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Preparedness Portfolios and Portfolio Studios

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We live in a time of great enthusiasm for the role that e-Portfolios can play in education and a time of exploration in which educators and researchers are investigating different approaches to using e-Portfolios to differentially support educational goals. In this paper, we focus on preparedness portfolios and portfolio studios as two key components of an approach to using portfolios in a specific educational context. The paper includes an identification of four commitments that contributed to the emergence of this particular approach, an explanation of the theoretical rationale associated with the approach, and a review of research data that substantiates enthusiasm for the approach. We close with comments on the potential for transferring this approach to other educational contexts.

E-Portfolios represent a flexible and powerful innovation in education. The flexibility is evident in the growing body of work that showcases e-Portfolio use across disciplines, across student populations, and for a variety of educational purposes (Cambridge, Cambridge, & Yancey, 2009; Jafari & Kaufman, 2006). The power is evident in the growing body of research that increasingly demonstrates that e-Portfolios are not only theoretically interesting, but also profoundly significant for the students and educators who use them (Cambridge, et al., 2009; Jafari & Kaufman, 2006). This body of research also raises questions about how to facilitate e-Portfolio activities to effectively leverage their potential.

In this paper, we contribute to these threads of flexibility, power, and facilitation as we describe work on preparedness portfolios and portfolio studios—two components to an approach for using e-Portfolios in engineering education. This work contributes to the notion of e-Portfolios as flexible, by showing their use in engineering education, a discipline that has not traditionally been strongly connected with work on e-Portfolios, and their use as a tool to help students connect the present to the future, hence the notion of preparedness. The work also contributes to the notion of e-Portfolios as powerful, through research linking students' e-Portfolio efforts to educationally significant issues of epistemology, identity, and meaning. Finally, the notion of portfolio studios—a structure for supporting students in their efforts to construct their e-Portfolios—contributes to the conversations on facilitation. The work we describe in this paper has been developing over the past several years (Eliot, Turns, & Xu, 2008; Kilgore, Sattler, & Turns, in press; Sattler, Kilgore, & Turns, 2010; Turns, Cuddihy, & Guan, 2010; Turns, Sattler, & Kilgore, 2010).

We anticipate that readers will take different things from this paper. For example, we feel that there is reason for people to consider adopting the entire approach, and we hope that some readers consider this. However, we envision other ways that readers can benefit from this paper. Readers currently engaged in using e-Portfolios may find this work useful as a catalyst for thinking about and reflecting on their own work. Readers who are considering becoming involved in some type of e-Portfolio initiative may begin to develop expectations appropriate to their own situations.

In the next section, we discuss the specific commitments that have guided this work. The two subsequent sections are devoted to discussing the two components of our approach—preparedness portfolios and portfolio studios—and the ways in which these components function within the particular situation in which we are working.

Commitments

The work presented in this paper and the decisions represented within the work are specific to the situation in which we have been operating and to the commitments associated with this situation. Specifically, our work involves a commitment to undergraduate engineering education, a commitment to putting learning before assessment, and an emphasis on student generation of e-Portfolio content rather than the development of technologies that support e-Portfolio creation. In addition, the efforts associated with this work have, to date, involved a commitment to research over full-scale implementation.

A Commitment to Undergraduate Engineering Education

Nationally and internationally, work with e-Portfolios has cut across a wide variety of academic levels including K-12, undergraduate, and graduate, as well as academic disciplines including English and Nursing (Jafari & Kaufman, 2006). It stands to reason that e-Portfolio activities situated in specific disciplines and with specific student populations would, in order to be successful, start to align with characteristics of the

discipline and/or the student population being emphasized. For example, since reflective activity plays a different role in the production of knowledge in the soft versus hard disciplines (Kreber & Castleden, 2009), e-Portfolio approaches enacted in different disciplinary contexts would likely need to accommodate these differences. Also, the ways in which students understand the nature of knowledge (i.e., issues of epistemological development), and specifically how sophisticated students are in terms of their understanding of the nature of knowledge (see Felder & Brent, 2004), would likely interact with how students make sense of and succeed with e-Portfolio tasks. Since such understanding is loosely correlated with academic level, we might thus anticipate that e-Portfolio activities would, over time, be different at different academic levels.

As we stated, this work is situated in undergraduate engineering education—a form of education that is not only undergraduate but also professional. Thus, students are developing intellectually and concurrently being brought into a profession. Engineering curricula are known for being "heavy" from a coursework perspective (see Atman et al., 2010), at a time when many students are still undergoing significant intellectual development. While this heavy coursework creates challenges in introducing additional activities such as e-Portfolios, the role of experiential learning in engineering and the interest in innovation in engineering education both create opportunities for using e-Portfolios (see Sheppard, Sullivan, Colby, Macatangay, & Shulman, 2008). The approach to using e-Portfolios presented in this paper aligns with a desire to support engineering students and align with engineering curricula.

A Commitment to Promoting Learning

While learning and assessment are both linked tightly with e-Portfolio work, many e-Portfolio implementations emphasize assessment. For example, e-Portfolios have been used as tools for assessing student work for a particular course or an entire program. Such emphases are often related to accountability pressures.

The emphasis in this work has been on learning. Moreover, we conceive of learning broadly (see Davis, 2004). In fact, much of this work is associated with broad overarching questions concerning the kinds of learning that can be engendered with e-Portfolio activities and whether e-Portfolio efforts can contribute to some of the ambitious learning goals that educators and higher education institutions have for students (e.g., large-scale integration of their knowledge, metacognitive awareness, self-authorship). Since this work is not committed to supporting specific forms of assessment, we can explore having students draw on experiences widely, make very personal choices in their e-Portfolios, create e-Portfolios that do not address the same content, and take risks in making their e-Portfolios. The resulting e-Portfolios can certainly support some type of assessment, but that is not the goal of this work.

An Emphasis on Content

The issue of technology is a strong theme in the work related to e-Portfolios. In fact, the first section of the Handbook of Research on e-Portfolios (including twenty two chapters) is devoted to issues of "Portfolio Thinking and Technology." Moreover, the effort at the University of Washington to build an e-Portfolio tool specific to the university (see Lewis & Fournier, 2009) and the Minnesota statewide exploration of an e-Portfolio system (Cambridge, 2008) underscore the emphasis on technology associated with work on e-Portfolios. When the goal is a large-scale deployment, then such an emphasis on technology, particularly an emphasis on creating robust, reliable, efficient, and supportive technology, makes sense. One challenge, however, is that technology is not neutral, and efforts to construct systems that organize and scaffold an activity typically embed assumptions about that activity. Also, once a technology becomes complicated, it takes effort to learn the technology itself—something that can interfere with the potential benefits of e-Portfolio activities.

In this work, we have been emphasizing e-Portfolio content and de-emphasizing technology. In particular, we help students develop content for their e-Portfolios that they publish on the internet via simple website authoring tools. Moreover, as we describe below, the specific nature of the content and ways in which we discuss the content with students is tied to the emphasis on learning.

A Commitment to Research

Given the national and international enthusiasm for e-Portfolios, many e-Portfolio projects involve large-scale deployments. Yet, once a deployment occurs, it can be hard to find the time and resources to conduct research even if that research could create insights that would help the entire effort operate more effectively.

In this work, we have been fortunate to be able to emphasize research without immediate pressure to scale up; however, the commitment to engineering education has meant that we always keep an eye toward ultimate deployments. The opportunity to focus on research has been possible because of funding from the National Science Foundation and an endowment. In terms of conducting the research, we have focused *less* on

proving that a specific approach works and *more* on understanding what could be possible with e-Portfolios and how e-Portfolios could contribute to significant educational outcomes. Most of this research has focused on asking students about their experiences with e-Portfolio construction, including the nature of their thinking and learning as well as the difficulties they encounter (similar to the work of Brown, 2002; Cambridge, 2008).

Understanding these commitments to engineering, learning, content, and research is important for understanding the approach presented in this paper (i.e., why preparedness portfolios and why portfolio studios) and also for interpreting the research results that we have gathered. The details of the approach and how it relates to the four commitments is the focus of the next two sections of this paper.

Preparedness Portfolios

In this work, students are invited to construct engineering preparedness portfolios, which are explained to them as arguments about the ways in which they are prepared to engage in engineering activity. Students are also told that their e-Portfolios should include the following elements: (1) a professional statement in which they make claims about the ways in which they are prepared for engineering, (2) artifacts—products and by-products of their experiences—that provide evidence for those claims, and (3) annotations of the artifacts that provide context for the artifacts and explain how the artifacts support one or more of the claims made. The overall organization of these elements is depicted schematically in Figure 1 and as implemented in Figure 2.

Engineering preparedness portfolios can differ in terms of their scope. In much of our work with this type of e-Portfolio, we have asked students to create life-wide engineering preparedness portfolios—e-Portfolios in which the artifacts are drawn from a lifetime of experiences including extra-curricular, personal, work, and other experiences, in addition to educational experiences. We have also worked with students to develop experience-based engineering preparedness portfolios in which they draw evidence for their preparedness claims from specific experiences such as a class or an undergraduate research activity.

In the remainder of this section, we provide rationale for characterizing the e-Portfolio as an argument, for asking students to construct an argument about preparedness, and for having them construct their argument using the professional statement and annotated artifacts as elements. In presenting this rationale, we draw on the four commitments introduced earlier: engineering, learning, content, and research. We then close this section by describing three studies that illustrate the potential educational significance of this approach.

Why Focus on Arguments?

In talking with students about the content and function of e-Portfolios, we use the language of argumentation—specifically, the idea that an e-Portfolio involves claims that are substantiated by evidence. Many types of e-Portfolios can be understood as arguments; for example, an assessment portfolio is an argument about what one knows, and a learning portfolio is an argument about what one has learned. The language of argumentation provides a specific and coherent vocabulary for talking about the e-Portfolio activity, a language that seems to be comfortable for engineering students.

There are several intersections between the commitment to learning and this emphasis on argumentation. For example, the language of argumentation is linked to epistemological development: higher levels of epistemological development involve deciding what to accept as knowledge based on the strength of evidence associated with potential knowledge claims (Hofer & Pintrich, 1997). Thus, having students engage in arguments about their knowledge/learning provides them with opportunities to practice discussing their knowledge and think explicitly about what they know. On a different thread, although we are very much interested in learning and reflection, the language of argumentation means that we rarely use the term reflection, and this practice has been purposeful. In our experience, the notion of reflection encounters resistance among engineering students; and, thus, rather than ask for reflection directly, we are seeking to understand the ways in which asking students to create arguments induces their reflection.

We are specifically interested in the link between e-Portfolios as argumentation and theoretical ideas about situations in which writing is knowledge transforming. As Bryson, Bereiter, Scardamalia, and Joram (1991) summarize:

> Writing involves solving two general kinds of problems—content problems, which are problems of the writer's own knowledge and beliefs, and rhetorical problems, which are problems having to do with achieving the goals of the compositions... problems arising in the 'rhetorical space' are often translated into problems requiring solution in the 'content space.' New decisions arrived at in the content space create new problems in the rhetorical space, and so on in a dialectical fashion. The result will often be that by the end of the composing process, both the writer's ideas and the nature of the written product have evolved in unexpected ways. Hence the experience of writing as discovery. (p. 71)

Figure 1
Portfolio Architecture

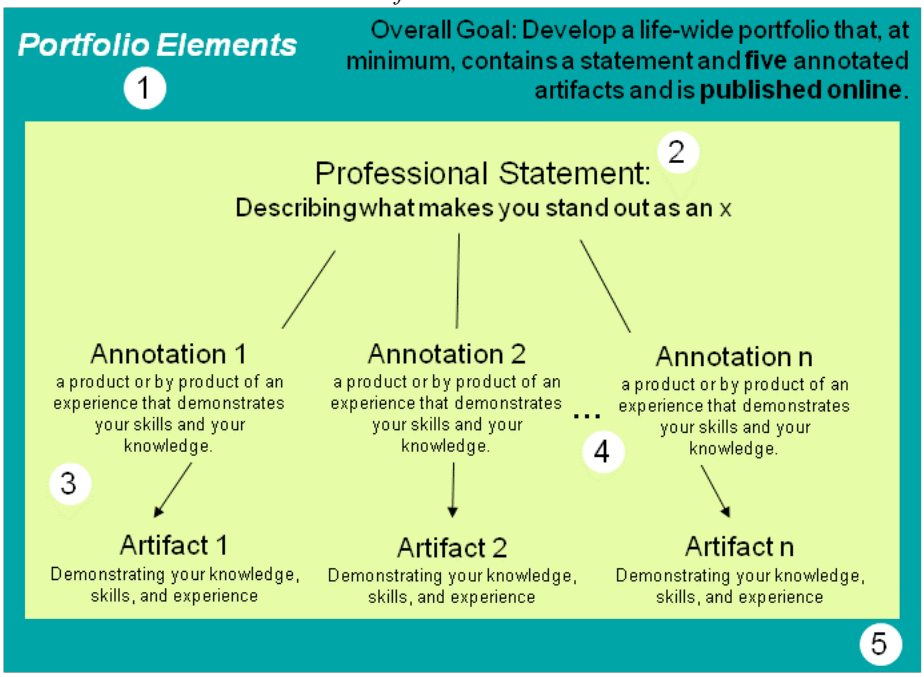
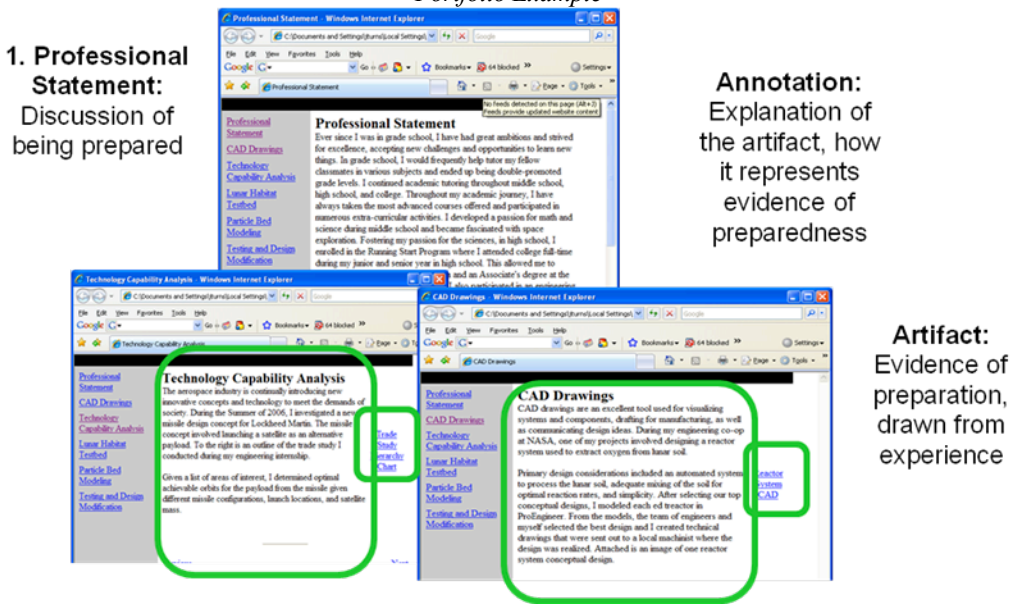


Figure 2
Portfolio Example



In the case of e-Portfolios, *rhetorical* problems for students could include the following: How do I explain my claims about my knowledge or learning to my audience? Which evidence is best for this audience? It is hard to imagine such rhetorical problems not giving rise to a host of challenging *content* problems, such as the following: What claims can I make? What do I know or did I learn? What does it look like to make a claim about my knowledge? What evidence do I have? Clearly, solving such problems would result in important knowledge. But, what would entice students to engage in solving such problems, and what specific

content problems could e-Portfolio construction induce? In the next section, we introduce the concept of preparedness as a way to address these issues.

Why Focus on Arguments About Preparedness?

In this work, students are asked to make arguments about their preparedness for future activity, as opposed to arguments about what they have learned or what they know. The decision to emphasize preparedness is tightly linked to the commitment to engineering in that a key goal of engineering education is to prepare students to function as engineers upon graduation. On a practical level, it is not uncommon for engineering educators to ask students *if* they are prepared (e.g., in graduation surveys); a logical next step is to ask students to explain their judgments by describing the ways in which they are prepared.

Preparedness is interestingly ambiguous with respect to audience. In this work, we invite students to think about their audience—who they would like to convince with their arguments. The attempt here is to help students transcend the school context that they are in and go beyond thinking of the educator as their implied audience. By bringing the issue of audience into the open, we also have a chance to talk about the types of claims that would interest a specific audience and the types of evidence that the audience would find appropriate and engaging. By emphasizing preparedness and having students think toward future audiences, we invite students to connect their past experiences with their future goals and, in this way, to work on establishing a continuity of experience (Dewey, 1938).

Having students make arguments about their preparedness can raise specific content problems for them because of the questions they may encounter (i.e., questions that may arise during their work). Their experience of grappling with such questions can provide an opportunity for transformative writing. While we have traditionally let these types of questions emerge for students, we do validate them when they emerge. These questions and the associated learning opportunities are highlighted.

- *How exactly did my experiences prepare me to be an engineer? Which experiences count as evidence of my preparation?* If students engage in such questions, they are engaging in reflection on their experiences. By engaging in such reflection on past experiences, students may be completing the Kolb learning cycle for past events (Kolb, 1983) and achieving Dewey's notion of a truly educative experience (Dewey, 1938).
- *In what ways **am** I prepared to be the kind of engineer that my audience expects me to be? In what ways am I **not** prepared to be the type of engineer society needs? What else do I need to do in order to strengthen my preparation?* By engaging with such questions, students are addressing issues of metacognitive awareness, which can then contribute to calibrating confidence and self-efficacy and pave the way for self-directed learning. Finding that one would like to (but cannot) make particular claims about preparedness could create an impetus for students to pursue future learning. At the same time, finding that one actually *can* make claims about preparedness that had not been considered before (i.e., discovering or at least re-remembering what one knows) can lead to increased confidence and self-efficacy.
- *What exactly does it mean to be prepared for engineering? What are different ways for one to be prepared for engineering? Who decides that someone is prepared?* These questions represent the potential of the preparedness argument task to help students engage in critical reflection—reflection that engages with one's assumptions about the world and issues of power (Brookfield, 1995). In framing the task to students, we provide little guidance on what it means to "be prepared for engineering." As a result, this is something that they have to grapple with in order to complete the e-Portfolio. While students may find their existing understanding of the issue sufficient, it is possible for them to start to question their existing understanding, particularly since the answer may depend on who they identify as the audience of their e-Portfolio. As such, the task can provide opportunities for students to critically reflect on issues such as how preparation for engineering might vary depending on the context into which one is going and who ultimately decides what it means to be prepared for engineering. Kegan (1994) would suggest that by engaging in this type of thinking, students have the potential to move from the realm of the socialized mind to the realm of the self-authoring mind—a move he argues is critical for effectively functioning in the modern world.
- *Who am I and how does engineering fit with that? What else am I? What do I want to be and how does that mesh with my argument about myself as an engineer? What kind of engineer do I want to be?* These questions represent the potential of the task to provide

> students with opportunities to explore significant issues related to identity. Viewed from within engineering, the task of arguing about one's preparedness for engineering can be seen as a request for an "institution" (e.g., a company, an established person in the field) to authorize one as an engineer (Gee, 2000-2001) and as a narrative about oneself as an engineer (Sfard & Prusak, 2005). However, the questions represented in this last set go beyond the "me as engineer" view. Because the nature of what it means to be prepared is left in the students' hands and the students are encouraged to draw their evidence of their preparedness from across their lives, the students have an opportunity to start to integrate their multiple selves together and engage in self-authorship (Baxter Magolda, 2008; Kegan, 1994).

While it may seem optimistic that the preparedness portfolio task could lead students to engage in such profound questions, theories of adult learning help to illustrate why this is possible. Imagine that the students want very much to be able to answer the questions above, but they find they are unable to do so. The students, at that point, could be experiencing what Mezirow terms a *disorienting dilemma* (Mezirow, 2000) and what Jarvis conceptualizes as *disjuncture* (Jarvis, 2006). These theories provide a way of understanding how mature learners experience profound shifts in their thinking, and they may be quite useful in explaining some student experiences with e-Portfolio activities. For example, some students become disoriented when they realize they have never thought about the questions raised by the preparedness portfolio tasks. Key to supporting students through these challenging issues, however, is ensuring that they do not get overwhelmed. This brings us to the third feature of the work—focusing on professional statements and annotated artifacts.

Why Focus on Professional Statements and Annotated Artifacts?

We ask students to make their preparedness arguments in the professional statements and annotated artifacts that serve as the central building blocks of the e-Portfolio. We also ask the students to create e-Portfolios by assembling these pieces as a website. By having students do these activities, we strike a balance between two important goals: supporting students in their creation of the preparedness argument and not undermining any of the potential learning opportunities that we have identified as associated with the tasks (see above).

Asking someone to create an argument is, indeed, quite an open task. Students could create such an argument in a single document; and, in fact, a cover letter can be seen as one manifestation of a preparedness argument. In the context of a preparedness portfolio, the argumentation ideas of claims and evidence translate relatively directly into the professional statement as the place where claims are made and the annotated artifacts as the place where evidence is presented and explained. With these elements as building blocks, we can support students by offering suggested word counts and a few examples to get them started. We also highlight to students that these general guidelines leave them in control of *what* to put in their e-Portfolios.

To translate these ideas into e-Portfolios, we help work with students to publish their portfolio elements using simple web authoring tools. For example, our university provides a simple website tool to all students and staff, and Google Sites™ provides a similar tool to the public. In mapping the portfolio building blocks to the website, the professional statement typically becomes the home page and the annotated artifacts become additional pages.

What do Students Say? Research Data

Because the ideas presented above represent a theory about what *could* happen with preparedness portfolios, we have been engaging in research to validate these theoretical ideas. Our various research studies have been exploring the extent to which such theoretical ideas about what *could* happen with e-Portfolios actually *does* happen for students, and what it looks like when it does. Here we highlight three such studies.

In one of the earlier studies (Turns, Cuddihy, et al., 2010), we interviewed thirteen students from a mechanical engineering class (n=35) where the students had been asked to create engineering preparedness portfolios that focused on how their experiences in the class had prepared them for their futures in engineering. In the interviews, we sought to understand how the students had experienced the preparedness portfolio assignment itself, specifically in terms of the type of thinking and knowing that it required, the nature of the effort associated with it, and the students' perceptions concerning its value. The theme *epistemically different* emerged to capture student comments about the types of thinking and knowing associated with working on the assignment. The students reported thinking about how topics in the class could be integrated with each other and with topics from other classes (a type of knowing we termed *integrated knowing*), what they personally thought was important (a type of knowing we termed *subjective knowing*), and how to explain

their knowledge to others and to themselves (a type of knowing we termed *externalized knowing*). We labeled the theme *epistemically different* in order to capture student comments that the ways of thinking and knowing that were involved in the assignment were unlike what they experience in "normal school." Such findings speak in general to the potential for this type of activity to lead to the range of learning opportunities suggested by the questions discussed above. Of interest, the student comments also suggested they found the activity to be *manageably effortful* (i.e., not trivial but definitely do-able) and *unexpectedly valuable* (i.e., they had not expected to appreciate the assignment but found themselves appreciating it once it was finished).

More recently we ran a study in which thirty-six students created "life-wide" engineering preparedness portfolios (Eliot & Turns, in press). Students were encouraged to use not just experiences from formal education, but also experiences from life in order to populate their e-Portfolios. In this study, we collected data from students via short surveys at intermediate points in the process and an extensive post questionnaire. We subsequently analyzed the data to explore the extent to which and ways in which students reported engaging in identity thinking while working on their e-Portfolios. In this context, identity thinking can be understood as thinking associated with understanding, or even crafting, one's identity. A qualitative analysis of students' questionnaire responses revealed activities related to framing their skills and experience according to others' expectations (external frame of reference) and their own expectations (internal frame of reference) of engineering professional practice. Quantitatively, the analysis revealed that identity work was prevalent (i.e., mentioned by most of the students), and that internal frame of reference comments outnumbered external frame of reference comments by two to one. These findings definitely speak to the potential for preparedness portfolios to induce students to grapple with issues of identity as mentioned above.

In one of the most recent studies we interviewed 11 students who created "life-wide" engineering preparedness portfolios, and subsequently analyzed the interviews as well as the actual e-Portfolios in order to better understand the ways in which students reflected on their experiences and thought about experience more generally (Kilgore, et al., accepted). It is useful to note that although we did not interview students directly about their experiences or perceptions of them, the reflective nature of the e-Portfolio work made such comments about reflection likely. As we discuss in the paper, we found (mostly from analysis of the e-Portfolios themselves) that the kinds of experiences that students reflected on were rich and varied, suggesting a broad sense of what kinds of experiences *count* toward preparing to become an engineer. Despite the variety of experiences and different ways that students talked about them, several common themes emerged. Students described the following phenomena: growing realization of value, growing awareness of engineering preparation, growing awareness of needing experience, recognition of continuity, and reasons for discontinuity. In general, the analysis supported the idea that, through the process of selecting and examining individual experiences, students' understandings of the general notion of *experience* changed, shifting from a compartmentalized, exclusionary view of experience to the examination of the "continuity" of experience that John Dewey wrote about and that we mentioned above. Moreover, we believe these realizations helped the students become better prepared for lifelong learning.

Studies such as these three support the claims made earlier in this section about the potential for the preparedness portfolio activity to be an educationally significant activity. In particular, these studies have demonstrated the possible *outcomes* that students experience when creating preparedness portfolios. As part of this work, we are also interested in how to structure student e-Portfolio activities in order to maximize the likelihood that such outcomes will occur. To explore this issue, we turn now to the ways in which we support students through the e-Portfolio process.

Supporting Students: The Emergence of Portfolio Studios

In the three studies described above, we experimented with the quantity and type of support provided to students. In the first study, in which e-Portfolios were an assignment in a specific class, students received support through two in-class brainstorming sessions and a simple grading rubric that clarified what was required to get credit for the assignment. In contrast, students in the second study participated in a four-session "e-Portfolio program." Students were supported through sessions devoted to helping them understand and brainstorm content for portfolio elements, and helping them give and receive comments on drafts of specific portfolio elements (e.g., peer review of initial drafts of the portfolio statements). Students in the third study participated in a five-session "portfolio studio." As in the second study, students in the third study were supported in understanding and brainstorming content and in giving and receiving comments. However, in a new fifth session, students were further supported with an opportunity to practice presenting their e-Portfolios. Based on observations of the studio sessions and feedback from students during these sessions, we have come to believe that the studio format as implemented in the third study has significant potential to help us

realize the educational value of e-Portfolios. We address this idea in the next section.

Portfolio Studios

In this work, the portfolio studio is a five-session experience designed to help students work through the activities involved in constructing a preparedness portfolio. The studio setting provides a collaborative, supportive, and student-driven environment. In this approach, peer review, community membership, camaraderie, and accountability are significant components. In each session, students are given the opportunity to help one another as they work through their thinking and experiment with different ideas. Questions raised by students are directed back to the group to discuss. An important characteristic of the portfolio studio environment is the absence of emphasis on "right" or "wrong" solutions or choices.

Over the past decade, we have refined the design of the studio with respect to length and timing of the studio sessions and the specific activities used in each session. Each studio session has the same general structure: the facilitator provides an agenda of session activities, revisits the previous sessions to create continuity, provides a snapshot of student feedback from previous sessions, facilitates session activities, and presents students with a wrap-up and description of work to be prepared for the next session.

The activities of the studio are organized around the key features of the preparedness portfolio as defined earlier. Figure 1 illustrates this structure by indicating the emphasis of each of the five sessions in relation to the portfolio elements (the sessions are indicated by numbers in the circles in the diagram).

- Session 1: Students are introduced to the notion of an e-Portfolio as an argument about one's preparedness for a future activity, invited to brainstorm the benefits of creating and having such an e-Portfolio, introduced to the specific terminology used for this e-Portfolio activity (i.e., professional statement, artifacts, and annotations), and prepared for writing the first draft of their professional statement, which they are told to bring to the second session.
- Session 2: Students share their experiences creating the professional statement, brainstorm ideas about effective peer review, use these ideas while reviewing each others' statements, and prepare for the upcoming task of finding and annotating one artifact.
- Session 3: Students and the facilitator review the current state of each student's e-Portfolio to highlight points of interest and concern, students peer review each other's artifact/annotation drafts and prepare for the upcoming task of more fully populating the e-Portfolio.
- Session 4: Students think out loud while interacting with a peer's e-Portfolio to give the e-Portfolio authors a chance to see how someone might experience their e-Portfolio, provide peer review/feedback to each other on one selected element, and prepare for the final task of presenting their final, fully populated and revised e-Portfolios to their peers and the facilitator. The final presentation is a two- to three-minute *elevator pitch* that is framed as the response to a situation in which a prospective employer, or alternative audience of their choosing, requests that the student "walk them through" their e-Portfolio.
- Session 5: Students deliver their presentations, provide feedback on their peers' presentations, and revisit the overall experience.

To capture students' reactions to e-Portfolios "in the moment," students complete feedback forms where they share their ideas about rewarding, frustrating, and surprising aspects of working on the e-Portfolios. Students complete these forms at the beginning and the end of the two-hour studio sessions. At the beginning of the sessions, they reflect on their experiences working on their e-Portfolios since the last session; at the end of the sessions, they reflect on their experiences participating in the session. Student responses on these session feedback forms allow facilitators to gauge and understand students' personal progress and experience. In addition, responding on the forms provides students with an opportunity to slow down and reflect on the process of constructing the e-Portfolio. Between sessions, results on these feedback forms are aggregated and insights shared with students during the following session. In this way, students learn how others are experiencing the portfolio studio activities, which can validate or reinforce their own experiences.

In the next three sections, we provide rationale for three features of this approach—the number of sessions, the emphasis on student progress on their e-Portfolios, and the emphasis on bringing students reactions to the activities into the conversations. In discussing the rationale, we draw not only on cognitive perspectives on learning, but also on issues of motivation and social construction and emergence of knowledge.

Why Five Sessions?

Over time, five has emerged as the number of sessions we believe to be particularly advantageous for a studio series. This number of sessions represents a

balance of two competing factors: (1) having enough session time with the students to adequately leverage the important learning opportunities inherent in the e-Portfolio experience; and (2) respecting the crowded nature of engineering curricula and the demands on students' time. The focus on content over technology has contributed to the ability to provide an effective learning experience in just five sessions because we do not have to allocate much contact time with students to issues of technology. The research focus requires that we are open to new ideas and continue to question existing ideas: Are studio sessions really needed? What additional value to they provide?

Why the Emphasis on Student Progress on Their e-Portfolios?

The portfolio studio experience revolves around the student portfolio elements, and specifically around student work on these portfolio elements. The studio experience includes many opportunities for students to give and receive feedback. Three sessions center on peer review: peer review of the professional statement, of an initial artifact annotation, and of an element of the author's choosing. One session includes a check-in activity focused on students' progress on their e-Portfolio. Another session involves a think-aloud activity in which students listen in as someone else walks through their e-Portfolio. And the final session includes feedback on students' e-Portfolio presentations. Again the commitment to content over technology means that we have more time for this focus on sharing and peer review.

The emphasis on supporting students as they reflect and make arguments about their preparedness stems from the commitment to an engineering undergraduate population, a population that may be less familiar with reflection and argumentation than students in other disciplines. The studio sessions help sustain engagement: distributing work over five sessions throughout a quarter, and supporting students with the specific activities we have developed, helps students meet the challenges associated with the e-Portfolio tasks. In addition, features of the studio environment are likely to support student motivation by providing an inclusive environment that helps students create meaning (see Ginsberg & Wlodkowski, 2009). In terms of promoting inclusion, the studio approach is premised on respecting the contributions of each student and providing ample opportunity for each student to be heard. In terms of meaning, the studio approach promotes engagement and manages challenge. In particular, the studio approach improves motivation and sustains effort through the distribution of activities and the opportunities provided for peer interactions mentioned above. However, the interest in putting student work at the center of the preparedness portfolio experience goes beyond empathy with engineering students.

We see the circumstances where students share intermediate portfolio elements as particularly well suited to students constructing profoundly important knowledge related to engineering and to being prepared for engineering. We arrive at this conclusion by thinking about the ways in which the activity in the studio aligns with what is known about how to structure group activity in order to occasion the emergence of knowledge (Davis & Sumara, 2006).

Davis and Sumara (2006) have offered an innovative contribution to designing educational activity by bringing complexity concepts and ideas together with the general issue of creating groups that produce knowledge. Their ideas formalize common educator intuitions about what makes good educational situations; for example, providing straightforward activities that students can elaborate and then using the student-generated elaborations to move the group forward. Davis and Sumara (2006) propose that to occasion the production of knowledge in a group, an educator should strive to balance redundancy and variability (i.e., balance the extent to which students in the group are similar with the extent to which they are different), balance coherence and randomness (i.e., provide the group with common activities while also permitting random things to happen), and promote neighbor interaction (specifically interaction of emerging ideas) and local control (i.e., control of the direction of knowledge generation). Note that these concepts of redundancy, variability, coherence, randomness, neighbor interactions, and local control and their use as described here are specific to Davis and Sumara (2006).

Looking at the studio through this lens, using the language of Davis and Sumara, we can note the following. In terms of redundancy and variability, the students in the studios have all been undergraduates in engineering (redundancy), yet they are from different disciplines, have had a variety of prior experiences, and have different intended directions (examples of variability). In terms of coherence and randomness, the portfolio studio is organized around a straightforward series of tasks that provide coherence, while students' ways of realizing these tasks provide randomness. One challenge in facilitating these studio sessions is to provide enough scaffolding for the students to feel comfortable exploring the space in which they will create their e-Portfolios, without confining their exploration—a situation described by Davis and Sumara (2006) as "liberating constraints." Also following Davis and Sumara, "promoting neighbor interactions" is the basis for much of the portfolio studio sessions—students spend the bulk of each

session sharing their work-to-date with other students. As a result, students' ideas about issues such as what counts as evidence of preparedness and the extent to which they actually believe themselves to be prepared have the opportunity to interact with other students' ideas concerning the same issues. Finally, while there is coherence provided by a predefined series of tasks, the students ultimately have control over their evolving e-Portfolios.

Why Emphasize Students' Reactions to the Activities?

The studio activities leverage not only students' work on their e-Portfolios, but also their reactions to this work. As noted previously, reactions are collected with session feedback forms, which invite students to report on surprises, frustrations, and rewards resulting from e-Portfolio activities. Feedback is summarized and shared with the students in the subsequent session. In addition, the facilitator leverages student reactions through a warm-up exercise that precedes the first peer review activity (i.e., the peer review of the professional statement). In this exercise, students share their thoughts on four topics concerning their professional statements: (1) the experience of writing the statement, (2) their assessment of the current state of the statement, (3) something they like about the statement, and (4) something they would like help with. Student thoughts are aggregated and organized so that students can understand group-wide patterns on these issues as well as their own experience relative to the patterns.

The decision to emphasize student reactions is partially related to a sense of empathy with engineering students—a student population that may find such activities foreign. By helping students appreciate how their experience fits in with the experiences of other students, and, in particular, that negative experiences are not isolated, we anticipate that students will feel more motivated as a result of feeling more connected with each other. And, again, it is interesting to note that the emphasis on content over technology creates more time to focus on student reactions and sharing.

However, as with the emphasis on emerging student products, the emphasis on student reactions is not strictly related to helping engineering students or taking advantage of not having to explain technology. Rather, the emphasis is tied to the commitment to promoting deep and profound learning. The types of prompts that we use are inspired by Brookfield's (1995) ideas about critical reflection as seeking and questioning assumptions. For example, a surprise represents an instance of something violating a pre-existing expectation, or assumption. We theorize that exposing students to the aggregated collection of student responses can trigger significant reflection.

As with the argument about preparedness portfolios, we recognize that the ideas presented above represent a theory about what *could* happen in portfolio studios. In this case, we have only recently begun to explore the extent to which such theoretical ideas about what could happen in portfolio studios actually *does* happen for students, and what it looks like when it does. Below we present emerging insights gained from examining student feedback forms.

What do Students Say? Research Data

So what does such a portfolio studio experience look like through the students' eyes? In this section, we provide emerging insights from analysis of one set of feedback forms—forms filled out by students in a portfolio studio that was offered in the spring of 2010. Unlike the completed analyses summarized earlier, this analysis represents a preliminary step to be followed later by more rigorous analyses.

We have focused this preliminary analysis on all of the feedback forms collected during this particular studio, with an average of 22 forms per session. In this analysis, we coded student responses on the forms (i.e., what they found rewarding, frustrating and surprising) relative to three broad categories that emerged from the data: identity and self, building an e-Portfolio, and peer interaction.

The issues of *identity and self*, issues that we addressed in the studies mentioned earlier, are also prominent in the students' responses related to their *preparation* for studio sessions. For example, in their responses, students comment that they learned about themselves (e.g., "realizing I have certain skills I didn't think I had"), were able to reflect on their own experiences (e.g., "I have learned a lot from my college education even though I didn't realize this before"), and that looking back made them feel proud of their accomplishments (e.g., "I looked back on the things and skills I have learned and felt proud of myself"). Students also comment on having more or less evidence of being an engineer than they initially thought (e.g., "Realizing the amount of projects I have worked on over the past 5 years" and "Have much technical stuff. I want more leadership").

The session feedback forms also reveal, and thus remind us of, the variety of pragmatic issues of *building an e-Portfolio*—issues that are important but often fail to come up in end-of-session surveys. Moreover, these portfolio-specific issues show up in the responses related to both *preparing for* a session and *engaging in* a session. For example, in their responses, students comment on trying to figure out what an e-Portfolio is, grappling with potential artifacts (e.g., "deciding what has worth") and how to organize the e-Portfolio, handling technical problems, and figuring out how to

effectively express ideas via the portfolio elements of professional statement, annotations and artifacts ("figuring out a professional versus a personal statement"). Such comments remind us of the significant challenges associated with making an e-Portfolio. These challenges include deciphering what potential employers or academic institutions deem important and tailoring one's e-Portfolio by including the most appropriate artifacts and annotations. Challenges also include the need to achieve a balance between personal (perhaps to give a sense of an individual's personality) and professional expression through the writing style and content of the professional statement. The opportunity to balance personal and professional considerations allows students to choose evidence from their academic and working history, as well as from their life-wide experiences. As one student wrote, "It's okay to use non-engineering, non-technical experience in the PS [professional statement]."

The feedback forms are proving particularly useful in helping us confirm that, indeed, the *peer interaction* components of the sessions are significant aspects of the studios. Notably, these peer interaction comments show up prominently in the responses related to *engaging in* a session. Involving peer activity allows for participants to "see other people's work and their perspective on the portfolio" and "look at what others had problems with." Students further comment on gaining a sense of shared knowledge or experiences with their peers, the benefits of giving and receiving feedback, being helped by seeing others' thought processes, the value of seeing different styles and formats, and finally having the encouragement of those around them to work on this project. We are particularly interested in their comments about shared knowledge, "seeing that people shared my troubles," "how many people had the same problems as me," and "it was helpful to see the thought processes of others." Such comments remind us of the contribution that a group dynamic has on this part of the procedure.

Conclusion

In this paper, we have described a body of work on preparedness portfolios and portfolio studios. We have emphasized features of the situation—engineering, learning, content, and research—that gave rise to the specific approach we have described. We have also shared findings from research studies associated with this work. At present the work continues in a number of areas. For example, we are currently offering portfolio studios as one-credit seminars, exploring the educational significance of having students engage in multiple portfolio studios over time, and exploring the educational benefits of e-Portfolio construction for students in specific curricular experiences such as coop and undergraduate research.

While we recognize that the work has stemmed from a specific situation, we believe the notions of preparedness portfolios and portfolio studios can be useful in other educational contexts and to other educators. For example, while engineering educators are clearly tasked with preparing students for engineering, they are not the only educators preparing students for something. Education in general is about preparing students for activities in their future—activities such as critical and independent thinking, securing and succeeding in jobs, and participating in a democracy. Educators in other disciplines could have such goals be the subject of preparedness portfolios. Having students grapple with what it means to be prepared for each of these types of goals, as well as how their experiences have (or have not) prepared them, has great potential to help students.

The idea of a portfolio studio has similar potential to be used in other contexts. While students can and do successfully create e-Portfolios while working individually, our research suggests that the studio environment supports students through the genuinely difficult tasks associated with constructing an e-Portfolio. In a studio environment, students can learn from each other, and even push each other to higher levels of achievement. Thus, educators involved in e-Portfolio activities are encouraged to consider the idea of a portfolio studio. Such a studio environment, or even elements from the one we describe in this paper, could be added to, and could significantly amplify, e-Portfolio activities in many other contexts.

The stakes in higher education are large—costs are going up, students are being asked to prepare for an increasingly complex world, and educators are being asked to help larger and more diverse groups of students prepare for the future. E-Portfolios have a role to play in this ever more complicated educational landscape, and the significance of that role is open to our imaginations about how to put e-Portfolios into practice. We are excited about the potential of preparedness portfolios and portfolio studios to contribute to such a goal.

References

Atman, C. J., Sheppard, S. D., Turns, J., Adams, R. S., Fleming, L. N., Stevens, R., . . . Lund, D. (2010). *Enabling engineering student success: The final report for the Center for the Advancement of Engineering Education*. San Rafael, CA: Morgan & Claypool Publishers.

Baxter Magolda, M. B. (2008). Three elements of self-authorship. *Journal of College Student Development, 49*(4), 269-284.

Brookfield, S. (1995). *Becoming a critically reflective teacher*. San Francisco, CA: Jossey-Bass.

Brown, J. (2002). Know thyself: The impact of portfolio development on adult learning. *Adult Education Quarterly, 52*(3), 228-245.

Bryson, M., Bereiter, C., Scardamalia, M., & Joram, E. (1991). Going beyond the problem as given: Problem solving in expert and novice writers. In R. J. Sternberg & P. A. French (Eds.), *Complex problem solving: Principles and mechanisms* (pp. 61-84). Hillsdale, NJ: Lawrence Erlbaum Associates.

Cambridge, D. (2008). Audience, integrity, and the living document: eFolio Minnesota and lifelong and lifewide learning with ePortfolios. *Computers and Education, 51*(3), 1227-1246. doi:10.1016/j.compedu.2007.11.010

Cambridge, D., Cambridge, B., & Yancey, K. (Eds.). (2009). *Electronic portfolios 2.0: Emergent research on implementation and impact*. Sterling, VA: Stylus.

Davis, B. (2004). *Inventions of teaching: A genealogy*. Mahweh, NJ: Lawrence Erlbaum Associates.

Davis, B., & Sumara, D. (2006). *Complexity and education*. Mahweh, NJ: Lawrence Erlbaum Associates.

Dewey, J. (1938). *Experience and education*. New York, NY: Simon & Schuster.

Eliot, M., & Turns, J. (in press). Constructing professional portfolios: Sense-making and professional identity development for engineering undergraduates. *Journal of Engineering Education, 100*(4).

Eliot, M., Turns, J., & Xu, K. (2008). *Engineering students' extrinsic and intrinsic strategies for the construction of professional identity*. Paper presented at the Research in Engineering Education Symposium, Davos, Switzerland.

Felder, R., & Brent, R. (2004). The intellectual development of science and engineering students. Part 1: Models and challenges. *Journal of Engineering Education, 93*(4), 269-277.

Gee, J. P. (2000-2001). Identity as an analytic lens for research in education. *Review of Research in Education, 25*(1), 99-125. doi:10.3102/0091732X025001099

Ginsberg, M., & Wlodkowski, R. (2009). *Diversity and motivation: Culturally responsive teaching in college*. San Francisco, CA: Jossey-Bass.

Hofer, B., & Pintrich, P. (1997). The development of epistemological theories: Beliefs about knowledge and knowing and their relation to learning. *The Review of Educational Research, 67*(1), 88-140. doi:10.2307/1170620

Jafari, A., & Kaufman, C. (Eds.). (2006). *Handbook of research on ePortfolios*. Hershey, PA: Idea Group Reference.

Jarvis, P. (2006). *Towards a comprehensive theory of human learning*. New York, NY: Routledge.

Kegan, R. (1994). *In over our heads: The mental demands of modern life*. Cambridge, MA: Harvard University Press.

Kilgore, D., Sattler, B., & Turns, J. (in press). From fragmentation to continuity: Engineering students making sense of experience through development of a professional portfolio. *Studies in Higher Education*.

Kolb, D. (1983). *Experiential learning: Experience as the source of learning and development*. Upper Saddle River, NJ: Prentice Hall.

Kreber, C., & Castleden, H. (2009). Reflection on teaching and epistemological structure: Reflective and critically reflective processes in 'pure/soft' and 'pure/hard' fields. *Higher Education, 57*(4), 509-531. doi:10.1007/s10734-008-9158-9

Lewis, T., & Fournier, J. (2009). A catalyst without a mandate. In D. Cambridge, B. Cambridge, & K. B. Yancey (Eds.), *Electronic portfolios 2.0: Emergent research on implementation and impact* (pp. 129-132). Sterling, VA: Stylus Publishing.

Mezirow, J. (2000). *Learning as transformation: Critical perspectives on a theory in progress*. San Francisco, CA: Jossey Bass.

Sattler, B., Kilgore, D., & Turns, J. (2010). *I have never spent time to think about what I have gained from my projects*. Paper presented at the Frontiers in Education, Washington, DC.

Sfard, A., & Prusak, A. (2005). Telling identities: In search of an analytic tool for investigating learning as a culturally shaped activity. *Educational Researcher, 34*(4), 14-22.

Sheppard, S. D., Sullivan, W. M., Colby, A., Macatangay, K., & Shulman, L. S. (2008). *Educating engineers: Designing for the future of the field*. New York, NY: John Wiley and Sons.

Turns, J., Cuddihy, E., & Guan, Z. (2010). I thought this was going to be a waste of time: Using portfolio construction to support reflection on project-based experiences. *Interdisciplinary Journal of Problem-Based Learning, 4*(2), 63-93.

Turns, J., Sattler, B., & Kilgore, D. (2010). *Disciplinary knowledge, identity, and navigation: The contributions of portfolio construction*. Paper presented at the International Conference of the Learning Sciences, Chicago, IL.

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