AC 2011-1678: ASSESSMENT OF ABET STUDENT OUTCOMES DURING INDUSTRIAL INTERNSHIPS

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Assessment of ABET Student Outcomes During Industrial Internships

Abstract

The Paper Science and Engineering (PSEN) program at UW-Stevens Point has had a three-credit industrial internship requirement since 1973. We assessed this requirement through comprehensive student papers covering the technology of the pulp and paper industry and the processes and products of the mills in which students worked. This assessment worked well until roughly ten years ago, when mills began retaining the reports, saying that they contained proprietary information. At the time, faculty decided to share the rubric used to evaluate student papers with mill supervisors so that they would have a standard by which they could rate papers, as well as an evaluation form to provide feedback on student work in the mill.

In 2010, we developed a new approach to assessing these internships. Taking advantage of the capabilities of the online course management system Desire2Learn®, students now respond to 16 questions about their internship work while they are in the mills. These responses help students to remember activities performed during the entire internship. When they return to campus, students provide two pieces of work to satisfy academic requirements: reflection papers and electronic portfolios that document their internship work, specifically addressing how their internships helped them develop skills in several ABET Student Outcomes for the PSEN program. The portfolios provide evidence that the faculty can use to assess the achievement level for outcomes associated with these internships.

In this paper, we describe the assessment method in more detail, and the conference presentation will include a demonstration of the technology. We also discuss the need for students to be able to more clearly identify and articulate achievement of learning outcomes. A critical finding of our initial study is that students often met learning outcomes without realizing they did, without understanding the importance of communicating that they did, or simply by not being able to effectively communicate that they did.

Background

The Paper Science and Engineering program (PSEN) at the University of Wisconsin-Stevens Point has educated process engineers for entry-level positions in the pulp and paper industry for 35 years. The curriculum consists of fundamental chemical engineering courses combined with pulp and paper technology courses. In addition, the program has required all students to complete a three-credit industrial internship in order to receive a degree. Fortunately, availability of internships for students has not been a problem; the university is located in the center of a dense concentration of pulp and paper mills, providing many opportunities for our students. A typical internship has the student employed by the mill for eight months (a summer plus an academic semester) beginning in the second semester of the sophomore year.

The internship is evaluated through a three-credit course that students take when they return to campus. Historically, students satisfied the academic requirements for this internship course by writing a lengthy technical paper. PSEN faculty provided an extensive outline for this document and evaluated all reports when the student returned to campus. Each report required students to
investigate all processes used for production of pulp and paper, regardless of the actual processes used at the mill where they worked. Predictably, student papers tended to emphasize processes and products with which they became familiar at a mill, paying scant attention to other processes. As reports focused more on specific mill operations, internship supervisors became concerned about proprietary information leaving the mills with student reports. Ultimately, almost all reports were kept by the mills, leaving PSEN faculty with no information about students’ work. We attempted to deal with this situation by sharing the rubric that PSEN faculty used to grade reports with internship supervisors. In this way, we could have some information about student work, and all supervisors were using a common standard to evaluate reports. Supervisors also were asked to fill out a short evaluation form to provide information on student performance during their internships. Although supervisors were diligent about providing evaluations we requested, a sense of uneasiness remained about assessment of these internships.

Our continuing concern about granting academic credit (and a grade) for internship work about which we had little knowledge led to development of a new plan to assess students during internships.

**A Different Approach**

During faculty discussions on how to deal with this issue, we agreed that the internship is a very important part of our students’ education. The question that arose was “Why?” What do these internships add to the required coursework that is so valuable? Put another way, what are the desired learning outcomes for these internships? Is there a way to assess those outcomes without adding a huge burden onto faculty and students?

Internships are a type of “experiential learning,” similar in some ways to service learning. Internships were identified as a high impact educational practice in a recent Association of American Colleges and Universities publication. There are six student behaviors required by high impact practices thought to significantly improve student learning:

1. Invest significant time and effort
2. Demand interaction with faculty and peers about substantive matters
3. Result in an experience of diversity through extensive contact with people very different from themselves
4. Receive and respond to frequent feedback
5. Requires students to use their classroom learning in very different settings
6. Students discover that their learning is relevant to real-world problems

Kuh identifies several student experiences as high-impact practices, including internships.

A Google search for the phrase “engineering internship learning outcomes” yielded more than 130,000 results. Perusal of outcomes shown at a few of these sites provided some starting points for faculty discussion. Comparing these outcomes with each faculty member’s idea of what the internship should accomplish, we settled on the following outcomes for the internship course:

*To satisfy the requirements for this course, students will:*

- explain the operation of the industrial facility in which they worked
• describe the professional skills they developed during their internship
• demonstrate communication skills (written and oral)

Initially, we also thought that the students’ experience would help them develop skills associated with the following ABET Student Outcomes:

Students will demonstrate:

• ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
• ability to function on multi-disciplinary teams
• ability to identify, formulate, and solve engineering problems
• understanding of professional and ethical responsibility
• knowledge of contemporary issues
• ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

These are easily recognized as ABET Student Outcomes c, d, e, f, j and k from Criterion 3 in the Criteria for Accrediting Engineering Programs.²

We decided to use a two-tiered approach to assessing student achievement of these outcomes. First, while students were off campus and working in the mills, they were required to post responses to 16 questions. The PSEN faculty developed these questions with input from our industry advisory board. We used the discussion forum tool in our campus learning management software, Desire2Learn®, to collect students’ responses to the questions. Questions for this activity are listed in Appendix A. Questions begin by requesting very simple information about the students’ living arrangements, a description of the mills where they work, etc. As their time in the mills progresses, questions become more challenging, requiring more thoughtful, reflective responses. Second, students take the PSEN 300 Mill Internship course upon their return to campus. The requirements for this course include (1) writing a reflection paper based on their internship experience and (2) creating an electronic portfolio containing representative examples of the work performed during their internships and a video of the students describing their work experiences.

The utility of electronic portfolios to enhance and document student learning is widely documented, primarily in the context of teacher education. Rutkowski³ described an electronic portfolio system developed at the University of Minnesota that allows students to collect examples of their work as electronic files (artifacts), and allows sharing these items with a target audience by creating folders containing the desired items and assigning appropriate access permissions.

Students in this project used the ePortfolio software product from Desire2Learn® to create their portfolios. There were two primary reasons for using this software:
1. Our campus is participating in a University of Wisconsin System pilot study of the use of the ePortfolio software. Involvement of students from an engineering program provides important information for the system-wide adoption of this software.

2. The internet-based software provides a secure environment for students to upload artifacts and develop portfolios, allows users to create different views (or presentations) of portfolios for different audiences, provides tools to create web pages to display artifacts with commentary, and gives users the capability to share portfolios with individuals of their choosing.

Figure 1 shows a view of the software’s main page. The links in the left navigation bar provide connections to the tools needed to upload artifacts, group artifacts into collections (an organizational aid), create presentations (selections of artifacts arranged and displayed for different audiences), and share presentations by giving access permission and/or exporting the presentation as a set of HTML files. The software provides great flexibility for display of presentations without requiring students to create their own HTML code. We should note here that work examples or other items displayed in D2L ePortfolios are called “artifacts” in the nomenclature of the software, just as any item we used as a target of analysis in NVIVO qualitative-analysis software is also known as an “artifact” in that software’s nomenclature. Thus, a student reflection over an internship could be uploaded to D2L as an artifact in that software and also could be analyzed as an artifact in NVIVO, but not all D2L artifacts were also NVIVO artifacts.

Figure 1. Main page of ePortfolio software. Screenshot taken within Desire2Learn® ePortfolio® 3.0
The initial purpose of this work was to provide a means for assessing internships without relying solely on supervisors’ evaluations. Electronic portfolios can also provide a framework that prompts students to think critically about their work, reflect on what they have learned, and connect their internships to coursework. If these features are structured appropriately, the impact on student learning will be profound. The remainder of this paper describes results from the first group of students to work with ePortfolio, the lessons learned and the changes planned.

**Results and Discussion**

The seven students involved in this study had internships from January to August of 2010. Six students worked at paper mills in Wisconsin, while the seventh participated in an international experience that included an internship in Germany. These students returned to campus for the fall 2010 semester. They produced reflection papers and electronic portfolios to satisfy requirements for the PSEN 300 Mill Internship course, submitting their final work on December 22, 2010.

**Discussion Posts**

Analysis of discussion-question postings provided some interesting information. The average length of posts, shown in Figure 2 (next page), ranged from 115 to 316 words. Responses to question 3, concerning the safety program in the mill, were the longest. This likely reflects the emphasis placed on safety in the industrial environment, especially with student interns. Question 5, in which the students described projects to which they had been assigned, had the second longest responses on average. Students were assigned to work on multiple projects, and their posts indicate that they made a real effort to understand both the projects and their significance to the mill. The shortest post, question 10, concerned report writing during the internship. Most students reported that they did not write any formal reports, but reported progress on their projects either orally or through spreadsheet work. Another interesting observation is that, although students were not required to read one another’s posts, all students read all of their colleagues’ posts, with a few even posting replies or questions (D2L has a reporting function that allows instructors to see statistics on posts read). This observation is gratifying, since one of our goals was to increase awareness of internship activities among all students. Use of the discussion board seems to have accomplished this goal.
Reflection Papers

Reflection papers were converted to electronic “artifacts” (documents) and imported into NVIVO 9\textsuperscript{4}, a program used for qualitative analysis of data. Each artifact initially was analyzed by a single coder, a communication researcher who co-authored this paper and who also is a member of the UW-Stevens Point pilot study on D2L’s ePortfolio. The coding structure closely mirrored the structure of reflection prompts given to students in their assignment (see Appendix B), which included references to the six ABET student outcomes to be addressed in the internship. This structure, which included a total of 42 “nodes” or categories into which individual text portions could be coded, allowed a thorough analysis of reflections on a line-by-line basis. Because this approach included many aspects of analysis based in grounded theory\textsuperscript{5} and close textual analysis\textsuperscript{6}, it encouraged a more rigorous examination than normal grading would of whether students addressed, either explicitly or implicitly, the topics assigned in the reflection prompts. It is important to mention that results of this analysis are applicable only to this group of students, and should not be generalized in any way.

A key aspect of this coding approach is that it allowed us to make some assumptions about whether students were able to address ABET outcomes even when students did not expressly write about particular outcomes. This is important because students often do not address such topics fully or even partially despite clear instructions (through reflection prompts) to do so. This
characteristic of student work is, in fact, an important part of our findings and discussion below. Use of NVIVO and a flexible coding system gave us the opportunity to interpret student descriptions of their internship tasks in such a way that we could assume, based on both literal meanings and contexts of descriptions, that students were meeting one or more outcomes.

We were careful to interpret student reflections conservatively, erring on the side of caution and not coding a reflection as indicating a particular learning outcome was met if it was not completely clear to us that it had been. We found several indications of learning outcomes met in student task descriptions even though students apparently did not intend to discuss those outcomes in their task descriptions. Discussion of this phenomenon is found below.

**Employer/Company Description**

This section of the reflection papers, overall, was the weakest in terms of the detail and depth of thought shown. Only one student knew the mission statement of the employing company; the rest either expressed ignorance of the mission statement or claimed to have searched for the statement and been unable to find it. These students could not, therefore, discuss whether the mission statement was consistent with their observations of company operation.

Students knew very little about the management structure of any company beyond their supervisor’s boss (whom they were required to interview for the discussion forum). Some students listed some common titles found in a mill hierarchy, but provided no names for the people in those positions in their mill.

None of the students were aware of a written code of conduct; many expressed the idea that employees were supposed to conduct themselves “in a professional manner.” There was no mention of any but the most rudimentary workplace rules (no smoking in the building, no horseplay, etc.) and no indication of any awareness of expectations of ethical behavior. It is possible that these sophomore students did not have sufficient background to know what to look for.

All students described communication within the companies in simplistic ways. Most simply noted that they or others took part in regular meetings for communication purposes or used standard tools such as e-mail or phone calls, but offered few examples of specific communication issues or evaluation of the effectiveness of these modes of communication.

**Internship Project Information**

This section was, in general, the longest in the papers. Although most of the students had no goals (personal or professional) before they started their internships, they did a good job of explaining their duties and the importance of their assignments. Two students reported that they were able to “negotiate” about their assignments; in reality, what they had done was ask for more work, but at least they took the initiative in that respect.

It was in this section, in fact, that students gave many clues to their outcomes-related experiences. Because they were most comfortable explaining what they did, they tended to give enough specific detail about their tasks that we were able to glean information about outcomes.
Students apparently did not realize, at times, that they were meeting these outcomes. An obvious indication of this was in the linear construction of student reflections; even though their reflections took narrative forms, all seven students addressed the reflection prompts in virtually the same order that those prompts were presented in the assignment. Because ABET outcomes were at the end of the assignment instructions, we could confidently identify student efforts to discuss those outcomes by looking at the final portions of their essays. The following quote is, for instance, the entirety of one student’s explicit reflection on specific outcomes:

I think the only ABET learning outcome I didn’t get any experience with was (e), ability to identify, formulate, and solve engineering problems. I didn’t have any problems that I had to solve. Determining consistencies was probably the extent of any calculations I did. The other learning outcomes were hit on at least a little. But, I am in no way an expert on them. (Student No. 7)

Much earlier in his reflection – in the section on internship-project information – the same student gave the following description of a major task:

My first task was dealing with centrifugal cleaners. They wanted me to test their abilities with de-aeration. They had run some tests previously that seemed to indicate that de-aeration was possible, but the results they were getting were showing that it may not be good enough to be worth the trouble. But, they wanted to be thorough, and make sure the results they had gotten before were consistent. There were consistent results with the cleaner model they had used before, but with another size, there were dramatic differences.

I was required to run a re-pulping system for my trials, which made it difficult to run under consistent conditions. Throughout the day the stock would heat up. At a certain point it began to drastically affect the equipment I was using to measure the air content of the stock. This was the biggest problem I had to deal with. [emphasis is ours] But, after many days of wrestling with this, I managed to collect enough data to make an accurate conclusion about the results. The conclusion we ended up with was that this was something they needed to take a step further. The data indicated that the proper size and shape of the cleaner could result in an incredible degree of de-aeration.

It is interesting to note that this student wrote that he had no experience dealing with engineering problems and then described one of his major accomplishments as a “problem I had to deal with.” Based on the description of this student’s efforts, we coded this experience as meeting learning outcome e.

In fact, for the six ABET outcomes measured for the internships, we coded a total of 24 explicit references by students to learning outcomes they believed they had met, but we also separately coded another 33 textual references that implicitly referred to learning outcomes met. Virtually all of these implicit references were found in student descriptions of their regular or special tasks rather than in the section where they addressed outcomes directly. Evaluation of Experience
Some students did a credible job of describing their accomplishments, including the impact their work had on the company. Most expressed an awareness of the economic importance of their work, but few provided any quantitative information. When their work was recognized by their employers, students were especially aware of and descriptive of these accomplishments.

The mill set a production record in September ’10 and considered my work as help towards that record; I’m very honored. (Student No. 4)

Another big accomplishment was the approval from the DNR to perform our own suspended solids testing onsite. In shifting the duties to the Main Lab, I was able to save the mill 1,500 dollars every month. (Student No. 5)

All of the students expressed a significant gain in knowledge about careers in the industry. All but one indicated that their choice of major was reinforced by their internship experience, and all were excited to see what their career possibilities were. All students worked in facilities where graduates of the PSEN program had positions of responsibility, from shift supervisors to mill managers. Most reported that they could easily see themselves in these positions in the future.

All students reported significant personal growth during their internships. Most could now see the direct connection between their coursework and the industrial environment, as well as the importance of a knowledge base to allow them to become better problem-solvers. All students mentioned their progress on ABET outcomes, with most demonstrating that they could connect specific work tasks with these outcomes, but with most also failing to do this to the extent we believe they should and to the extent that it would benefit them professionally. None made any mention of their level of achievement of the outcomes (described in the next section).

**Electronic Portfolios**

We evaluated electronic portfolios using a rubric for the portfolio itself, as well as the rubrics for each of our ABET Student Outcomes addressed during the internship. These rubrics are shown in Appendix C.

**Evaluation of Portfolios**

Student portfolios included several examples of their work during their internships. Unfortunately, many portfolios were disorganized, making it difficult to easily find these artifacts. One student created a portfolio that contained only his internship material; all others placed internship materials in portfolios they had created for another course, making their internship artifacts difficult to identify. Some added navigational links specific to the internship to guide the viewer to the relevant internship information. Further, others simply placed artifacts on pages that were already dedicated to their ABET outcomes. Unfortunately, none of the students included reflections on their artifacts that went beyond a brief description of the file, with no indication of how any artifact demonstrated achievement of any ABET outcomes. As shown in Figure 3, six of the student portfolios were rated as “Beginning” on all three criteria in the rubric (Appendix C), with the remaining student portfolio rating “Developed” on the Technical and Design criteria, and “Beginning” on the Reflections criterion. None of the portfolios deserved a rating of “Accomplished.”
Video reflections included in the portfolios were simple recordings of students speaking directly to a camera, describing their internship experiences. The students knew (based on the course syllabus) that these videos would provide evidence of achieving internship course objectives: explaining the operation of the industrial facility, describing professional skills they developed, and demonstrating their communication skills. Transcripts of the videos were analyzed using the same approach (NVIVO 9 software) as the analysis of the reflection papers.

The final videos varied widely in quality. Some were sized appropriately for the computer screen; others were so small that it was difficult to recognize the student in the video. All of the video files were quite large, one of them in excess of 100 MB (ironically, this was the video with the very small screen size). Although our students are frequently described as being “tech savvy,” they clearly did not have a good understanding of how to create quality multimedia for an internet-based portfolio.

None of the students included any significant description of the mill in which they worked, and only three identified their supervisors. Descriptions of their professional skills development were similar to the following:

I learned the importance of safety. I was able to develop my communication skills as I worked with people throughout the mill. Whether it was at the treatment plants, or whether it was … operators, I work [sic] with people throughout the mill. I gained confidence both in my work and in my decision for having paper science and engineering as my major… (Student No. 7)
The oral communication skills demonstrated in the videos were at a level expected from sophomores in the program. Three students used outlines to help structure their presentations; the remaining four students did impromptu presentations, which were at times rambling and disorganized. There were a distracting number of “vocal pauses” (um, er, ah) in these presentations, indicating a lack of practice during their preparation for recording the video.

The analysis of the video transcripts showed that, overall, the students were unaware of the connection between their internship tasks and the ABET outcomes. This result is consistent with the lack of connection observed in their reflection papers. In fact, none of the students mentioned any of the ABET outcomes at all in their videos. They provided information about tasks that would have demonstrated achievement of these outcomes, such as the following:

…the results I ended up with indicated that with the correct size and shape of cleaner you could actually have very significant de-aeration of the stock stream. (Student No. 7)

As in his reflection paper, this student made no connection between results in his project and ABET outcome e. To be fair, the instructions for the video did not require the students to speak about ABET outcomes. These students did exactly what was indicated as a requirement for this assignment and nothing more. This is made most clear by a direct comparison of coding results from the analyses of both reflection documents and transcripts. While we coded (as noted earlier) 24 direct references and 33 indirect but apparent references to learning outcomes in reflections, we coded only 14 apparent references to outcomes in video transcripts. Of these, 11 referred to techniques, skills and tools; three referred to development of systems, components or processes; and none referred to the other four outcomes.

**Evaluation of Artifacts**

Students were required to include evidence of their work during their internships (artifacts) in their portfolios. All artifacts included in the students’ portfolios were solid examples of using Excel, Word and PowerPoint well for engineering tasks, making all of these artifacts examples for outcome k. On average, students included between four and five artifacts created while they were on their internship. All of these rated at a level of “Acceptable” on the rubric for ABET outcome k. Evaluation of these artifacts required 10-15 minutes per student. For a small group of students (like the group in this pilot study) this was not an overwhelming time commitment. For larger groups of students, we would evaluate a representative sample of the portfolios to keep the faculty time commitment at a reasonable level.

Here is an example of a student reflection for a report presented in the portfolio to demonstrate achievement of outcome k:

This project demonstrates my ability to use statistical analysis and laboratory techniques to solving engineering issues that arise in the mill environment. The report presents a logical method of studying pulp variability and reaction to
refining. The report gives important parameters for duplication of the study as well as pointing out inconsistencies in the data. (Student No. 3)

This description sets the artifact as an example of work satisfying ABET outcome b, a program outcome that is not included in the outcomes for this course. Clearly the student is not aware of all the ABET outcomes for our program since the artifact was presented as an example of achievement of outcome k. Some students attempted to provide artifacts in support of their achievement of the other five ABET outcomes, but it was clear that they did not have a solid understanding of what was expected. For example, one student who had participated in a design project at the mill posted the following reflection on the report posted as an example of design work:

This is the progress outline of the Safety Walkway Project completed during my co-op at [the mill]. It was a chance to not only familiarize myself with the mill, but it gave me a chance to meet most of the employees in different departments. I'm glad I was able to improve safety at a mill that focuses so much on it. It was also a chance to lead a project in a mill setting, something that at the time was new for me. (Student No. 5)

The document was simply a progress report, without any indication of design considerations other than safety. This is understandable since these students are sophomores and have had little exposure to engineering design principles.

CONCLUDING THOUGHTS

The in-depth analysis of student work has convinced us that electronic portfolios are extremely useful for assessment of student learning outcomes. The electronic portfolio provides a tool that students can use to collect and display examples of their work, as well as sharing the portfolio with faculty. We now know much more about the work that our students perform during their internships. The information that we receive about our students’ internships has proven extremely valuable, and provides evidence for us to assign grades for this activity.

This analysis has helped us to realize that, as instructors, we need to:

- Find ways to encourage or direct students to more clearly recognize and understand big-picture outcomes and issues – not only learning outcomes, but industry issues, corporate values and goals, and simply how the industry works. This is critical for development of executives and other leaders, as well as spokesmen and women and other representatives of the industry.
- Help students learn to articulate this understanding and the goals, achievements and concerns of both themselves as professionals and of the industry as a whole. Acquiring and practicing communication skills is a process of lifelong learning, but it is critical that students demonstrate appropriate communication ability during and after these
To do these things, we may need to find ways to more clearly emphasize the importance of recognizing and thinking about learning outcomes during the internship process, as well as afterwards. This could be as simple as providing pre-internship discussion of outcomes and reminders to consider outcomes during daily tasks, online discussion questions during the internship that are focused on outcomes, journaling focused on reflection over outcomes, post-internship analysis that immediately and thoroughly focuses on explication of tasks and related outcomes, and clear examples (throughout the process) of these approaches that guide students in their thinking and communication about outcomes. We have been pleased with improvements in assessment that electronic portfolios have allowed, and we look forward to a great deal more improvement as we reassess our own instruction in and use of these portfolios.

REFERENCES

APPENDIX A: Internship Discussion Forum Questions

1. Describe your living accommodations: apartment, roommates, neighborhood, etc.
2. Describe where you work: location, equipment, products made, number of employees, etc.
3. Describe the safety program at your facility/facilities and what you have to do to comply with it.
4. Introduce your supervisor to us. What is his/her title? Primary job responsibilities? Who is his/her supervisor? What degree(s) does he/she have? What is his/her work history? Does he/she participate in any continuing education associated with his/her career? Plans for future career? Hobbies? Family? Hometown? You get the idea.
5. Describe the projects that have been assigned to you. Please do not include any information that could be considered proprietary, such as chemical names, etc. If you are unsure about your response, please have your supervisor review your writing before posting.
6. Interview your supervisor’s supervisor, using the same types of questions as you asked your supervisor. Introduce us to this person in your posting.
7. By now you have discovered that many things you learned in your courses at UWSP are useful on the job. Please describe two instances where you have applied something you learned in class to your co-op assignments.
8. Describe (in generic terms, no proprietary information) any spreadsheet work you have done. Did you need to use any special features in the spreadsheet program, such as equation solving, macro programming, table lookup functions, etc? Why are you creating/modifying the spreadsheet? What is the importance of this work? If you are unsure about your response, please have your supervisor review your writing before posting.
9. Describe equipment at your site that is important for environmental compliance (e.g., effluent treatment, scrubbers, etc.). Has the facility made changes that prevent the formation of regulated substances (pollutants)? What were those changes? How effective are they? Please have your supervisor review your description before you post it here.
10. Describe the types of reports that you have written thus far. How long are they? Do they contain tables, graphs, figures, etc? Who is the audience for your reports?
11. Now that you are more than halfway through your co-op assignment, do you have any new projects? Please describe your current work assignments, without including any proprietary information. Why are the projects important to the company? If you are unsure about your response, please have your supervisor review your writing before posting.
12. Describe your experience working as part of a project team during your co-op. What was expected of you? How did you contribute to the team effort? What problems arose? Do not mention names of any individuals in your response, and do not include proprietary information. If you are unsure about your response, please have your supervisor review your writing before posting.
13. Describe interactions that you have had with the operating and/or maintenance personnel in your mill. Why did you need to work with them? How did the interaction go?
14. Comment on the development of your leadership and/or management skills.
15. Describe an incident involving a significant conflict in which you were involved. What caused the problem? How did you deal with the situation? What do you think you could have done differently to handle the situation better? Was the issue resolved to everyone’s satisfaction? If you were not
involved in a significant conflict during your co-op, discuss how you might deal with a conflict with your supervisor and post the results of your conversation here.

16. How have you changed as a result of your work during your co-op?

APPENDIX B: Reflection Paper Assignment

Co-op Internship Reflection Paper

This report is an in-depth assessment and reflection of your internship and should include the following:

1. Employer/Company: List the name of the employer/company, the type of business (purpose), location (full address, phone/fax numbers, website address), and the internship site supervisor.
   a. Mission of Company: Include the company’s mission statement and discuss whether you feel it is an accurate reflection of the company.
   b. Organizational Hierarchy/Management Structure: Provide a structure of the company’s hierarchy. Describe the management structure, both formal and informal, of the company.
   c. Personnel Policies/Code of Conduct: Describe the company’s personnel policies or code of conduct, and discuss the strengths and weaknesses of these. If the company does not have a written code of conduct, discuss any unwritten (or understood) codes of conduct.
   d. Communication Methods and Effectiveness: Describe the communication characteristics of the company, citing examples of effective and ineffective communication you observed. Discuss any changes you feel would benefit the current structure.

2. Internship Project Information: Provide the specific title of your position as an intern.
   a. Goals (Company and Personal) of the Internship: Discuss what goals you established at the onset of the internship (if any), as well as the goals that were established for you by your supervisor. Give examples of how these goals were achieved.
   b. Tasks/assignments: Discuss the specific tasks/assignments you were given throughout the course of the internship in as much detail as possible without revealing proprietary information.
   c. Negotiation of Role and/or Tasks: Discuss how, if at all, you were able to negotiate your role or position in the company and/or how you negotiated some of the tasks given to you.

3. Evaluation of Experience:
   a. Summary of Accomplishments: Describe your accomplishments in the internship. Include in your discussion how you feel your accomplishments impacted/impacts the company.
   b. Career Implications: Discuss the career implications of your internship experience, detailing the connection between your formal education in your major and the internship.
   c. Evaluation: Discuss what professional, academic, and personal impact the internship had on you, explaining what you learned about yourself and any insights you gained. Include in your discussion the extent to which you progressed on the ABET Learning Outcomes listed in the PSEN course syllabus. Also discuss how the internship may or may not have influenced your career goals, how it did or did not meet your expectations, and whether you would recommend your internship site to future students.
# APPENDIX C: Rubrics

## Rubric for ePortfolio

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>BEGINNING</th>
<th>DEVELOPED</th>
<th>ACCOMPLISHED</th>
</tr>
</thead>
<tbody>
<tr>
<td>TECHNICAL</td>
<td>Hard to navigate; many links do not work; all text docs with few images; audio/or video not included; documents have many grammatical errors</td>
<td>Navigation is clear; some links do not work; content includes audio/video, digital images, slide show, and/or PDF docs; few grammar errors in documents</td>
<td>Clear navigation; links work; content includes audio/video, digital images, slide show, and/or PDF docs; documents are error-free.</td>
</tr>
<tr>
<td>DESIGN</td>
<td>Not organized or presented well; lacks personalization; not visual; poor use of design, audio, text elements</td>
<td>Organized; some evidence of personalization; is visual; good use of design, audio, and text elements</td>
<td>Well organized; unique/imaginative approach to design; highly visual; excellent use of design, audio, and text elements</td>
</tr>
<tr>
<td>REFLECTIONS</td>
<td>Reflections not related to artifacts; many reflections missing and/or need substantial improvement and revisions; reflections overall are of poor quality</td>
<td>Reflections are related to artifacts; some reflections missing and/or need of improvement and revisions; reflections overall are of good quality</td>
<td>Reflections are clearly related to artifacts; reflections are well written and reveal depth and breadth of thought; reflections have no grammatical errors</td>
</tr>
</tbody>
</table>
### Outcome C: Design Project Evaluation Standards

<table>
<thead>
<tr>
<th>Performance Criteria</th>
<th>Exceptional</th>
<th>Acceptable</th>
<th>Marginal</th>
<th>Unacceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design Problem and Boundaries</strong></td>
<td>Clear and complete understanding of design goal and constraints.</td>
<td>Overall sound understanding of the problem and constraints. Does not significantly impair solution.</td>
<td>Some understanding of problem. Major deficiencies that will impact the quality of solution.</td>
<td>Little or no grasp of problem. Incapable of producing a successful solution.</td>
</tr>
<tr>
<td><strong>Alternative Designs</strong></td>
<td>Final design achieved after review of reasonable alternatives.</td>
<td>Alternative approaches identified to some degree.</td>
<td>Serious deficiencies in exploring and identifying alternative designs.</td>
<td>Only one design presented or clearly infeasible alternative given.</td>
</tr>
<tr>
<td><strong>Use of Computer–Aided Tools</strong></td>
<td>Computer–aided tools are used effectively to develop and analyze designs.</td>
<td>Computer–aided tools used with moderate effectiveness to develop designs.</td>
<td>Minimal application and use of appropriate tools.</td>
<td>Serious deficiencies in understanding the correct selection and/or use of tools.</td>
</tr>
<tr>
<td><strong>Application of Engineering Principles</strong></td>
<td>Critical selection and application of engineering principles ensuring reasonable results.</td>
<td>Effective application of engineering principles resulting in reasonable solution.</td>
<td>Serious deficiencies in proper selection and use of engineering principles.</td>
<td>No or erroneous application of engineering principles yielding unreasonable solution.</td>
</tr>
<tr>
<td><strong>Final design meets objectives</strong></td>
<td>Design meets or exceeds desired objectives.</td>
<td>Design meets desired objectives.</td>
<td>Barely capable of achieving desired objectives.</td>
<td>Not capable of achieving desired objectives.</td>
</tr>
<tr>
<td><strong>Final Design uses resources wisely</strong></td>
<td>Effective implementation of resource conservation and recycle strategies.</td>
<td>Moderately effective use of resource conservation and recycle potentials.</td>
<td>Minimal use of resource conservation and recycle potentials.</td>
<td>No implementation of resources conservation and recycle strategies.</td>
</tr>
<tr>
<td><strong>Process Economics</strong></td>
<td>Effective use of profitability analysis leading to better recommendations.</td>
<td>Reasonable profitability analysis presented, but no interpretation of the results.</td>
<td>Reasonable cost estimates presented, but no profitability analysis included.</td>
<td>No or totally erroneous cost estimates presented.</td>
</tr>
<tr>
<td><strong>Interpretation of Results</strong></td>
<td>Insightful, fully supported conclusions and recommendations.</td>
<td>Sound conclusions based on achieved results.</td>
<td>Serious deficiencies in support for stated conclusions.</td>
<td>No or erroneous conclusions based on achieved results</td>
</tr>
</tbody>
</table>
## Outcome D: Teamwork

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Preparation</td>
<td>Had a complete awareness of assigned role and did not require any help from other team members.</td>
<td>Had an adequate idea of assigned role and only sometimes relied on others to compensate for lack of preparation.</td>
<td>Had a limited idea of assigned role and relied on others to compensate for lack of preparation.</td>
<td>Did not prepare for assigned role or come to meetings prepared.</td>
</tr>
<tr>
<td>Share work equally</td>
<td>Always does the assigned work without having to be reminded.</td>
<td>Usually does the assigned work; rarely needs reminding.</td>
<td>Rarely does the assigned work; often needs reminding.</td>
<td>Does none of the assigned work OR takes on too much project work (lack of trust in teammates to do good work).</td>
</tr>
<tr>
<td>Listen to teammates</td>
<td>Balances listening and speaking fairly to all group members.</td>
<td>Listens, but sometimes talks too much.</td>
<td>Rarely allows others to speak OR rarely speaks at all.</td>
<td>Never allows others to speak OR never speaks at all.</td>
</tr>
</tbody>
</table>

## Outcome E: Identify, formulate and solve engineering problems

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Applies concepts, governing math or physics equations and algorithms to solve a problem</td>
<td>Applies correct concepts, chooses correct governing equations and optimum algorithms (or methods) to solve a problem.</td>
<td>Applies correct concepts, chooses correct governing equations but use sub-optimum algorithms (or methods) to solve a problem.</td>
<td>Applies some correct concepts and chooses some correct governing equations but makes mistakes</td>
</tr>
<tr>
<td>Demonstrates effective open-ended problem solving techniques</td>
<td>Always solves problems using step-by-step logical procedure and obtains correct solution(s) independently</td>
<td>Solves problems using step-by-step logical procedure; needs occasional guidance but still obtains correct solution(s)</td>
<td>Mostly solves problems using step-by-step logical procedure but needs substantial guidance to obtain the correct solution.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Solves problems without logical step-by-step procedure and/or makes major procedural errors resulting in incorrect solution</td>
</tr>
</tbody>
</table>
## Outcome F: Understands professional and ethical responsibility

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</tr>
</thead>
<tbody>
<tr>
<td><strong>Knowledge of Standardized Code of Ethics</strong></td>
<td>Student knows and abides by the NSPE Code of Ethics</td>
<td>Student knows the NSPE Code of Ethics and other bases for ethical behavior</td>
<td>Student is aware of the existence of the NSPE Code of Ethics and other bases for ethical behavior</td>
<td>Student is not aware of any codes for ethical behavior</td>
</tr>
<tr>
<td><strong>Behavior</strong></td>
<td>Always demonstrates ethical behavior among peers and faculty</td>
<td>Usually demonstrates ethical behavior among peers and faculty</td>
<td>Does not model ethical behavior among peers and faculty</td>
<td>Student has been caught cheating or plagiarizing the work of others</td>
</tr>
<tr>
<td><strong>Responsibility</strong></td>
<td>Always takes personal responsibility for his/her actions</td>
<td>Usually takes personal responsibility for his/her actions</td>
<td>Blames others for own issues and problems</td>
<td>Doesn’t recognize the need to take personal responsibility for his/her actions</td>
</tr>
<tr>
<td><strong>Respect for Others</strong></td>
<td>Is always punctual, professional, and collegial; attends classes regularly</td>
<td>Rarely exhibits unprofessional behavior; when absent from class there is always a reason</td>
<td>Sometimes exhibits unprofessional behavior; is sometimes absent from class without reason</td>
<td>Is frequently absent from class and is generally not collegial to fellow students, staff, and faculty</td>
</tr>
<tr>
<td><strong>Objectivity</strong></td>
<td>Evaluates and judges a situation in practice or as a case study, using facts and a professional code of ethics</td>
<td>Evaluates and judges a situation in practice or as a case study using personal understanding of the situation</td>
<td>Applies a personal value system to a situation or case study with minimal understanding of the situation</td>
<td>Evaluates and judges a situation in practice or as a case study using a biased perspective without objectivity</td>
</tr>
</tbody>
</table>
## Outcome J: Knowledge of contemporary issues

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</thead>
<tbody>
<tr>
<td><strong>Current Events</strong></td>
<td>Has knowledge of current events in industry and in society</td>
<td>Has knowledge of current events in industry</td>
<td>Has some knowledge of current events</td>
<td>Has no knowledge about issues and events in the world</td>
</tr>
<tr>
<td><strong>Job Market</strong></td>
<td>Takes initiative in job search</td>
<td>Has a good perspective on the current job market</td>
<td>Has a somewhat narrow perspective on the current job market</td>
<td>Hopes that a job will fall into his/her lap</td>
</tr>
<tr>
<td><strong>Political Issues</strong></td>
<td>Able to discuss in-depth major political issues at national, state and local levels and their effect on industry. Can summarize essence of several issues, take and defend a position on them</td>
<td>Able to discuss in-depth major political issues at national, state and local levels. Can summarize essence of several issues, take and defend a position on them</td>
<td>Able to comment on major political issues, but is not familiar enough with them to defend a position on them. Can summarize the facts of the issues</td>
<td>Unable to comment on political solutions or is unaware of world and local happenings</td>
</tr>
</tbody>
</table>
Outcome K: Ability to use the techniques, skills and modern engineering tools necessary for engineering practice

<table>
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</thead>
<tbody>
<tr>
<td><strong>Tool Selection</strong></td>
<td>Selection of tools is based on sound technical criteria. Relevant industry standard class tools (software CAD, simulation, test equipment, emulators, measurement and lab equipment, planning and project management tools) are selected for carrying out specific tasks.</td>
<td>Selection of tools is based on prior knowledge of the tools. Relevance of the selected tools is close to the standard practices.</td>
<td>Selection of tools is not based on technical criteria. Tools are selected based on personal preference.</td>
<td>Selection of tools is not discussed. Use of the wrong set of tools is commonly noticed.</td>
</tr>
<tr>
<td><strong>Tool Usage</strong></td>
<td>Usage of the tools shows a good awareness of the tools’ capabilities and features. Tools are used correctly and in a consistent way with the stated objectives. Any issue with the tools is resolved using the tools documentation, FAQs or the customer support. Accurate description of credible problems encountered is noticed.</td>
<td>Usage of the tools shows a fair awareness of the tools’ capabilities and features. Tools are used correctly and in a consistent way with the stated objectives. Some issues with the tools where the answers are present in the documentation are not properly resolved. Accurate description of credible problems encountered is not always seen.</td>
<td>Usage of the tools shows a little awareness of the tools capabilities and features. Tools are used correctly and in a consistent way with the stated objectives. Improper use of the tools documentation. Several issues with the tools where the answers are present in the documentation are not properly resolved. Accurate description of credible problems encountered is missing.</td>
<td>Usage of the tools shows no awareness of the tools capabilities and features. Tools are used incorrectly and in an inconsistent way with the stated objectives. Improper use of the tools documentation. Most issues with the tools where the answers are present in the documentation are not properly resolved. Accurate description of credible problems encountered is missing.</td>
</tr>
</tbody>
</table>