

1. *Students will be proficient in designing hardware, software and a variety of computer-controlled engineering systems. (Program Outcomes 1,2,3,4,5)*
2. *Students will develop an understanding of contemporary global and societal issues, ethical considerations and communication skills, both oral and written. (Program Outcomes 8,11,12)*
3. *Student will develop abilities in applying mathematical and scientific tools to solve engineering problems. (Program Outcomes 6,7,9,10)*
4. *Students will develop skills that will prepare them for employment upon graduation and the ability to undertake life-long learning. (Program Outcomes 13,14,15)*

The ABET visit feedback provided the department with helpful pointers to improve its metrics and processes for assessing achievement of program objectives. At the time the paper was revised, the department uses the feedback from the curriculum development committee, the industrial advisory board (IAB), the course assessment committee, students and alumni to evaluate the various program objectives.

The curriculum development committee is the main committee that reviews the feedback from the latter four constituents, reviews the results and recommends actions for program improvement. The IAB reviews participation in sponsored internships, regional and national competitions and evaluates co-op performance. The course assessment committee is comprised of the department faculty and reviews the data collected in lieu of the program outcomes and uses that to evaluate the program objectives. Student and alumni survey results serve as a secondary measure in the assessment process. The e-assessment system serves as a user-friendly portal of this information.

The e-assessment system was developed by the department in answer to its need for a robust system that is seamlessly integrated with the program and its assessment activities. Few assessment software packages were available at the time. EnableOA [1], TrueOutcomes [3] and eLumen [6] were three such software packages; however, the fact that not many institutions had adopted them at the time along with the associated costs including faculty training prevented the department from adopting them. Another group of researchers from five different universities were developing and applying a variety of assessment methods administered either via the web or PC to form a core of what they termed the "Assessment Toolkit" [2]. Again, this was a pilot study that was yet to mature. Hence, the department went ahead with the design and development of the e-assessment system that is being described in this paper.

3.1.3. Student Oriented Outcomes

The School of Engineering has defined fifteen student outcomes for the Computer Engineering program that covers all ABET criteria [Appendix A]. The listing of these outcomes can be found in Appendix B. The tools described in the following two sections help in mapping the courses with the outcomes and ABET criteria. The discussion of the assessment process for the program outcomes is thus, included after these sections.

3.1.4. Courses vs. Outcomes Grids

The Courses versus Outcomes Grids [Appendix C] were developed for both programs with material gathered from the faculty members teaching each of the courses. The grids list the program course requirements and describe at what level each of the fifteen student outcomes is met in each course. Depending on the level a particular outcome is achieved in a given course, the level is indicated by B (for Beginner), D (for Developing) and P (for Proficient).

3.1.5. Outcomes vs. ABET Criteria Grids

Two versions of the said grid have been prepared. The first one [Appendix D] was developed as a mapping between the program outcomes and the ABET criteria. The second is a more detailed version where the individual courses which form the intersection of the two axes are listed (http://assesseng.bridgeport.edu/grids.htm). At the time of the visit, the department learned that since a large number of courses mapped to each outcome, a representative number of courses could be used to verify each outcome. This representative listing illustrates where the data will be gathered. Mostly required courses are used as all students are guaranteed to take them. Also, the chosen courses show a progression from beginning to proficient accomplishment of each outcome.

Having chosen the courses from which the data would be collected, the next task was to determine what data would be collected. This is decided by the course instructors of the chosen courses for each outcome. Potential measures could include things such as programming projects/lab reports/project reports, exams/quizzes, evaluation of presentations, evaluation of written reports, grades in general education courses. The course instructors are responsible to provide the necessary deliverables along with a summary assessment. Strengths and weaknesses are identified and recommended solutions developed. Student and alumni surveys are used to collect data that serves as a secondary measure for assessing achievement of course outcomes based on established rubrics.

As mentioned earlier, the e-assessment system provides a convenient portal to present the collected data and the following components are representative of the same.

3.1.6. Course Grids

The contents of an individual course grid match each outcome applicable for the course with the class activities that satisfy it and the

ABET criteria that this particular outcome covers. The course grids describe course Outcomes, Performance Indicators, Strategies and Actions, Assessment Methods and Metrics, Evaluation and Feedback. Some sample course grids are listed in Appendix E.

3.1.7. Course Material Websites

All applicable course material was gathered for each course in the Computer Engineering and Computer Science programs including courses from other Schools of the University of Bridgeport, for example, the School of Arts and Sciences. The gathered material is from courses taught in the Fall 2002 and Spring 2003 semesters.

A detailed example showing how each of the individual components is connected to the other components in the e-assessment system follows in the next section of this paper.

The authors of the paper had the full cooperation of the faculty members and received all the materials requested.

3.2 Technical Implementation

3.2.1. Architecture of the E-Assessment System

The School of Engineering Assessment website (http://assesseng.bridgeport.edu/) is an interface for the ABET accreditation visit in Fall 2003. The website consists of an Assessment Presentation Website and Courses Material Websites for each of the School of Engineering courses as well as courses from other schools that are included in the Computer Science and Computer Engineering programs.

The function of the Assessment System is to present to the accreditation evaluator with the various components highlighting their interrelatedness. The gathered student samples include but are not limited to: exams and quizzes as well as assignments and project reports. Additionally, course lectures and presentation material is gathered from the courses instructors. Also, available on the website are the survey forms and the gathered results.

The system implementation allows the assessment evaluator to browse in a logical and convenient manner, starting from the objectives and outcomes to specific course materials where they are being met. The process also includes browsing the course versus outcomes matrix and individual course grids.

3.2.2. Assessment Website (Interface to the System)

Figure 2 shows the outlook of the assessment website interface.

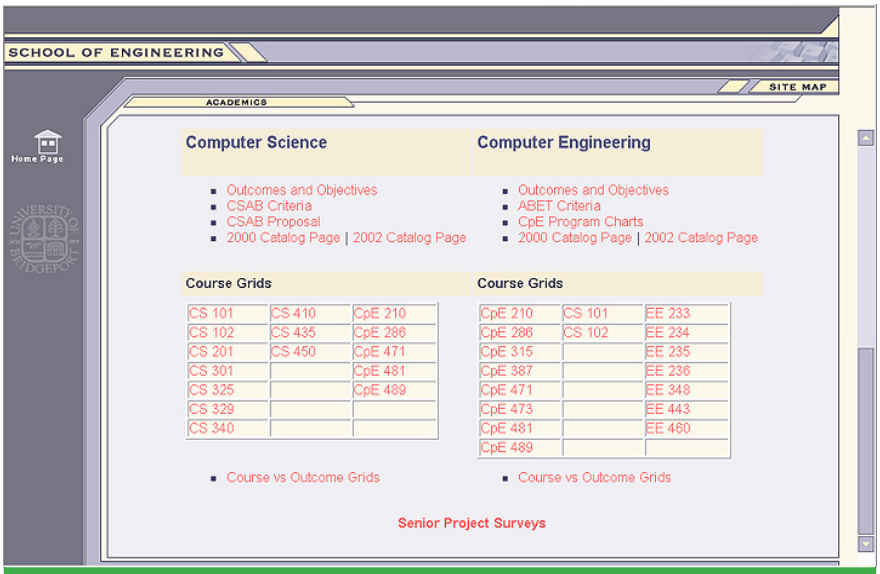


Fig. 2 – The general outlook of the Assessment Website of School of Engineering

3.2.2.1. Website Content

Figure 3 shows the structure of the assessment website.

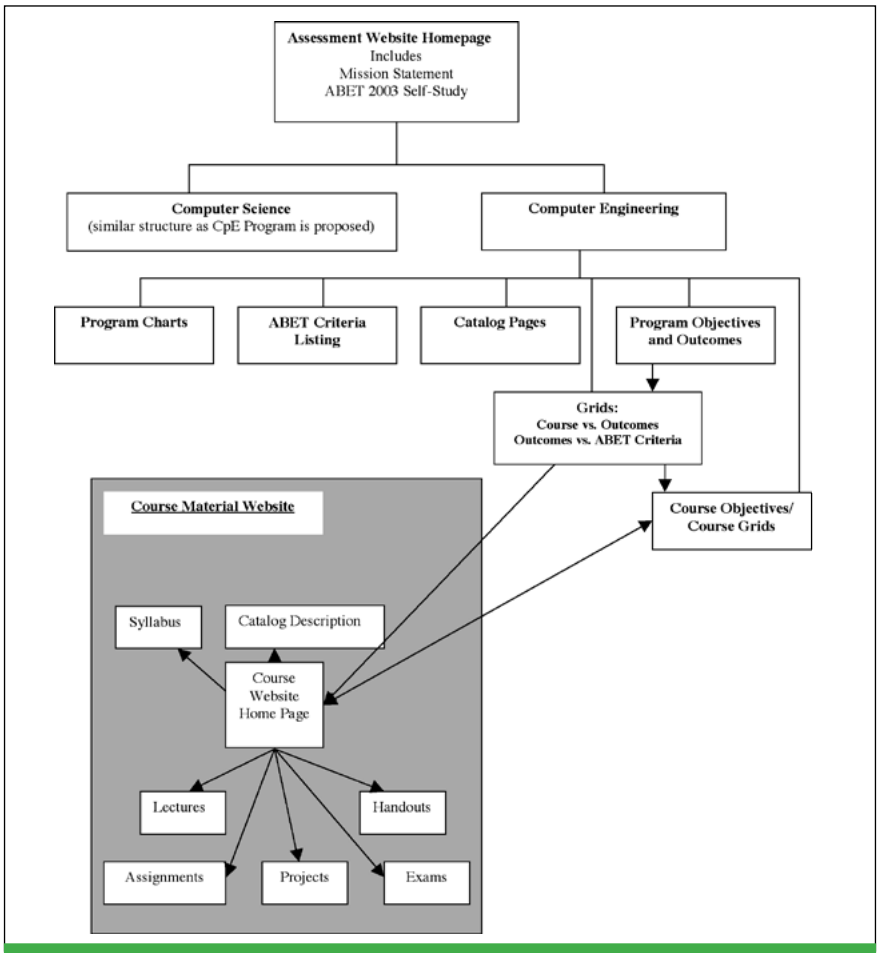


Fig. 3 – Structure of the Assessment Website

Figure 4 shows the Outcomes and Objectives page that displays the list of the fifteen outcomes defined by the School of Engineering of the University of Bridgeport.

The user can select any outcome from the Outcomes and Objective page. If the user selects Outcome 7, then the Course vs. Outcomes grid is displayed with the Outcome 7 highlighted as shown in Figure 5. Thus, the user can see which course leads to the achievement of the particular outcome and at what level. In Figure 5, for example, one can observe that Engr 111 achieves the outcome at a Beginners level while Engr 300 meets it at a proficient level. Likewise, each of the outcomes is dynamically linked to courses vs. outcomes grid.

The Courses vs. Outcomes grid displays a matrix of all the courses from the Computer Engineering (Computer Science) program versus the fifteen outcomes for this program as defined by School of Engineering. In each cell is placed the level with which the outcome is covered in the class:

- "B" – Beginner Level
- "D" – Developer Level
- "P" – Professional Level
- "-" – Non Applicable for the course

The letters are linked to the Course Grid for the course they describe. In the current example, the letter "B" from Outcome 11 for the course CS101/101a will link to two pages as shown in Figures 6 and 7.

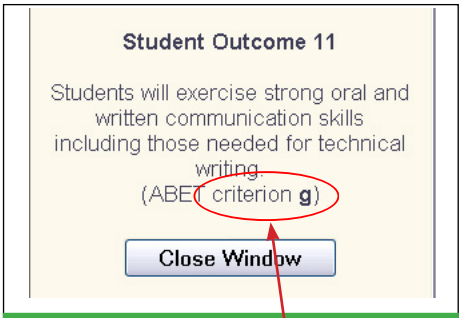


Fig. 6 – Screenshot of an Outcome description

The chosen Outcome description is displayed in a pop-up page as a reminder for the accreditation evaluator. The ABET (CSAB) criteria connected to the outcome (in this case "g") should appear in the list of all ABET (CSAB) criteria applicable for the course. They are listed on the top of the second page that opens - the course grid page as shown in Figure 7.

Some of the indicators that students achieve each of the course outcomes are not assessable (for example answering questions in class, reading assignments, etc.) but the collectable

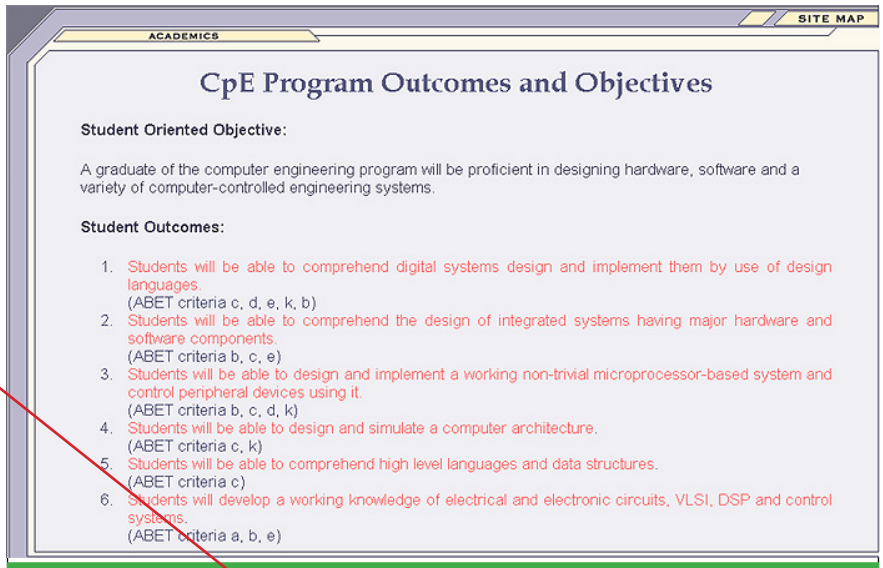


Fig. 4 – Screenshot of the CpE Outcomes and Objectives Page

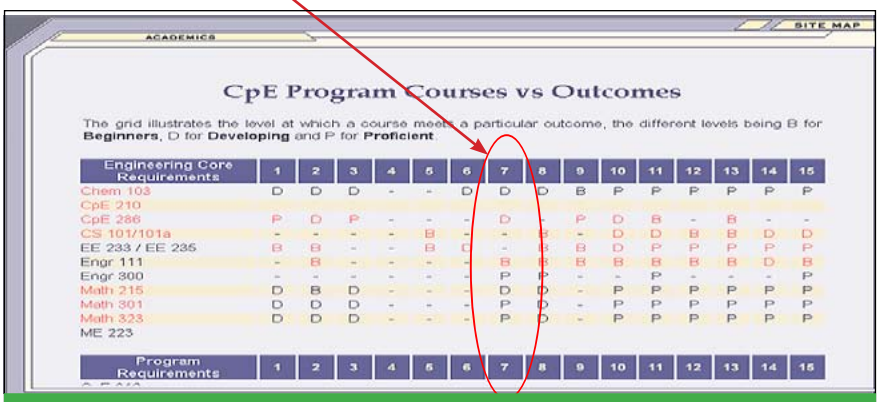


Fig. 5 – Screenshot of the CpE Courses vs. Outcomes Grid Page

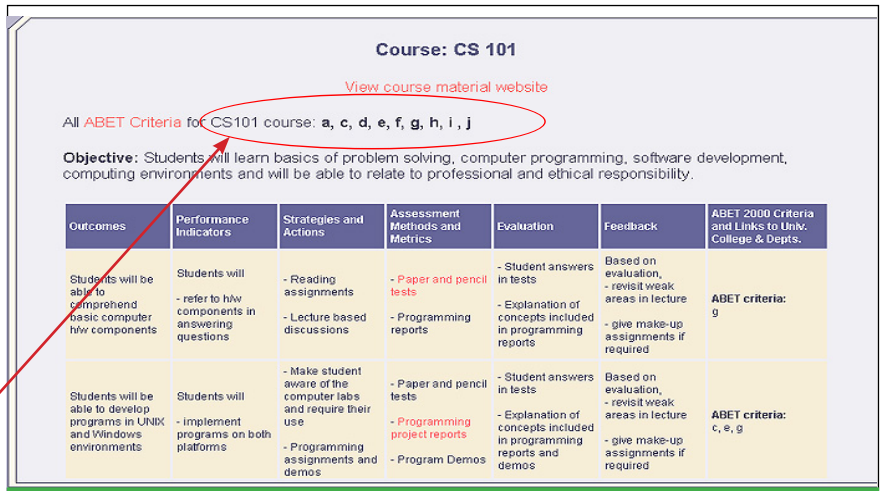


Fig. 7 – Screenshot of a Course Grid Page

materials (quizzes, tests, exams, assignments, projects, etc.) is organized and evaluated in accordance with the assessment process.

In the current example, the link "Paper and Pencil Tests" will lead the inspector to the fol-

lowing page with certain written tests or quizzes which include questions and tasks evaluating the first outcome as shown in Figure 8.

The accreditation evaluator can further check the test assignment, listed questions, as well as the student work samples for this test. Similarly the link "Programming Project Reports" for Outcome 2 will open a page listing all programming assignments that validate this outcome as shown in Figure 9.

The above example demonstrates the logical path from what is stated to where it is achieved in the program. This can be utilized both by the department as well as the accreditors to assess the program by monitoring if the said outcomes have been met in a satisfactory manner. Another point of interest is to ascertain if the ABET criteria has been met in the curriculum. The aforesaid data can be used to that purpose by using the Outcomes versus ABET criteria grids. Figure 10 shows the compact version of the two grids. Here, for example, if outcomes 6, 7 and 10 have been successfully achieved, ABET criteria 'a' can be claimed to have been attained.

Other than being part of the outcomes based assessment, the evaluator can browse the complete course contents (accessible via the "View course material Website" link) that are organized into separate websites.

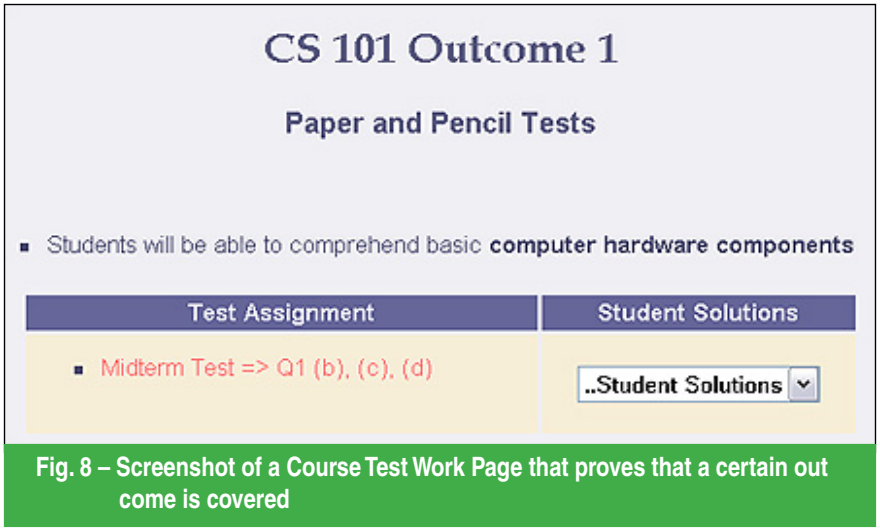


Fig. 8 – Screenshot of a Course Test Work Page that proves that a certain out come is covered

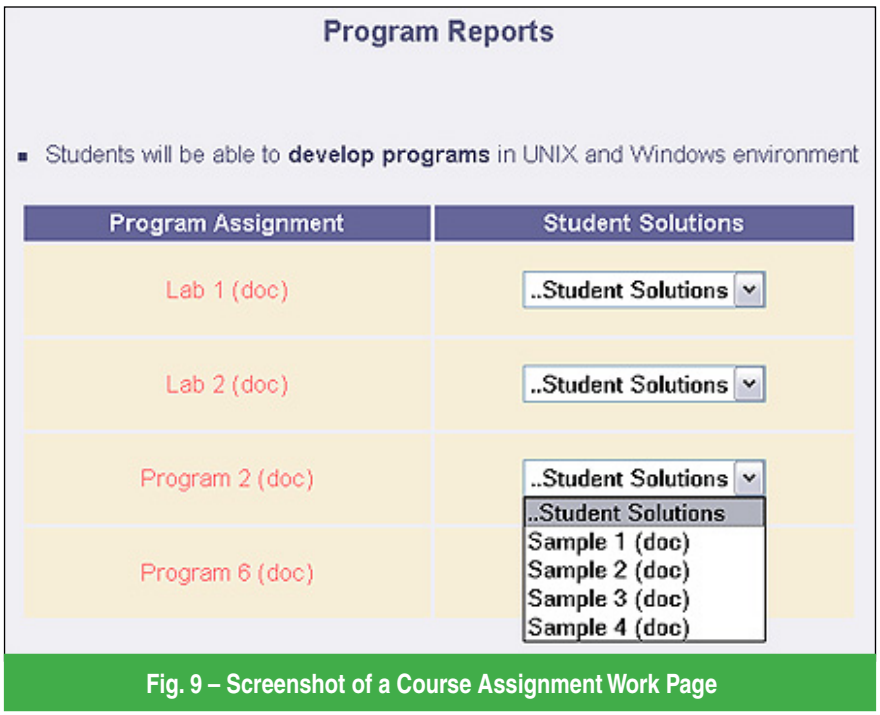
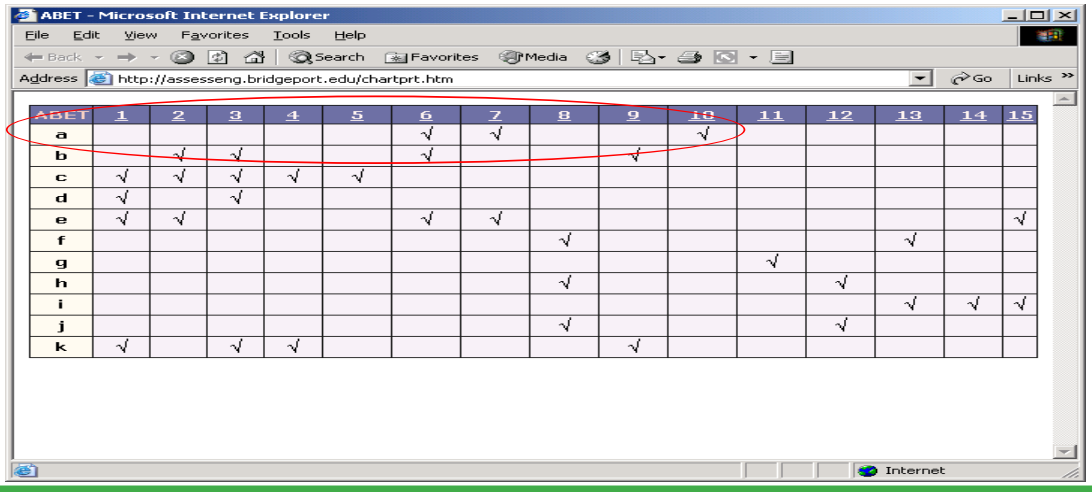


Fig. 9 – Screenshot of a Course Assignment Work Page



ABET	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
a						√	√			√					
b		√	√			√			√						
c	√	√	√	√	√										
d	√		√												
e	√	√				√	√								√
f								√					√		
g											√				
h								√				√			
i													√	√	√
j								√				√			
k	√		√	√					√						

Fig. 10 – Screenshot of Outcomes versus ABET Criteria Grid

3.2.3. Course Material Websites

Figure 11 shows a sample view from the main page of one of the course material websites (CS 102, in this case):

The particular course material is decided in advance by the course instructor and each website is built accordingly. The full set of pages would include Projects, Assignments, Exams, Quizzes, Lectures and Handouts pages. The course Syllabus and Objective are also part of the content. Student sample material can be found in all applicable pages (assignments, projects, exams, quizzes). Figure 12 shows a screen shot of the assignments page.

The authors are happy to report that this tool was cited as a strength by ABET evaluators during their Fall 2003 visit.

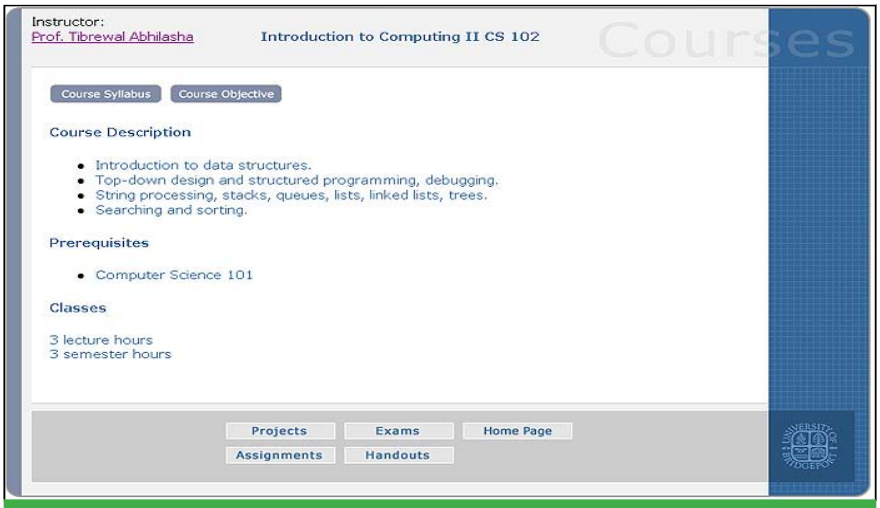


Fig. 11 – Screenshot with the general outlook of a Course Material Website

3.2.4. Hardware and Software Used

The system was implemented using the following software:

- Macromedia Dreamweaver MX
- Adobe Photoshop 7.0
- Microsoft Office XP (MS Word, MS PowerPoint, MS Excel)
- Adobe Acrobat 5.0

The Assessment website is best viewed with Internet Explorer 5+. The course content websites require an installed Acrobat Reader 5.0, MS Word and MS PowerPoint for the student work samples preview.

The system was developed and tested on Windows 2000/NT/XP platforms. It is hosted on an Apache Web server.

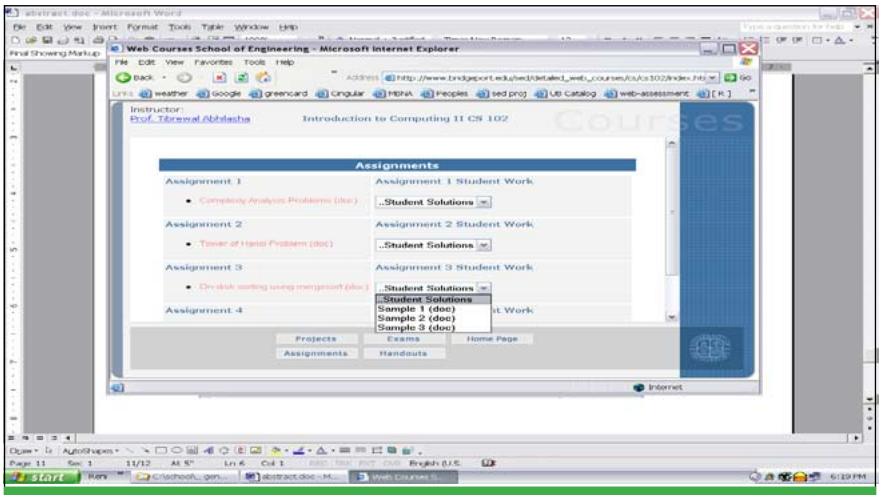


Fig. 12 – Screenshot of the Assignments Page

3.2.5. Privacy and Security

The folder with student sample materials and courses websites on the server is protected by password and only faculty members are able to access it for review purposes. Unauthorized individuals could not access any file in this folder. The files were stored on the University of Bridgeport Apache web server machine that also has very limited access (only the System Administrator and the Webmaster).

The primary author of the paper was the only individual to add and edit in the Course Material Websites as well as the Assessment Website. All course materials are posted as received from the courses' instructors. No student work was exposed in any way to external individuals or used for other purposes but to build the online e-assessment system.

4. Conclusion

This paper presents the School of Engineering of University of Bridgeport's work towards the accreditation visit in the fall of 2003. One goal of the paper is to present the comprehensive, measurable and flexible educational objectives and outcomes as well as their systematic evaluation process.

Another goal of the paper is to describe a new technique for presentation of assessment material for accreditation by ABET and CSAB Criteria for Engineering and Computer Science programs. The e-assessment presentation system is highly integrated and deployed throughout the CS and CpE programs and clearly driven by the School of Engineering outcomes and objectives.

The developed system is to be systematically reviewed and updated to ensure a com-

plete and realistic reflection of the quality of education in the CS and CpE programs of the School of Engineering. It will allow the faculty and instructors to control and evaluate their own teaching techniques and improve the system of education.

The mission of the complete e-assessment system is not only to serve as a presentation tool of the CS and CpE educational programs, but also to be generally viewed as a benchmark by other institutions and programs.

5. References

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10. Council on Higher Education Accreditation: http://www.chea.org/
11. List of CSAB accredited programs: http://www.csab.org/acrsch_jnt.html
12. List of ABET accredited programs: http://www.abet.org/accredited_programs/EAC-Website.html

6. Appendices

Appendix A – ABET Criteria

ABET Criteria

- a - apply math, science and engineering principles
- b - design and conduct experiments
- c - design a system, comp. or process
- d - function in teams
- e - solve engineering problems
- f - be professional and ethical
- g - communicate effectively
- h - understand global and societal impact
- i - learn life-long
- j - understand contemporary issues
- k - use modern engineering tools

Appendix B – School of Engineering Objectives and Outcomes

Computer Engineering Program

Student Oriented Objective:

1. Students will be proficient in designing hardware, software and a variety of computer-controlled engineering systems. (Program Outcomes 1,2,3,4,5)
2. Students will develop an understanding of contemporary global and societal issues, ethical considerations and communication skills, both oral and written. (Program Outcomes 8,11,12)
3. Student will develop abilities in applying mathematical and scientific tools to solve engineering problems. (Program Outcomes 6,7,9,10)
4. Students will develop skills that will prepare them for employment upon graduation and the ability to undertake life-long learning. (Program Outcomes 13,14,15)

Student Outcomes:

1. Students will be able to comprehend digtal systems design and implement them by use of design languages. [ABET criteria c, d, e, k, b]
2. Students will be able to comprehend the design of integrated systems having major hardware and software components. [ABET criteria b, c, e]
3. Students will be able to design and implement a working non-trivial microprocessor-based system and control peripheral devices using it. [ABET criteria b, c, d, k]
4. Students will be able to design and simulate computer architecture. [ABET criteria c, k]
5. Students will be able to comprehend high level languages and data structures. [ABET criteria c]
6. Students will develop a working knowledge of electrical and electronic circuits, VLSI, DSP and control systems. [ABET criteria a, b, e]
7. Students will be able to identify and apply concepts of engineering economics and project planning. [ABET criteria a, e]
8. Students will demonstrate knowledge of contemporary global and societal issues and their relationship to professional ethics and engineering solutions. [ABET criteria f, h, j]
9. Students will be able to plan and conduct laboratory experiments and interpret and report the results. [ABET criteria b, k]
10. Students will demonstrate basic math and science skills. [ABET criterion a]
11. Students will exercise strong oral and written communication skills including those needed for technical writing. [ABET criterion g]
12. Students will develop appreciation of diversity in the world and in intellectual areas such as but no limited to humanities and social sciences. [ABET criteria h, j]
13. Students will be able to function competently in a related entry-level career. [ABET criteria i, f]
14. Students will show the desire and ability to keep learning throughout life. [ABET criterion i]
15. Students will develop the cognitive and analytical skills needed to succeed in graduate programs. [ABET criteria i, e]

Appendix C – Courses vs. Outcomes Grids

Computer Engineering Program Courses vs. Outcomes grid:

Courses	Outcome														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Core Requirements															
Chem 103	D	D	D	-	-	D	D	D	B	P	P	P	P	P	P
CpE 210															
CpE 286	P	D	P	-	-	-	D	-	P	D	B	-	B	-	-
CS 101/101a	-	-	-	-	B	-	-	B	-	D	D	B	B	D	D
EE 233/235	B	B	-	-	B	D	-	B	B	D	P	P	P	P	P
Engr 111	-	B	-	-	-	-	B	B	B	B	B	B	B	D	B
Engr 300	-	-	-	-	-	-	P	P	-	-	P	-	-	-	P
Math 215	D	B	D	-	-	-	D	D	-	P	P	P	P	P	P
Math 301	D	D	D	-	-	-	P	D	-	P	P	P	P	P	P
Math 323	D	D	D	-	-	-	P	D	-	P	P	P	P	P	P
ME 223															
Program Requirements															
CpE 312															
CpE 315															
CpE 387															
CpE 408	-	P	-	-	D	-	-	-	D	-	D	-	-	-	P
CpE 447															
CpE 448															
CpE 449A,B															
CpE 489	-	B	-	-	P	-	P	D	P	P	P	D	P	P	P
CS 102/102a	-	-	-	-	D	-	-	-	B	D	D	B	B	D	D
CS 227	D	D	D	B	D	-	D	D	-	P	P	P	P	P	P
EE 234/236	B	B	B	B	D	P	B	D	D	P	P	P	P	P	P
EE 348	D	D	D	D	P	P	D	P	P	P	P	P	P	P	P
Program Requirements (Contd.)															
EE 460	P	P	D	P	P	P	P	P	P	P	P	P	P	P	P
EE 443	P	P	D	P	P	P	P	P	P	P	P	P	P	P	P
Engl 204															
Math 214/314	D	D	D	B	-	-	P	D	-	P	P	P	P	P	P
2 Technical Electives															
1 Free Elective															
General Education Requirements															
Engl C101	-	-	-	-	-	-	-	B	B	-	B	B	B	B	B
Math 110	D	B	D	-	-	-	D	D	-	B	D	D	D	P	D
Math 112	D	B	D	-	-	-	D	D	-	D	P	D	P	P	P
Phys 111	D	D	D	-	-	D	D	D	B	D	P	P	P	P	P
Phys 112	D	D	D	-	-	D	D	D	D	D	P	P	P	P	P
Hum C201	-	-	-	-	-	-	-	D	-	-	D	P	B	B	D
Hum C202	-	-	-	-	-	-	-	D	-	-	D	P	B	B	D
SoSc C201	-	-	-	-	-	-	-	D	D	-	D	P	B	B	D
SoSc C202	-	-	-	-	-	-	-	D	D	-	D	P	B	B	D
IntSt C101															
A&D C101	-	-	-	-	-	-	-	D	-	-	B	B	B	B	B
Caps C390	-	-	-	-	-	-	-	D	-	-	P	P	D	B	D
Choice of Technical Electives															
CpE 410															
CpE 460	-	P	D	-	-	P	-	-	P	-	D	-	-	-	P
CpE 471															
CpE 473	-	-	-	-	-	-	D	-	-	B	B	-	D	-	-

Appendix D – Outcomes vs. ABET Criteria Grid

ABET Criteria	Program Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
a						✓	✓			✓					
b		✓	✓			✓			✓						
c	✓	✓	✓	✓	✓										
d	✓		✓												
e	✓	✓				✓	✓								✓
f								✓					✓		
g											✓				
h								✓				✓			
i													✓	✓	✓
j								✓				✓			
k	✓		✓	✓					✓						

Outcomes vs. ABET criteria (Detailed)
Here, the expanded view of the second row is depicted. For the complete grid please refer to
http://assesseng.bridgeport.edu/grids.htm.

ABET Criteria	Program Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
b		CPE 286 (D) ENGR 111 (B) CPE 315 (D) CPE 387 (P) CPE 408 (P) CPE 447 (D) CPE 449 (P) CPE 489 (B) CPE 460 (P)	CPE 286 (P) CPE 387 (P) CPE 447 (D) CPE 449 (P) CPE 460 (B)			CPE 448 (P) EE 348 (B) EE 360 (B) EE 443 (B) CPE 460 (P)			CPE 210 (D) CPE 286 (P) ENGR 111 (B) CPE 315 (D CPE 387 (P) CPE 408 (D) CPE 447 (P) CPE 448 (D) CPE 449 (P) CPE 489 (P) CS102 (B) EE 360 (P) EE 443 (P) CPE 481 (P) CPE 460 (P)						

Appendix E – Sample Course Grid

CS 101 Course grid with ABET and CSAB Criteria:

Outcomes	Performance Indicators	Strategies and Actions	Assessment Methods and Metrics	Evaluation	Feedback	ABET 2000 Criteria and Links to Univ., College & Depts.
Students will be able to comprehend basic computer h/w components	Students will refer to h/w components in answering questions	Reading assignments Lecture based discussions	Paper and pencil tests Programming reports	Student answers in tests Explanation of concepts included in programming reports	Based on evaluation, revisit weak areas in lecture give make-up assignments if required	ABET criteria: g CSAB criteria: IV-6, IV-7, IV-8, IV-16
Students will be able to develop programs in UNIX and Windows environments	Students will implement programs on both platforms	Make student aware of the computer labs and require their use Programming assignments and demos	Paper and pencil tests Programming project reports Program Demos	Student answers in tests Explanation of concepts included in programming reports and demos	Based on evaluation, revisit weak areas in lecture give make-up assignments if required	ABET criteria: e, g CSAB criteria: IV-6, IV-7, IV-8, IV-16
Students will be able to solve problems through programming	Students will participate in class discussions implement programs to solve problems	Lecture based discussions Programming assignments	Paper and pencil tests Programming project reports	Student answers in tests Explanation of concepts included in programming reports	Based on evaluation, revisit weak areas in lecture give make-up assignments if required	ABET criteria: e, g CSAB criteria: IV-6, IV-7, IV-8, IV-16
Students will be able to exercise the basics of object-oriented design and programming	Students will participate in class discussion implement programs using object-oriented approach	Lecture based discussions Programming assignments and demos	Paper and pencil tests Programming project reports Program demos	Student answers in tests Explanation of concepts included in programming reports and demos	Based on evaluation, revisit weak areas in lecture give make-up assignments if required	ABET criteria: e, g CSAB criteria: IV-6, IV-7, IV-8, IV-16
Students will be able to exercise the basics of object-oriented design and programming	Students will participate in class discussion implement programs using object-oriented approach	Lecture based discussions Programming assignments and demos	Paper and pencil tests Programming project reports Program demos	Student answers in tests Explanation of concepts included in programming reports and demos	Based on evaluation, revisit weak areas in lecture give make-up assignments if required	ABET criteria: e, g
Students will be able to cite and relate to the code of ethics outlined by the ACM	Students will participate in class discussion prepare and present a project based on the ACM code of ethics	Project presentation and written report based on ACM code of ethics	Paper and pencil tests Project presentation Project report	Student answers in tests Presentation of material in the ethics assignment report	Based on evaluation, revisit relevant topics in lecture	ABET criteria: d, f, g, h CSAB criteria: IV-15, IV-16, IV-17

NOTE: For all the stated assessment methods, student progress is systematically documented based on established rubrics.

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