AC 2011-2558: ”I JUST THOUGHT I DID INSIGNIFICANT TASKS”: USING E-PORTFOLIOS TO UNDERSTAND CO-OP AND UNDERGRADUATE RESEARCH EXPERIENCES

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"I just thought I did insignificant tasks": Using E-portfolios to Understand Co-op and Undergraduate Research Experiences

Abstract

This paper discusses initial work with having engineering students in optional, industry-sponsored Co-op and summer research programs construct e-portfolios in studio settings. It focuses on the challenges and opportunities students experienced in constructing the portfolios, which were explained as arguments about preparedness for future careers. The impetus was the recommendation by the industry visiting committee that engineering students in experiential learning programs create portfolios. The studio activities were adapted from other settings to explore the use of e-portfolios in the reporting requirements for students. Students experienced the following challenges: 1) identifying what their future careers may be; 2) choosing the audience for the portfolio; and 3) locating and choosing appropriate artifacts to include as evidence for their claims. Students were able to overcome these challenges and found that doing so helped them articulate and focus their understanding of their future careers and their preparedness claims. They found both the process of constructing the portfolio and having a portfolio to be valuable. The studio setting provided a number of opportunities and benefits that other reporting requirements do not, including meeting other participants in the program and sharing reflections with their peers. These outcomes are consistent with our broader research on the use of preparedness arguments to support knowledge integration and reflection. Because of the success of these activities, the opportunities and constraints associated with institutionalizing the use of e-portfolios are considered.

Introduction

Portfolios have been used widely at the University of Washington in a variety of ways. However, the use of portfolios has been up to individual College of Engineering (COE) faculty and departments. The COE visiting committee, which includes industry and academic representatives, challenged us to include portfolios in the reporting requirements for students participating in COE experiential learning programs. Responding to this call, our two units—COE's Experiential Learning and Student Leadership Programs, which sponsors these co-curricular activities, and the Department of Human Centered Design & Engineering (HCD&E), an academic department that has institutionalized the use of portfolios—conducted a set of initial activities during the 2010 academic year. In addition, the academic co-authors are conducting ongoing research sponsored by the National Science Foundation with students across the college about the educational significance of having students construct such arguments [1-6].

The studio activities developed for other settings were adapted for participants in two optional, co-curricular experiential learning programs: the engineering undergraduate research program (EURP) and the Co-op program. Approximately 40 students participated in these activities. We explored the opportunities associated with including portfolios in the reporting requirements required for credit when applicable or upon completion of the program. We asked students to answer the question of "How Co-op or research prepared you for future professional practice." Students then crafted their responses as arguments about preparedness, illustrated in the form of

an e-portfolio consisting of a professional statement and annotated artifacts explaining technical and professional skills and other competencies.

To set the context for this work, we first provide an overview of COE's experiential learning programs and the research that informs our work. In the subsequent sections we briefly summarize the outcomes from the studio activities from our point of view then illustrate the challenges and opportunities experienced by the students, using their own words from their portfolios and feedback forms. We consider the following issues: a) the significance of asking students to construct arguments about their own preparedness and b) the benefits of constructing e-portfolios in interactive workshops with peer review. We also briefly consider c) the potential benefits to industry partners of having students document their experiences in e-portfolios, and d) the opportunities and constraints associated with institutionalizing e-portfolios within existing experiential learning programs.

COE's Experiential Learning Programs

The University of Washington College of Engineering Experiential Learning and Student Leadership Programs comprise Engineering Co-op, Engineering Undergraduate Research Program, Emerging Leaders Scholars Program, and Student Organizations and Societies. These programs attempt to provide students with the support that encourages a sense of "home" within the college and the challenge to stretch and grow as students while increasing their identity as engineers.

Co-op first began at the University of Washington in 1957 with two primary local employers: Boeing and Puget Sound Naval Shipyard. The number of students participating in Co-op has varied over the years depending on both the local and national economy. During the past decade, participation has varied with the flexibility of engineering curriculum, the emphasis on graduation within 4-4.5 years, and the availability of resources for students seeking industry experience. In the past few years the average number of students participating in Co-op has been around 250 per year. It is unknown how many students get related work experience outside Co-op because there is no reliable method of quantifying summer internships.

The optional Co-op program allows students to gain full-time supervised paid industry work experience related to their area of study while earning college credit. Students complete pre- and post-work self-assessment of professional and technical skills; collaborate with their supervisor on-the-job to develop a learning objectives report; and submit a final summary report detailing the nature of their work experience and its relationship to their course of studies.

Advising plays a central role. The Co-op adviser and manager, who is one of the co-authors of this paper, works with supervisors as well as students in conjunction with engineering faculty to ensure that all jobs meet Co-op requirements. The Co-op adviser is in communication with students throughout the work period. Some engineering departments match students with faculty advisers who oversee the Co-op experience. Other departments provide faculty as resources for the Co-op adviser.

Deliverables by students are evaluated by the Co-op adviser who determines if credit for the Co-op is earned. Departments that accept the Co-op credit (ENGR 321) to meet specific department requirements (option credits in mechanical engineering; chemistry electives in chemical engineering; senior electives in computer science and engineering; technical electives for materials science and engineering; internship requirement for human centered design & engineering) have faculty who review the deliverable and determine if the ENGR 321 credits earned qualify for departmental credits.

The Engineering Undergraduate Research Program (EURP) is an optional summer intensive research program during which students work full-time in faculty-led ongoing engineering research on campus and participate in a series of seminars and workshops focused on enhancing students' understanding of research and graduate school. The program advisor (who is the same person as the Co-op advisor) convenes a weekly seminar group for participants. Students present their research findings at a campus-wide research poster symposium and write a research paper at the conclusion of the summer quarter. Over 80% of students continue in research after the program concludes.

Portfolio Construction Approach

Our approach to portfolio construction is informed by theories of learning that emphasize the importance of experience and reflection on experience[7-10] as well as research on the ways in which portfolios support reflection[11-12]. This approach expands on Dewey's[7] notion of the continuity of experience by explicitly asking students to imagine how past experience prepares them for the future. Few students from among the more than 200 participating in the portfolio workshops associated with our ongoing research are familiar with portfolios[1-6]. Even fewer have ever constructed a portfolio. Thus, our workshops begin with introducing students to the notion of portfolios and its use as a means for presenting a preparedness argument to potential employers.

The workshops begin with an assignment such as the following:

- Construct an argument in the form of a professional e-portfolio in which you make claims about your **preparedness** for engineering practice, and use products and by-products of any of your experiences to-date as evidence for your claims.

Students then create e-portfolios, over periods ranging from one week to one academic term, consisting of a professional statement and several annotated artifacts, using the university's e-portfolio and web site construction tools. To support students with this construction, the studio activities feature peer-to-peer interactions with educators taking a facilitator's role. Multiple sessions provide opportunities for peer review and feedback on the portfolio elements, usually leading to richer portfolios and learning outcomes. Portfolios in this context are a reflective tool for students to use to integrate their technical knowledge and relevant experiences and relate them to imagined futures.

The portfolio activities were included in the required weekly meeting for EURP participants. The workshop facilitators (the academic co-authors) met with the students three times as follows:

1. E-portfolio orientation workshop at beginning of summer (1 hour workshop)

2. Check point mid-summer, with brainstorming about what skills they were practicing and why employers might want a portfolio (15 minutes)
3. Peer review of portfolios at end of summer (1 hour workshop)

In addition, the experiential learning program advisor met individually with students to talk about their portfolios and answered questions during their weekly meetings throughout the summer. The students created portfolios and provided the URLs to the workshop facilitators. These were then linked to the common online workspace so that all students could view them.

It was more difficult to incorporate portfolio activities into existing processes since Co-op is optional for students; the only requirement to meet with Co-op staff is a one on one pre-placement meeting with the program advisor; they all are on different schedules (usually gone 1-3 quarters); and include a mix of undergraduates and graduate students. Given the limited contact time, we conducted a pilot workshop during the spring term in order to investigate potential constraints and opportunities with asking Co-op students to construct portfolios. Our informant was articulate and provided us with a number of insights that helped tailor the orientation to the needs of Co-op students. For example, the issue of audience and having artifacts to include at the end of the placement loomed large. Anticipating bringing artifacts back from the experience was illuminating and proves to be common among other students, but proprietary and intellectual property issues are raised for Co-op.

Two portfolio orientation workshops were offered at the end of the spring quarter to all students going out on Co-op placements for the summer. A total of 19 students attended the one-hour sessions. They were offered the option of submitting a portfolio at the end of their placements. Most students had no intention of this being a completed project at the point when we parted company. As we write this paper, not everyone is finished with their Co-op position; some are just returning now and some of the graduate students are still out.

Nevertheless, the Co-op students who did construct portfolios found the experience to be valuable. They did not feel comfortable with providing the experiential learning advisor with the entire portfolio but said that they had leveraged the portfolio to integrate other experiences in school and work. Although the portfolio was offered as an option instead of the report, some students did the report anyway and included it as an artifact in the portfolio. Informal conversations with students indicate that they felt ownership of their portfolios in ways not associated with formal report.

Findings

The title of our paper begins with a quotation from a pilot Co-op informant who said that creating a portfolio helped her see the value of her experience. Career-focused learning experiences such as Co-op and undergraduate research activities are intended to help students prepare for professional activities. However, although programs usually require students to report, or even better reflect on these experiences, students may not have an appropriate context for projecting the relevance of these experiences to future preparedness. For example, students may not know what profession they will ultimately choose or they may not understand the importance of dimensions such as understanding organizational culture to professional success.

We found that these same challenges held for the EURP students in the studio activities. As discussed below, we had more contact time with the EURP students. Furthermore, the EURP students produced portfolios and presented them to the group. We have access to their portfolios. We are currently conducting a survey of Co-op students who participated in the workshops to check on their status. Our impressions and their feedback from the orientations about the value of constructing preparedness arguments in the form of a portfolio are consistent with our ongoing research with groups of students across the college.

For those students who constructed and presented portfolios, we observed that identifying the appropriate audience for the portfolio is difficult but helps focus the preparedness claims; and that locating and choosing appropriate artifacts produces anxiety for most students. Students were able to overcome these challenges and found both the process of constructing the portfolio and having the portfolio to be valuable. The studio setting provided a number of opportunities and benefits that other reporting requirements do not, including: 1) meeting other participants in the program and sharing reflections with their peers; 2) addressing how the experience prepared them for future practice with employers as the intended audience; and 3) articulating their understanding of what engineers do, and what contributes to effective practice.

Our pilot Co-op project suggested that writing the final experience report involves an unknown audience. Our informant said that she was unclear what happened with her report and that no-one talked to her about her experience, even at the poster presentation she gave. The most obvious benefit of participating in group activities is that they provide interaction and feedback as well as opportunities to reflect on experience. Thus, the portfolio studios involve talking with other students more than the report writing experience does. Furthermore, anticipating having to collect artifacts prepares students to talk to their employers and co-workers about their work and the products of their work. The portfolio is more of a shared presentation format than the report, which tends to be more private in the academic setting.

We all agree that research and work experience are valuable but we don't always know how they are valuable. Student feedback indicated that constructing their portfolios helped them see the value of their experiences in industry or in research as well as helped them come to a deeper understanding themselves. For example, they came to understand that going to meetings is about learning organizational culture. They learned that research involves working with other people, problem solving, and understanding the complexity of evidence and knowledge construction.

Insight 1: Students' Reactions to Being Introduced to Portfolios

Since students don't have much prior knowledge about portfolios, the orientation workshops ask students to consider and discuss two questions: 1) what is the value of having a portfolio? and 2) what is the value of constructing a portfolio? Below are examples of the feedback we got from students in the Co-op and URP workshops. These reflections on the workshop and portfolios are consistent with what other students in our research have said. We have found that students reiterate these same thoughts at the end of the construction process but become clearer and more certain about their experience. To illustrate, in a group discussion at the beginning of the Co-op orientation students replied as follows:

Prompt: What are your thoughts on the usefulness of having a portfolio?

Co-op Group 1
- More in depth, without boring, say to an employer
- Show off your personality
- Use at an interview, link in resume
- Show examples of work vs. description
- See it—helps understanding
- Your integration of your knowledge, understanding

Co-op Group 2
- Links to portfolio on online professional networking sites, more info than just list of experience
- Explain why majoring in engineering in order to go to med school…. types of thought processes, similar types of models/metaphors, passion…
- Fit in/stand out
- PASSION!!! How to express it?

Prompt: What are your thoughts on the usefulness of making a portfolio?

Co-op Group 1
- Think about the experience, how useful, what learned
- Cheat sheet
- Practice and demonstrate communication skills
- ID area to improve, or goals
- What about academic portfolio?

Co-op Group 2
- Give a clear idea of what you have done and how to tell people about it (rehearsal)
- Recap what done and organize it
- Learn more from the experience (not just a boring meeting); goal is to take experience forward
- Extra reflection…what really got out of it…..

<u>Insight 2: Articulating What it Means to be an Engineer</u>

One of the first activities in the workshop is to have students introduce themselves and briefly describe their career plans. Many did not have a clear idea of what profession they were headed for. Writing the professional (or personal) statement was a challenge for some, but helped them articulate both their version of what their chosen career consists of, and how they can contribute to it.

The assignment given to students was to imagine a potential employer as their audience. In our midterm discussion with EURP students, we addressed the question of why employers want

students to have a portfolio. We suggested that employers probably don't want people to "have" portfolios, but rather to have employees who "have" a wide set of skills and who "know what they know." Having a portfolio is excellent evidence of this meta-knowledge. The following excerpts are from EURP students' portfolios and demonstrate this type of meta-knowledge:

From Statement of Purpose (EURP student):

> *Now, after going through the electrical engineering curriculum and doing undergraduate research (EURP), my perception of engineers has changed. I believe that an engineer needs to learn two sets of skills of equal importance, namely analytical problem solving and people skills. The first consists of equipping the student with the scientific tools developed over centuries in order to tackle engineering problems effectively. People skills are learned by proactively interacting with professors, classmates, and colleagues…..*
>
> *I feel that learning the basics of both sets of skills has prepared me to become a successful engineer. I don't think that one skill is better that the other, instead I think they complement each other. Knowing when and where to apply each of them can make an engineer to excel not only in problem solving but also in developing relationships.*

From Personal Statement (EURP Student)

> *What does it mean to be a successful engineer?*
> *But in truth, I do not have a solid, specific answer as to what good engineers are made of. I can however, point out times in my own professional, educational and personal experiences where I have found glimmers of a good engineer. I can also recall the sound advice I've been given as to how to improve and increase my skill-set in order to achieve such the lofty, but attainable, goal of "successful engineer." Most importantly, I will demonstrate my ability to learn and to manage through various projects, internships and research experiences that I have participated in, in the past. Specifically, I will describe the impacts of the following experiences: my undergraduate research at UW; my six month internship at [Firm x]; my various extra-curricular activities; and my projects and coursework for my computer engineering degree at the UW. I focus on the following skills, which I have found to be very important to employers and my co-workers and peers:*
>
> - *Multitasking*
> - *Documenting Your work*
> - *Self-Directed Learning*
> - *Goal Setting and Setting Personal Deadlines*
> - *Networking and Making Friends*
> - *Talking to your Boss*
> - *Leadership*
> - *Technical*
>
> *Through the learning and improving of these skills, as well as my strong abilities to learn quickly in a diverse set of situations and to manage my life efficiently, effectively and with fun, I demonstrate how I have what it takes to be a strong and successful engineer.*

Dealing with the issue of an ambiguous audience was productive. At first students were uncertain about what employers want but in the studio workshops they are able to identify some common themes and to articulate their preparedness. Many of the skills that they describe in their portfolios would be considered professional rather than technical skills.

The workshops also allow them to *discuss* their intended professions with their peers. As one student in the EURP commented:

> *Last year, I participated in the Undergraduate Research Program and was able to greatly develop my skills in research. This year, I again entered a conference room to attend URP's first meeting, but found myself facing a new group of people. I realized that I had not taken the opportunity last year to get to know my peers and their viewpoints, but now I had a second chance. The URP is not just about developing undergraduates into skilled researchers; it is also an opportunity to develop professional relationships with others and participate in discussion about the state of technology and science.*

This is an important professional development opportunity. Because of the size of the college, COE students generally do not know students in other departments. The experiential learning advisor found that portfolios "really bumped up their [students'] enthusiasm and their interest in sharing; it became less of a private experience and helped them globalize and generalize." In fact, expressing enthusiasm and a passion for their chosen careers and their current activities is one of the common elements that students identify as contributing to a successful portfolio.

Insight 3: Arguments and Artifact Anxiety

Students seem to be intrigued by the notion of constructing arguments. They seem to be comfortable with making claims and evidence. However, most students have artifact anxiety. The workshops provided an opportunity for students to brainstorm the claims that they want to make and the appropriate artifacts to include as evidence. They also saw examples from other students and how they have created annotations. Two issues loom large for Co-op students in particular: a) the issue of non-disclosure and proprietary information and b) the issue of what to show for a computer science/software engineering work that involves coding. Students come up with numerous solutions to these problems. Knowing in advance that they should be thinking about collecting artifacts helps them talk to their employers about these issues.

Helping students find and commit to artifacts is important so that they can have time to reflect on and then write about these artifacts in their portfolios. We use the term "annotation" to describe the text provided to the reader about the artifact. The examples below illustrate the types of annotations that students wrote. In the first example, the student is writing about the significance of a perl script (the artifact) and linking it to self-directed learning. In the second example, the student is using a performance evaluation (the artifact) to talk about self-evaluation and relationships in the workplace. In the third example, the student is linking a programming experience not only to programming skill but also enthusiasm and interest in having a social impact.

Example 1: I actually had to learn how to use Microsoft Visual Studio 2005 and learn the scripting language Perl by myself. Much of my work at [Firm x] involved writing complicated scripts to modify C code. I provide a copy of a very simple Perl script called find_file.pl at the bottom of this page. I wrote find_file.pl while at [Firm x] when I was still working on learning Perl. No one at [Firm x] had the time to sit with me and teach me Perl. I spent a few days to a week learning Perl and experimenting with regular expressions (which I needed to write in order to recognize and modify C code). My code was not without errors, and sometimes I would have to fix C code that my scripts had incorrectly modified before debugging the scripts. However, learning and mastering Perl was a lot of fun, and I did great work on the project. By the end of the project, my Perl scripts had probably saved hundreds of hours of manual find and replace work on the project.

Example 2: While I interned at [Firm x], I had weekly meetings with my manager. We would discuss my progress through the project, how I was getting along with the other intern I worked with, and how things were in general for me. It really forced me to set goals and prove myself to get my deliverables done before the end of my internship. It also forced me to take an honest look at my performance and provide constructive criticism for my work and my professional skills. My manager was extremely supportive throughout my internship, and I now have a good idea of what I should look for in a employee-manager relationship. I've placed a copy of the performance review I had to write about myself for download at the end of this page. I brainstormed with my manager about things I could or should write about, spent a day writing the actual review, and edited it as I received feedback from my manager. It was a very helpful and eye-opening experience. It helped me see management positions in a different light, and how I as an employee still need to be an active participant in the management process.

Example 3: This programming work has definitely extended my practical knowledge of Windows C++. More importantly, however, I had to pay attention to what users wanted from our application, and deliver a usable and efficient solution. During the field study, it was exciting to see that my work was actually helping make a positive use experience for our participants.

Future Work

The process of constructing a portfolio provided students with the understanding and ability to articulate their preparedness. The critical difference between an internship and a research or Co-op experience is the “academic component”: the reflection, guidance, making something public, getting feedback, and bouncing ideas off others. In the portfolio studios, reflection and sharing an experience with others supports a different level of inquiry into the experience. Students think that it will be easy to describe what they learned during a research or Co-op experience, but find that it is hard. The portfolio is enticing enough that when they hit the difficulty, they are willing to go on because they want the portfolio.

Students get excited about portfolios, which is exciting to us. “I am really excited.” We never hear that kind of comment about the final summary reports. Some of this excitement may be due

to a novelty effect. However, our research suggests that portfolios offer affordances that the canonical experience report does not. Furthermore, the studio workshop requirements are open-ended and we support students in being creative in how they construct and present their portfolios.

We need to consider further the opportunities and constraints associated with institutionalizing e-portfolios in COE's experiential learning programs. The biggest constraint we faced was incorporating enough face time with students. Perhaps the easiest solution to this issue is to require students to register for a 1-credit seminar. Since departments do not require Co-op participation, it would help if this seminar could be included in credits that students really need to graduate.

But we can imagine other constraints and concerns that educators might raise. For example, educators might ask about additional burdens placed on busy students who may have a learning curve to master the e-portfolio tools. Or they might raise the issue of whether portfolios detract from the rigor of a technical report or the value of a preparedness argument given the uncertainty of student career paths. In our experience, these are all addressable concerns. The overarching issue, it seems, is what exactly is the function of the reporting requirement? While a typical experience report does provide documentation, the reporting requirement is also about helping students share their experiences with others and, of particular interest, reflect on their experiences. In this project, as in our other work, having students construct preparedness portfolios seems a valuable way to support such reflection.

For now, we have seen the value of portfolios to students and to staff and are very optimistic that this could revise current reporting requirements. As educators we get to see their world and get to see their excitement through their portfolios. The initial activities have provided the experiential learning staff with a deeper understanding of students' experience, allowing them to be more effective in supporting students' learning. Having students construct portfolios is more in tune with what industry expects of student employees. One benefit to students, educators, and employers alike is a subtle skill that comprises knowing how to learn in different contexts. We know as educators that learning in school is different than learning in the workplace. Constructing portfolios about these experiences has helped students understand the differences.

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