Use of E-PORTFOLIOS in an Engineering Technology Undergraduate Degree Program

by

Sohail Anwar
sxa15@psu.edu
The Pennsylvania State University,
Altoona College, Pennsylvania

Abstract - *This manuscript describes development and implementation of a WebCT-based course which requires the undergraduate engineering technology students at Excelsior College to develop electronic or e-portfolios reflecting technical and non-technical competencies acquired by them during their academic studies. This engineering technology capstone course is titled "Integrated Technology Assessment" (ITA). This course allows students to document their ability to integrate knowledge from technology and general education areas and to apply it in a meaningful way. The e-portfolios developed by the Excelsior College undergraduate engineering technology students include students' skills and competencies in formal and non formal settings as well as their informal learning. Through the development of the e-portfolios, students assess their own learning and therefore, are better prepared to pursue their future career goals.*

I. Introduction

With the advancement of Internet, on-line instruction is becoming popular in engineering education. Although not yet "mainstream", on-line courses delivered over the Internet are becoming more common [1]. Traditional and non-traditional educational institutions are using a variety of instructional tools and technologies to deliver on-line courses to their students.

The on-line learning environment facilitates a learner-centered approach to learning, with the learner as an active participant in the learning process [2]. On-line learning provides a greater degree of learner control over the course materials. It also offers an enhanced level of interaction both in relation to the course materials themselves and in the opportunities presented for active learning through conferencing, discussion groups, and collaborative learning projects.

Excelsior College, located in Albany, New York, offers 31 different degree programs at the associate and baccalaureate levels in business, liberal arts, nursing, and technology. Excelsior College has been continuously accredited by the Commission on Higher Education of the Middle States Association of Colleges and Schools since 1977. Recognizing that college-level knowledge can be obtained in many ways, Excelsior provides access to many different avenues for earning college credit, focusing on what students know, rather than on where or how they learned it. Undergraduate credits are earned through a variety of accredited sources including for-credit exams, distance learning and online courses offered by Excelsior and other institutions; traditional campus-based courses; and military and corporate training. Excelsior's graduate degrees are delivered online. Through these means, the college makes associate, baccalaureate, and master's degrees more accessible to busy, working adults.

Excelsior's associate, bachelor's 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 Accreditation Board for Engineering and Technology. The American Council on Education (ACE) recognizes all Excelsior College Examinations for the award of college-level credit.

II. E-Portfolios and the Excelsior College BSEET Degree Program

The ABET-accredited BS in Electronics Engineering Technology (BSEET) degree program offered by Excelsior College requires 124 semester hours of credits, including at least 60 credits in the arts and sciences component and at least 48 credits in the electronics engineering technology component. All the BS-Electronics Engineering Technology students must complete at least one course or examination in each of the following subjects constituting the Electronics Engineering Technology core requirements.

- Circuit Theory I
- Circuit Theory II
- Electronics I
- Electronics II
- Digital Electronics
- Microprocessors
- Systems
- Electronic Communications or Data Communications Systems
- Computer Programming

In addition to the Electronics Engineering Technology core requirements, students must complete a 3-credit hour Integrated Technology Assessment (ITA) requirement which involves development and submission of E-portfolios.

As described in [3], a portfolio is a purposeful collection of student work that shows the student's effort, progress, and achievements. Such a collection must include student participation in selection of contents, the criteria for selection, the criteria for judging merit, and evidence of student self-reflection. A portfolio has at least four characteristics which represent improvement in standard educational practice [4]. These characteristics are as follows:

(1) Opportunity to better represent the work, both in terms of providing multiple examples and collecting work samples over a period of time.
(2) Development of context, which is a part the reflective process complete through portfolios
(3) Shift of control to the learner allowing him/her to select such materials for the portfolio which allows for a more effective self assessment process.
(4) Evidence that learning is a process that extends over time.

The Integrated Technology Assessment (ITA) process in the Excelsior College BSEET Program provides students with an opportunity to create and manage web-accessed electronic portfolios that document their knowledge, skills, and achievements from coursework, practical work experience, and other extracurricular activities. These portfolios support student reflection and provide a thoughtful accumulation of academic and non-academic work over a period of time.

III. The E-Portfolio Process

As previously mentioned in this manuscript, the ITA is an electronic portfolio development process that allows an Excelsior College BSEET student to describe his/her academic and professional achievements. Students participating in the ITA process need to collect and electronically submit various documents and pieces of evidence to demonstrate that they have successfully mastered the thirteen learning outcomes of the Excelsior College BSEET degree program. These outcomes are listed below in TABLE 1.

Objective Number	An electronic engineering technology graduate will be able to:
1	Demonstrate a fundamental knowledge of natural sciences, including physics.
2	Demonstrate the ability to measure, and provide quantitative expressions of natural science phenomena, including experimentation, observation, and accurate measurement.
3	Apply the fundamentals of algebra, trigonometry, and calculus to problem solving in the electronics engineering technology area.
4	Make technical presentations in English using language appropriate to the audience.
5	Demonstrate proficiency in the written communication of technical information using standard English.
6	Demonstrate a working knowledge of computer usage including knowledge of one or more computer languages and documentation of the use of one or more computer software packages for technical problem solving appropriate to the electronics engineering technology discipline.
7	Demonstrate technical competency in electronics, circuit analysis, digital electronics, electronic communications, microprocessors, and systems.
8	Integrate knowledge of the functional areas of electronics engineering technology.
9	Demonstrate the ability to analyze, apply design concepts, and implement systems as appropriate to electronics engineering technology.
10	Participate effectively in groups, and apply project management techniques as appropriate to complete assignments.
11	Demonstrate an ability to understand professional, ethical and social responsibilities, including the impacts of culture, diversity, and interpersonal relations.
12	Demonstrate a commitment and ability to continue to engage in lifelong learning.
13	Demonstrate a commitment to quality, timeliness, and continuous improvement.

Table 1: BS-Electronics Engineering Technology ITA learning Objectives

Every student enrolled in the BS-Electronic Engineering Technology program at Excelsior College is required to participate in the ITA development process by taking a senior-level WebCT-based asynchronous online course labeled ELEC 495 and is assigned a faculty mentor. The entire course process consists of a 15-week timeline. In general, weekly assignments for students during the 15 weeks are as follows:

- Week 1 – Review course and Develop professional resume
- Week 2 – Develop ITA plan/outline
- Week 3 – Develop draft learning statements for ITA objectives 1-6
- Week 4 – Develop draft learning statements for ITA objectives 7-13
- Weeks 5 through 12 – Student completion of ITA/E-portfolio
- Week thirteen – Faculty mentor review of complete ITA/E-portfolio document.
- Week fourteen – Student revision, if necessary
- Week fifteen – Final grading by faculty mentor

The faculty mentor is required to review and provide feedback on the student's professional resume during week 2, ITA plan/outline during week 3, draft learning statements for ITA objectives 1-6 during week 4, draft learning statements for ITA objectives 7-13 during week 5, different parts of the ITA during weeks 5 through 12, and ITA report as indicated in the above list. To allow flexibility, individual students and the faculty may agree to change the above schedule so long as the overall 15 week schedule is followed.

IV. Learning Statements for E-Portfolios

Students enrolled in ELEC 495 are required to develop learning statements that objectively address the program learning outcomes. A learning statement must include an explanation and examples(s) of how a given learning outcome has been met. Evidence must be provided in support of every learning statement. The relationship between the given learning outcome and the corresponding evidence must be explained. The essential elements of good learning statements are as follows:
- Written clearly and concisely in Standard Written English
- Written in the form of a narrative
- Supporting evidence is referenced and provided
- Describe how the evidence supports the learning statement
- Show how the learning statements relate directly to the outcomes
- Address each of the characteristics of the outcomes in full

The learning statements are developed in the following way:
- For each Learning Statement, the student may wish to combine information from a variety of experiences. The student does not need to cite learning from each work experience, but may refer to more than one job situation for each Learning Statement, as is appropriate, e.g., one might cite previous educational experience, experience as an electrician's mate in the navy, and position as a senior reactor operator in a nuclear plant, as related to a specific objective.
- Student should write a brief description of experiences in each position and the learning gained from them. As the student reflects on these experiences, questions listed below should be asked by the student. In answering the questions, be sure to include the learning attained from the college-level studies and any continuing education that may help the student to demonstrate competency.
    - What specific technology-related competencies did I acquire?
    - How did I use these competencies in my work?
    - What knowledge and skills am I still able to use?
    - Did I attend any continuing education activities?
    - Do I have any certifications to document attendance and completion of training programs?
    - Do I have any project reports or letters of acknowledgement of work produced?
- Student should compare each learning experience to the required program outcomes. These outcomes are the standards by which student's learning will be measured. Student's reflection and analysis at this point represent a significant learning opportunity for the student. This is the most critical step in the entire ITA process. It will help the student to determine his/her areas of strength and areas requiring improvement.

An example of a learning statement is given below:

Outcome 1 for the BS-Electronics Engineering Technology Program:
Demonstrate a fundamental knowledge of natural sciences, including physics.

Characteristics:
- Recognize the connections between the knowledge of natural sciences and your discipline, job, hobby, or courses completed later.
- Identify the specific scientific principles used.

Learning Statement:

As a student enrolled in the Electronics Technology program at Pennsylvania School of Technology I learned the basic theory of electricity, energy and solid state devices. To gain an in-depth understanding of these principles and an understanding of other natural phenomenon I later enrolled in a series of Physics correspondence courses. The courses imparted a solid understanding of physical quantities and vectors, equilibrium, motion, gravity, work and energy, impulse and momentum, elasticity, periodic motion, fluid-static and dynamic, thermal properties, molecular motion, mechanical waves, vibrating bodies, acoustics, electric and magnetic principles, electromotive force, electromagnetic waves, propagation of light, quantum mechanics, and nuclear physics. The knowledge imparted permits me to quickly grasp the complex concepts I have encountered in the work place. With the exception of quantum and nuclear physics, I have had the opportunity to apply my knowledge of these principles at least once, if not more, during the past 25 years. A few Physics homework assignments are provided as evidence of my understanding of natural phenomena.

The essential elements of good sources of evidence are as follows:
- Legible
- Clearly labeled and referenced in text
- Relevant to the learning statement
- Supportive of the learning statement
- Letters from supervisors or other individuals should include contact information (if possible)
- Letters should be written on official letterhead (if possible)

Having identified the match between student's professional and educational experiences and the competencies, student must demonstrate how the evidence clearly validates that student has met the program outcomes. This can be accomplished in the following ways:
- Acceptable evidence includes graded coursework (exams, papers, lab reports, homework, computer programs, projects) documenting student's college-level studies from regionally accredited colleges or universities, military courses completed and/or occupational specialties/ratings held; job performance reviews which verify the skills identified; certificates from continuing education courses; position descriptions and letters from supervisors attesting to our competence in specific areas; videotapes of presentations student have made for employment or class projects or to civic or professional groups; copies of computer programs student have developed, etc.
- Letters from supervisors should specifically address the objectives rather than provide testimony to student's character. Analyze student's entire ITA and carefully identify all areas in which the writer can assist student. For example, a supervisor might be able to describe student's ability to apply mathematical concepts to solve problems (objective 3), as well as student's proficiency in written communications (objective 5). Be sure to confirm that the supervisor is willing and available to receive a phone call from the faculty mentor if follow-up information is needed.
- Supportive evidence should be clearly identified by the specific page number. Highlight the specific reference on that page, if it is not easily identifiable.
- Supportive evidence must be legible. Letters and performance reviews must be signed and dated. Evidence must be specific to student's work and educational experience.
- The faculty mentor reserves the right to authenticate all sources of evidence.

V. Grading Process

ITA students submit all the E-portfolio materials via WebCT, e-mail, and/or computer disk. The professional resume, ITA plan/outline, and learning statements should be in Word format. Evidence may also be in Word files or may be scanned onto a CD-ROM. The completed ITA must be submitted by the end of week twelve. Upon review, the faculty mentor may require the student to resubmit a section or sections. The resubmission/final draft of ITA must be submitted by the end of week fourteen.

The student must satisfactorily address each program outcome by developing appropriate learning statements and providing evidence for each. The learning statements for each objective are graded on the following scale:

0 = Not Responsive to Outcome (Evidence not provided for relevant courses or experiences: coursework and other examples not demonstrative of required knowledge)

1 = Minimally Responsive to Outcome (Presents appropriate course evidence with a few examples from coursework and a few connections between coursework and applications)

2 = Responsive to Outcome (As in 1 above, and presents multiple examples of applications in coursework, on the job, or in other life experiences)

3 = Highly Responsive to Outcome (As in 2 above, and presents many detailed examples of applications in coursework, on the job, and in other life experiences)

Then a letter grade is assigned based on the sum of the integer values for each grading scale point. Please refer to TABLE 2 below for the integer values and the corresponding letter grade.

Sum of Grading Scale Integer Values	Corresponding Letter Grade
31-39	A
22-30	B
13-21	C
0-12	F

Table 2: Scoring Rubrics for the ITA

The ITA outcomes average for September 2007, January 2008, and May 2008 terms are provided in TABLE 3 below. As seen from the data provided in TABLE 3, the minimum score for any outcome has been 2.0 for September 2007, January 2008 and May 2008 terms.

	ITA Outcomes Average for 9/07, 1/08 & 5/08 Terms		

	Sept. 2007	Jan. 2007	May-08
Outcomes	N=4	N=2	N=1
1	2	2.5	3
2	2	3	3
3	2.5	2.5	3
4	2.5	2.5	3
5	2.25	2.5	3
6	2.5	2	3
7	2.75	3	3
8	2.25	2.5	3
9	2.75	2	3
10	2.5	2	3
11	2.25	2	3
12	2.5	2.5	3
13	2.25	2.5	3
Total:	31	31.5	39

Table 3: ITA Outcomes Average

VI. Course Evaluations

A course evaluation template is provided to students in each on-line course for course evaluation. The template has been developed by the College and is administered at the end of the course in a way that avoids any conflict of interest and the results are then provided for review and use by the individual schools. The template 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". The remaining three questions solicit a subjective response from students. All the twenty seven questions are listed below:

Course Objectives:
1. Initial instructions did not clarify the course objectives and content at the beginning of the course.
2. The grading policy was made clear at the beginning of the course

Global Evaluation:

    3. The course schedule was not flexible enough to meet my needs.

    4. I would recommend this course to others.

    5. Overall I am very satisfied with this course.

Perception of Assignments:

    6. Assignments stimulated my interest in the topics covered in this course.

    7. The feedback I received on my assignments from this course helped me perform better on subsequent assignments.

    8. The time given to complete assignments allowed me to do my best work.

    9. Graded assignments for this course were returned quickly.

    10. Graded assignments were not related to the course objectives.

    11. The discussion questions did not help me learn the content of the course.

    12. I understood what I needed to do to complete my assignments.

Perception of Faculty:

    13. The instructor for this course did not seem interested in helping me learn the material.

    14. The instructor conducted this course in a way that accomplished the stated objectives.

    15. The instructor's feedback helped me learn.

    16. The instructor for this course responded to questions in a timely manner.

Perception of Reading and Tests:

    17. The readings for this course stimulated new thinking about course content.

    18. The readings for this course were not presented in a logical order.

    19. The readings for this course helped me meet the learning objectives of the course.

Precourse Information:

    20. Before starting my online course(s) I received sufficient information about student support services.

    21. Before starting my online course(s) I received sufficient information about registration requirements and prerequisites.

Quality of Interaction:

    22. Engaging with other students in course related activities (e.g., discussions, team projects, etc.) made me feel like I was part of a community.

    23. The instructor did an excellent job interacting with students using available technology (e.g. email, discussion boards, chat).

    24. Interacting with other students helped me meet the learning objectives of this course.

Open-Ended Questions:

    25. Do you have any additional comments you would like to share with us?

    26. If you felt this course faired poorly on any of the above dimensions (or any that were not included above), what could we change to improve the course?

    27. WebCT is the name of the software program used to administer this course. Did you have any problems using WebCT that you would like to share? If yes, what were they?

It may be noted that the questions in this evaluation are designed for a typical online course and not necessarily for an ITA/E-portfolio course such as ELEC 495. In this course, there is no text or readings, no discussion boards, no student to student interaction, no testing, no faculty instruction to whole class, assignments are not designed to practice any knowledge but to complete the parts of ITA, etc. The course is conducted in a way to mentor students on individual basis online. This makes sense, as the portfolios of different students are not necessarily the same.

It is observed that the questions in the currently used evaluation tools that are irrelevant to an ITA process are the question numbers 6, 11, 17, 18, 19, 22, and 24. Also, some of the questions need to be re-written to reflect the ITA course requirements.

The open-ended questions ask students about perception of their online learning experience. In summary, the results from these questions for the past few years indicated that the students needed certain changes in course design and more technical assistance in order to navigate through the course. The College is making these changes in the course revisions. Also, the qualitative data collected from the open-ended questions reinforced the findings that some of the questions in the evaluation tool were not applicable or relevant for the type of course that ELEC 495 was. In a typical course, the overall student satisfaction is influenced by the interaction with the instructor, interaction with the students, interaction with the content, and interaction with the interface. The design of ELEC 495 does not render itself for some of these interactions and consequently the evaluation results tend to be skewed.

VII. Conclusion

This manuscript describes development and implementation of a WebCT-based course which requires the engineering technology students at Excelsior College to develop on-line portfolios reflecting technical competencies acquired by them during their academic studies. The course is titled "Integrated Technology Assessment" (ITA). It is a capstone experience for students documenting their ability to integrate knowledge from technology and general education areas and apply it in a meaningful way.

The ITA assessment method requires that students take an active part in the learning process and participate by formulating initial ideas, considering faculty mentor's responses, and reflecting on ideas in the light of contribution to the discussions with faculty mentor. In this way, learners go through a cognitive process whereby thoughts and ideas are refined and adapted taking into consideration other views and perspectives of the original concept. The ITA students view ITA development process as a transforming process which leads to greater personal understanding.

This E-portfolio experience has identified an important issue that the Excelsior College is currently addressing. This issue is related to the end of course evaluation completed by the students. It is designed for typical online courses and not for a capstone or ITA course. Many of the questions asked of the students in the evaluation tool may not be applicable or relevant to the ITA experience. Consequently, the evaluation results tend to be skewed and not truly representative of the ITA course. The College is changing the evaluation questions that are relevant and applicable to ITA course and provide results that can then be used to improve the course and its delivery online.

References

1   Long, R., A. Memon, L. Shih, and B. Thinger, "Nuclear Engineering Technology Students Capstone Experience to Access the Technical Competencies: A Case Study", *Proceedings of the 2000 American Society for Engineering Education Annual Conference & Exposition,* June 18-21, 2006, Chicago, IL.

2   Anwar, S., J. A. Rolle, and A. Memon, "Use of Web-based Portfolios to Access the Technical Competencies of Engineering Technology Students: A Case Study", *Proceedings of the 2005 American Society for Engineering Education Annual Conference and Exposition,* June 12-15, 2005, Portland, OR.

3   Knott, T. W., V. K. Lohani, O. H. Griffin, G. V. Loganathan, G. T. Adel, and T. M. Wildman, " Bridges for Engineering Education: Exploring ePortfolios in Engineering Education at Virginia Tech", *Proceedings of the 2004 American Society for Engineering Education Annual Conference and Exposition,* June 20-23, 2004, Salt Lake City, UT.

4   Cambridge, B. L., S. Kahn, D. P. Tompkins, and K. B. Yancey (Eds.). *Electronic portfolios: Emerging practices in student, faculty, and institutional learning,* Washington DC: American Association of Higher Education, 2001.