AC 2011-170: IMPLEMENTATION OF AN EPORTFOLIO REQUIREMENT AND PROFESSIONAL DEVELOPMENT SEMINAR SERIES FOR AN ET PROGRAM

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Implementation of an ePortfolio Requirement and Professional Development Seminar Series for an ET Program

Abstract

The University of Delaware’s Department of Bioresources Engineering offers a B.S. degree in Engineering Technology (ET), which has been a TAC of ABET accredited general ET program since 1988. The program typically graduates about 20 majors per year. Recent revisions of the ET program that include the addition of a four-year seminar series focusing on professional development and documentation of student workplace competencies / program outcomes went into effect for students entering fall semester 2010. Students, as a requirement for graduation, must individually submit integrative and reflective ePortfolios to document with direct evidence their intellectual growth and mastery of the ET program’s workplace competencies. Compilation of the ePortfolio contributes to the students’ professional development, and its completion and submittal for summative evaluation in the senior seminar is considered a fundamental component of the capstone experience. The four-year seminar series provides an opportunity for formative assessment and regular systematic feedback to the students for continuing improvements to their ePortfolios throughout the students’ academic careers. Evaluation rubrics are used to determine acceptability of the submitted ePortfolios and to help pinpoint components that require revision and resubmission. Student ePortfolios will be routinely evaluated as part of the department’s continuous quality improvement plan for the ET program and as a direct measure of the TAC of ABET general criteria \( a \) through \( k \) outcomes for accreditation.

Introduction

The portfolio has long been recognized as an excellent method for direct assessment of program outcomes\(^1,2\). Apart from assessment, portfolios have additional benefits. Linda Suskie\(^3\) (p 185) lists three “clear educational purposes” typically associated with portfolios:

- **Helping students learn.**
- **Assessing what students have learned**
- **Providing feedback to the portfolio’s audience on what students have learned and how their learning might be improved.**

After Suskie\(^3\) (p 186-187), portfolios provide “compelling evidence of what a student has learned.” The comprehensive educational program-based portfolio:

- serves as a single compendium of evidence for many varied types of learning and competencies,
- requires faculty to examine student learning as an integrated whole – not as skills and knowledge “compartmentalized” independently within single courses or short course sequences,
- shows not only the final outcome of the educational program, but also the intellectual growth of the student,
- includes information not only on what students have learned but the process by which the learning occurred – information that “helps us refine what and how we teach.”
• combines instruction and assessment by engaging the student simultaneously in those two endeavors,
• promotes and documents diverse student learning activities, and
• promotes student reflection along with concomitant skills in synthesis and metacognition.

The ePortfolio has several advantages over the traditional paper portfolio. First, graduates are expected to have modern communication skills that demand facility with a host of electronic media. In developing their ePortfolios, students are able to include a variety of electronic artifacts that range from simple word-processing documents or functioning spreadsheets to audio and video clips. Students can gain valuable experience creating, working with, and manipulating a variety of file formats such as html, pdf, and flash that are critical for modern electronic communications.

Portfolios are not without their detractors, however. Some have criticized use of portfolios as direct assessment methods in higher education because they are by their nature not standardized and because they may be potentially biased and difficult to evaluate. There may also be logistical difficulties with implementation for large numbers of students.

Competency-Based Assessment and ePortfolios

The B.S. degree in ET at the University of Delaware (UD) has been a TAC of ABET-accredited general ET program since 1988. The program typically graduates 20 to 25 majors per year, so the difficulties associated with use of ePortfolios for large student numbers pointed out by Shavelson et al. do not apply. In the fall of 2009, the Department of Bioreources Engineering (BREG) at UD initiated significant revisions of the ET program that went into effect beginning with the freshman class in fall 2010. Course and curriculum changes were designed to improve student learning and to improve assessment of that learning. Two important components of the change were use of a competency-based approach for assessment of program outcomes and adoption of an ePortfolio requirement through which students would demonstrate their competencies as a necessity for graduation.

Balascio et al discuss the rationale for using a competency-based assessment approach for the ET program. ET at UD is a general ET program, and as such, must satisfy just the TAC of ABET Criterion 3, $a$ through $k$ program outcomes. The TAC of ABET $a$ through $k$ program outcomes are ability-, skill-, or understanding-based. As such, they are “complex combinations of motivations, dispositions, attitudes, values, strategies, behaviors, self-perceptions and knowledge of concepts and procedures.” Complex abilities “cannot be observed directly but must be inferred from performance.” The TAC of ABET ability-, skill-, and understanding-based outcomes are written very broadly and can be viewed as complicated blends of independent competencies.

Workplace competencies are the application of knowledge, skill, attitudes, values, and behaviors in the workplace. Successful employees will exhibit mastery of the workplace competencies required for their positions. Fourteen clear, concise, independent workplace competencies were adopted for the ET program along with observable, directly measureable key actions that demonstrate their mastery. The fourteen ET workplace competencies adopted were.
<table>
<thead>
<tr>
<th>Engineering/Technical Knowledge</th>
<th>Analysis and Judgment</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Knowledge</td>
<td>Planning</td>
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<tr>
<td>Continuous Learning</td>
<td>Communication</td>
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<td>Quality Orientation</td>
<td>Teamwork</td>
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<td>Initiative</td>
<td>Integrity</td>
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<tr>
<td>Innovation</td>
<td>Professional Impact</td>
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<tr>
<td>Cultural Adaptability</td>
<td>Customer Focus</td>
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As an example, the communications competency and associated key actions are defined as follows:13

**Communication Competency:** Clearly conveying information and ideas through a variety of media to individuals or groups in a manner that engages the audience and helps them understand and retain the message.

**Key Actions:**
- Organizes the communication. Clarifies purpose and importance; stresses major points; follows a logical sequence.
- Maintains audience attention. Keeps the audience engaged through use of techniques such as analogies, illustrations, body language, and voice inflection.
- Adjusts to the audience. Frames message in line with audience experience, background, and expectations; uses terms, examples, and analogies that are meaningful to the audience.
- Ensures understanding. Seeks input from audience; checks understanding; presents message in different ways to enhance understanding.
- Adheres to accepted conventions. Uses syntax, pace, volume, diction, and mechanics appropriate to the media being used.
- Comprehends communication from others. Attends to messages from others; correctly interprets messages and responds appropriately.

The workplace competencies were then mapped to the TAC of ABET $a$ through $k$ general criteria program outcomes so that mastery of the workplace competencies indicates achievement of the ABET program outcomes. Within the context of the ePortfolio, the directly measurable workplace competencies replace the difficult to measure TAC of ABET $a$ through $k$ program outcomes. Competency-based assessment through demonstration of the workplace competencies becomes the framework around which the students’ ePortfolios are constructed. Since the workplace competencies are demonstrated through student performance of directly observable and measureable Key Actions, the influence of bias and non-standardization to which Shavelson et al.14 object is reduced.

**Professional Development Seminar Series and ePortfolio Construction**

UD’s Center for Educational Effectiveness initiated a grant program in the fall of 2009 to “fund several academic departments/programs to design, implement, assess, and sustain E-Portfolios as a required part of their majors’ undergraduate experience.” The planned revisions to the ET program previously initiated by the Department of BREG already satisfied all provisions of the grant program; no adjustments were necessary. The Department of BREG submitted a proposal and received funding as a part of the Center for Educational Effectiveness grant program.
A major portion of the grant contained funding for technical assistance with software development. There are several ePortfolio software systems from which to choose. The proprietary ePortfolio system, LiveText\textsuperscript{15}, has been popular with schools of education around the country in connection with meeting NCATE\textsuperscript{16} accreditation requirements. Google Sites\textsuperscript{17} has a web site-hosting environment that has many of the features required of an ePortfolio platform. ISU\textsuperscript{18} and Clemson University\textsuperscript{19} have custom-designed systems. Virginia Tech’s College of Engineering\textsuperscript{20} uses software available through the Open Source Portfolio (OSP) Initiative\textsuperscript{21}. UD uses the open-source course-management system Sakai which incorporates OSP\textsuperscript{22}. Consequently, we use OSP for this effort because it is supported by our institution, which is planning to extract outcomes assessment data for regional accreditation purposes. The grant also paid for joint meetings between the department faculty and the industrial advisory committee during which the aforementioned mapping of workplace competencies to the TAC of ABET outcomes was accomplished and validated.

As a matter of best practice, compilation of the ePortfolios cannot be left until the senior year. Ideally, students should be exposed to the concept and begin working on their ePortfolios during the freshman year. Students must be given regular systematic input and guidance regarding their progress in compiling the ePortfolio throughout their four-years of study. With those ideals in mind, the ET program revisions include the addition of a four-year seminar series focusing on professional development and documentation of student competencies / program outcomes through use of ePortfolios. Table 2 describes the five seminar courses in the series.

<table>
<thead>
<tr>
<th>New Courses and Catalog Descriptions</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>___ 165 New Student Seminar: Focuses on academic services, career exploration and preparation, campus resources, and practical skills helpful in mastering freshman year. Accreditation issues, ET program competencies, and introduction to ePortfolios. (fall semester)</td>
<td>0</td>
</tr>
<tr>
<td>___ 175 Freshman Seminar: ET program competencies, ePortfolio development, Continuation of ___ 165. (spring semester)</td>
<td>1</td>
</tr>
<tr>
<td>___ 265 Engineering Technology Sophomore Seminar: Accreditation, ePortfolio development, entrepreneurship, ethics, and professional practice issues. (spring semester)</td>
<td>1</td>
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<tr>
<td>___ 365 Engineering Technology Junior Seminar: Accreditation, ePortfolio development, professional certifications and licensure, leadership and ethics, case studies, entrepreneurship, resume writing, preparation for internship experience. (spring semester)</td>
<td>1</td>
</tr>
<tr>
<td>___ 465 Senior Seminar and Capstone Experience: Accreditation, professional practice issues, leadership and ethics, ePortfolio submittal for evaluation, report writing, oral presentations. (spring semester)</td>
<td>1</td>
</tr>
</tbody>
</table>

First year ET students and transfer students new to the ET program receive an intensive introduction and orientation to the ET major and the ePortfolio system in BREG 165, a required zero-credit new student seminar course offered in the fall semester. In BREG 165, students are familiarized with concepts related to professionalism, accreditation of their major, workplace competencies, and mapping of ET workplace competencies to TAC of ABET program outcome criteria. Students are introduced to the ePortfolio software platform and start collecting artifacts and writing reflective commentary to begin documenting their mastery of the ET program workplace competencies. UD has a First Year Experience (FYE) requirement for all first-year
students, and zero-credit seminars are explicitly allowed. In addition to being a required ET course, BREG 165 counts as the FYE for ET students; a passing grade is needed for graduation.

Many students in the ET program are non-traditional older students who transfer in with an associate’s degree in ET and often many years of work experience. Such students have no need for some of the topics covered in BREG 165 that are intended to orient 18-yr old freshman to university life. The zero-credit format gives us the flexibility of excusing non-traditional students from the portions of the course that are not germane for them and lets them focus on topics related to the major, workplace competency concepts, and building the ePortfolio.

BREG 175 is a one-credit extension of BREG 165 offered during the spring semester in which students continue to refine their ePortfolio style and content. BREG 265 and 365 are one-credit sophomore- and junior-level seminars, respectively, also offered during the spring semester, in which topics related to entrepreneurship, professionalism, ethics, and engineering licensure are examined. BREG 365 focuses on career skills and professional preparation for the internship/undergraduate research experience. Student progress with compilation of their ePortfolios is monitored and feedback provided each year.

BREG 465, also a one-credit seminar offered during the spring semester, is meant to be an integrative capstone experience in which students complete their ePortfolios and submit them for evaluation. Submission of an acceptable ePortfolio is required of each student to pass the class and graduate. By this point, each ePortfolio should be a polished, comprehensive compendium of a student’s experiences throughout his or her academic career. Through the ePortfolio, the student’s mastery of the ET program workplace competencies has been documented. The ePortfolios, containing artifacts accompanied by reflective commentaries that explain and demonstrate student mastery of the ET program workplace competencies will have been refined by several annual cycles of submission, faculty feedback, and revision.

The aforementioned students transferring into the program with an associate’s degree in ET can be excused from the lower-level seminars, BREG 175 and 265, and can enroll directly in the junior- and senior-level seminars, BREG 365 and 465, as appropriate. Once the revised curriculum has been implemented for two cohorts of students, innovative scheduling of the spring semester seminars will be used to make best use of faculty time and provide an opportunity for beneficial interaction among the different class-years of students. A two- or three-hour common time slot will be reserved for the four seminars that meet during the spring semester. This time will be used creatively for various activities and will allow for joint meetings of all four classes or separate staggered 50-minute meeting times as needs dictate. Since the seminars are one credit apiece, each class will not necessarily meet every week if some activities take the full two- or three-hour session.

Students experienced with the ePortfolio software system, workplace competency concepts, and the process of ePortfolio development can help tutor newer students during joint meetings. Oral presentations about their internships, undergraduate research activities, or nearly finished ePortfolios delivered to students in freshman- through junior-level seminars will give seniors an opportunity to polish their communications skills and are good preparation for entering the professional job market. Such presentations by seniors in BREG 465 will have the added benefit
of making ET underclassmen aware of opportunities and expectations as they progress through the ET major.

The current ET program requires a discovery learning experience – typically either an internship or undergraduate research. During the initial years of implementing the revised curriculum when no or few seniors will need to meet the requirements of the revised program (i.e. before 2014), senior students completing their required internships or undergraduate research will be asked to make oral presentations to the 100-, 200-, and 300-level seminars that are offered.

Artifacts for ePortfolios, Reflection, and Assessment

Students upload artifacts that demonstrate the workplace competencies. The system prompts students for reflective commentary regarding their artifacts. The ePortfolio system was piloted in fall 2010 and spring 2011 with the incoming class of new students. We did not want to overwhelm students with 14 competencies that needed to be addressed in one course. Three competencies were initially considered during this pilot run: Engineering/Technical Knowledge, Planning, and Integrity. We anticipate adding three or four competencies each year until all fourteen are covered. It was thought that these three competencies would be good starting choices either because there would be a wide selection of possible artifacts in the case of Engineering/Technical Knowledge or the topics were to be the special focus of class discussions as with Planning and Integrity. Students are, of course, not expected to demonstrate complete mastery of any competencies until their senior years. The process of feedback and revision promotes gradual consistent improvement in the reflective commentaries and selection of appropriate artifacts with each iteration.

It was anticipated that students might have out-of-classroom experiences that demonstrate the workplace competencies through performance of the key actions without a tangible artifact to post. Cultural Adaptability and Customer Focus are competencies that would most likely be demonstrated during an internship, for example. To document such instances, the STAR format for behavioral-based interviews is employed. STAR stands for Situation/Task, Action, Result, the sequence that should be used in addressing a behavioral interview question such as “Tell me about a time when you had to analyze a lot of information before making a decision.” In the STAR form, the students are asked to describe the relevant situation/task, the action they took, and the ultimate result. They are directed to identify the specific Key Actions that were performed. The STAR form can then be uploaded as an alternative to a conventional artifact.

For the pilot runs, students were instructed to identify specific Key Actions associated with each featured competency and discuss how they were demonstrated through their artifacts or STARs. In their reflective commentary, the students were told to address four questions with respect to the artifacts or STARs they posted:

- To what degree have you achieved the competency?
- How do the attached artifacts and/or STARs show that you have demonstrated the key actions for the competency?
- What have you learned as you’ve developed and demonstrated the competency?
- What will you do differently or continue to do as a result of the experiences documented by the artifacts and/or STARs?
In practice no students in the pilot course satisfactorily answered these four questions. In particular, they failed to address performance of the Key Actions. It was decided to replace the first question with a self-assessment. For each Key Action, one of the five-point Likert-scale ratings ranging from Excellent to Not Yet Adequately Demonstrated is selected by the student.

The self-assessment for Engineering/Technical Knowledge is illustrated below:

As demonstrated by your artifacts and STARs, assess your mastery of the Engineering/Technical Knowledge competency by indicating your level of performance for each of the associated key actions:

- **Knowledge of Mathematics.** Demonstrates knowledge of the mathematical principles required to practice engineering or apply and manage technology in one's specialty area.
  - Excellent  
  - Good  
  - Fair  
  - Minimally Adequate  
  - Not Yet Adequately Demonstrated

- **Knowledge of Science.** Demonstrates knowledge of the scientific principles required to practice engineering or apply and manage technology in one's specialty area.
  - Excellent  
  - Good  
  - Fair  
  - Minimally Adequate  
  - Not Yet Adequately Demonstrated

- **Knowledge of experimental analysis.** Demonstrates knowledge of the principles of experimental data analysis in one's specialty area.
  - Excellent  
  - Good  
  - Fair  
  - Minimally Adequate  
  - Not Yet Adequately Demonstrated

- **Knowledge of current engineering/technology tools.** Demonstrates knowledge of the use of contemporary tools needed to practice engineering or apply and manage technology in an effective manner.
  - Excellent  
  - Good  
  - Fair  
  - Minimally Adequate  
  - Not Yet Adequately Demonstrated

- **Knowledge of technology.** Demonstrates knowledge of engineering/technology principles required to practice in one's specialty area.
  - Excellent  
  - Good  
  - Fair  
  - Minimally Adequate  
  - Not Yet Adequately Demonstrated

The revised reflection prompt with self-assessment will be pilot-tested in spring 2011. The system will also include a feature to allow faculty and Industrial Advisory Committee evaluators to complete identically formatted assessments.

**Capstone Experience**

It is well recognized in a variety of disciplines (e.g., education\textsuperscript{25}, business\textsuperscript{26}, health and human biology\textsuperscript{27}) that completion of a comprehensive ePortfolio documenting the student’s undergraduate studies provides an excellent fundamental component of a capstone experience. Indeed, some institutions encourage or require completion of a “capstone ePortfolio.”\textsuperscript{28,29} Recent experience at UD during the last TAC of ABET visit in fall of 2010 provides a cautionary note, however. Admittedly, the ePortfolio requirement had only just been implemented for
incoming freshmen at the time of the visit. The team leader, however, was unfamiliar with ePortfolios and was somewhat incredulous that the ePortfolio in conjunction with the required internship (or undergraduate research) and senior capstone seminar could provide an adequate capstone experience for the ET students. The lack of a capstone experience was cited as a weakness, and no mention of the recently implemented capstone ePortfolio was made in the preliminary report. If such unfamiliarity with and resistance to use of the ePortfolio is common in the ET community in general and amongst TAC of ABET evaluators in particular, then programs may be well advised to retain a traditional senior project in conjunction with a capstone ePortfolio.

Summary

Internal funding was obtained from a UD Center for Educational Effectiveness grant program that provides assistance with implementation of the ePortfolio system and adaptation of the ISU competency-based assessment model for use in UD’s ET program. Revisions to the four-year ET program at UD include provisions for use of competency-based assessment as a means of demonstrating TAC of ABET general criteria outcomes. Difficult-to-measure ability-based outcomes are mapped to measurable workplace competencies that resonate with students and employers. Competency-based assessment provides a means to assess the achievement of ability-based program outcomes.

For best practice, students are introduced to workplace competency concepts and the ePortfolio system during their first year at the university. Systematic feedback and guidance for improvement of their ePortfolios is provided to students every year through a series of professional development seminars that culminates with a capstone senior seminar. Because the ET community may not yet be familiar with ePortfolios as a component of the capstone experience, ET programs may wish to combine use of capstone ePortfolios with continued retention of a traditional senior project.

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