Graduate Students Designing Graduate Assessment: ePortfolio Design as Problem-Based Learning

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Abstract – **We present results from a graduate course project to design an ePortfolio tool to support graduate program assessment, student learning development, and professional preparation for a "client" traditional engineering department. Students were tasked with meeting their clients, conducting a needs assessment, and designing and presenting an assessment plan using ePortfolio. Student reflections on the project, a focus group, and artifacts prepared for the client served as our data sources. The students encountered significant challenges transferring theory to practice in a real-world context, specifically balancing client desires with good assessment practice. This department's approach to annual reviews was primarily as administrative, data-driven reporting. The final design met several quantitative data needs, but also included opportunities for reflection and professional goal-setting. As a PBL assignment, the project helped these future engineering educators explore their values, career aspirations and goals, particularly in regards to spanning the gap between education practice and research. These students clearly indicated that the project was challenging but extremely valuable in preparing them for their chosen careers, and helped to reinforce their decisions. The project also increased students' awareness and engagement in the processes and challenges of program assessment, situating assessment as an integral component of engineering education.**

Index Terms – change agents, ePortfolio, graduate assessement, participatory design

INTRODUCTION

While accreditation such as ABET requires engineering faculty to focus on assessment at the undergraduate level, most faculty knowledge of outcomes-based assessment is not transferred to graduate programs [1, 2]. In the U.S., regional accreditation bodies such as SACS (Southern Association of Colleges and Schools), which have also moved to outcomes-based assessment, provide unique motivation for engineering faculty and administrators to organize assessment efforts at the graduate level.

Assessment of graduate programs differs from that of undergraduate programs due to many factors, including the individualized nature and less structured timeline of graduate programs. Learning objectives are also cognitively intricate and more difficult to measure, and programs tend to be interdisciplinary, all adding complexity to the process. As a result, graduate assessment tends to focus at the program level, with productivity measures including time to degree and publications [3].

Portfolios, including those presented electronically (ePortfolios), can serve as a flexible and creative holistic assessment, as students select artifacts to present evidence of their learning and professional development. Portfolios encourage meta-cognition and reflection, as well as identity construction. This higher-order thinking, flexibility, career focus and individual customizability make portfolios a good fit for assessing graduate education. However, few, if any, engineering graduate programs have reported on their use of ePortfolios.

The purpose of this paper is to present results from a graduate course project that exemplifies problem-based learning (PBL) by tasking students with the design of an ePortfolio tool to support graduate program assessment, student learning development, and professional preparation. This pilot project has provided positive evidence in support of the long-term goal of using ePortfolios for graduate-level assessment at both individual and program levels for each department in the College of Engineering at our institution. As part of the assignment, students were asked to employ a participatory design approach (versus a top-down approach) that gives users control of various parts of design, layout, and content. In theory, this approach offers a greater degree of autonomy, thus improving motivation for participating in personal and program evaluation.

LITERATURE REVIEW

The following section briefly reviews the concepts of portfolios, participatory design and problem-based learning.

I. Portfolios

Portfolios are commonly defined as

> "a purposeful collection of student work that exhibits to the student (and/or others) the student's efforts, progress, or achievement in given areas. This collection must include: student participation in selection of portfolio content; the criteria for selection; the criteria for judging merit; and evidence of student self-reflection" [4].

Reflective acts can include written and multi-media descriptions, self-evaluations of work and progress, and designing for presentation to an audience. This act of

narrative has been theorized as an effective mode of deep learning and identity formation [5]. Fundamentally, presenting one's accomplishments is an act of identity construction: by organizing and conceptually framing artifacts, people present their perceptions of who they are, what their value is in relation to a particular context, and even a vision of "possible selves" [6]. Importantly, reflection and portfolio design is meant to occur as a meta-cognitive process in which individuals situate their accomplishments and their goals in relation to ongoing learning development [7]. Designed effectively, portfolios can support three purposes simultaneously: learning development, career preparation and program evaluation.

II. Participatory Design

Our focus in implementing this course project was in engaging student participants through participatory design. We borrow the term from a user-centered design strategy in software development:

> "Participatory Design of computer applications is about the direct participation of those who will be affected by the development of a particular computer application in the decision-making, design and/or development process" [8, p. 177].

This project was based on the theory that involving students as collaborative co-designers of their portfolio structure can enhance the reflective, student-centered goals of portfolio work [9].

Intrinsic motivation is a central goal in this project. In their self-determination theory, Deci and Ryan [10] argue that if people are to internalize their motivations and maintain psychological well-being, they must fulfill needs of autonomy, competence, and relatedness. Greenberg [11] emphasizes motivation in assessment and warns against how efforts can quickly be reduced to a process that faculty and students must follow, rather than a task that is valued. Further, Barrett [12] stresses that involving faculty and students in the construction of assessments can help to clarify the value of assessment and increase perceived autonomy in the process. Lappenbusch and Turns [13] found that involving undergraduates in the construction, not just completion, of their student portfolios helped them to better understand the learning objectives that the department had for them, leading to increased levels of motivation for learning and self-assessment.

III. Problem-based learning

Smith et al. describe problem-based learning as a principal "pedagogy of engagement," citing studies to document the successes the teacher "who becomes less an imparter of knowledge and more a designer and facilitator of learning experiences and opportunities" [14, p. 88]. In problem-based learning, students learn by working on a problem or project that they encounter for the first time in the classroom [15, 16]. The learning environment is usually cooperative, with students working interdependently in small groups. This approach of focusing on a problem versus a subject [17] and cooperatively versus competitively [14] separates PBL from teaching strategies that until recently have been typical in engineering curricula. Recent research [14] indicates that PBL increases students' ability to apply their knowledge and skills, and that cooperative learning increases positive interdependence, individual accountability, and teamwork skills—all learning outcomes that we hoped for our students to achieve.

METHODS

The ePortfolio design project described in this paper was a course assignment in the Fall 2009 offering of a graduate-level course on Engineering Education Assessment offered by the Department of Engineering Education. According to PBL principles, the students worked on an authentic project with a traditional engineering department as their client. (However, unlike PBL, important frameworks for structuring and evaluating an assessment design were presented and discussed earlier in the semester.) Specifically, the client was a traditional engineering department's graduate program, which offers multiple Master's and doctoral degrees. Stakeholders included faculty, staff and students who were consulted in developing a plan for implementing ePortfolios. This project builds upon a similar project in Fall 2008 of designing ePortfolio procedures for the Engineering Education PhD program. (Participatory design was the primary motivation in 2008, as most of the former students in the class continued as engineering education PhD students who are now required to develop individual ePortfolios.)

The 2009 course participants included 9 engineering and engineering education graduate students who formed the "assessment team." In the results section that follows, their degree programs are signified as "engineering education" or "engineering" for more traditional programs. Most students who were not engineering education PhDs were working toward the Graduate Certificate in Engineering Education. (This course is also a core course for the PhD in engineering education.) Although we tried to solicit interest, there were no students from the client department enrolled in the assessment course. The client audience was three-fold, consisting of graduate students, departmental administrators, and a college dean. Students were tasked with meeting their clients (in focus groups scheduled during class time), conducting a needs assessment, and designing and presenting an ePortfolio assessment plan to the faculty and administrator clients. The project lasted an intense three weeks, and was completed by the mid-November Thanksgiving holiday to avoid overlap with final projects in the students' other courses. Project grades were based on student reflections and faculty observations. They constituted 40% of the course grade.

After the completion of the project, a focus group was conducted with the students, and each student wrote a reflective evaluation of his or her learning experience during the project. Along with the artifacts prepared for the client, these served as our primary data sources. Both the focus

group and the individual reflections were analyzed using an open coding approach to identify major themes [18], which were verified by both authors.

RESULTS

The students in the assessment course encountered significant challenges transferring theory to practice in a real-world context, specifically having trouble balancing client desires with good assessment practice. The client department's approach toward annual reviews was primarily as administrative, data-driven reporting with little time for personal and professional growth. This was part of the reason participation in the design by graduate students in the client department was minimal. The solution presented by the assessment team met several quantitative data needs, but also included opportunities for reflection and professional goal-setting. As a PBL assignment, the project helped these future engineering educators explore their values, career aspirations and goals, particularly in regards to spanning the gap between education practice and scholarship. These students clearly indicated that the project was challenging but extremely valuable in preparing them for their chosen careers, and helped to positively reinforce their decisions. The project also increased students' awareness and engagement in the processes and challenges of program assessment, situating assessment as an integral component of engineering education.

I. Student Reflections

The student assessment team encountered many challenges and constraints. An engineering education student characterized the challenges of the audience as "attitudinal, knowledge, and practical systemic barriers." Other team members supported these statements, noting that initially "the general attitude of the audience was something of complete disbelief and confusion." Neither the students nor the faculty of the client department were on board with the theory-driven presentation of ePortfolios that emphasized reflective and longitudinal assessment. Instead, the client faculty "wanted their paperwork to be automated so as to ease their current workload. Never at any time did the participants show any interest in program improvement." The types of data they seemed interested in were primarily quantitative measures of research productivity, such as publications, and the ease with which an electronic system could be used to collect and compile this type of data. The client students regarded their current annual review requirements as "administrative nonsense" and saw ePortfolio as "just another complicated hoop that they must jump through." On the other hand, every member of the assessment team noted the extreme difficulty they had in meeting the client's estimation of annually spending only "15 minutes of student time to create and 5 minutes of faculty time to assess student ePortfolios." However, at the end of the semester, the assessment team members affirmed that one of the most important steps in assessment was to involve the end users and create value for them.

User participation, in fact, was cited as "one of the most significant points in designing future assessment tools." An engineering team member stated that the users' "feedback in different stages of the design process is vital to achieve an easy-to-use and useful plan." An engineering education student reflected that in the future it "would be good to have a [client] department student that has insight into the department as well as knowledge from the class about assessment and might serve as a vital tool for bridging the gap." This recommendation is central to participatory action research, which is underpinned by the philosophy of researching and designing *with* people rather than just *for* people [19]. In terms of usability, this approach was echoed by other students who "learned that the 'usability' of an assessment instrument is subjective and that the client should have the most say in determining if an instrument is usable or not." Team members were looking at concepts of value from both designer and user perspectives:

> "the most important part of designing an assessment plan is to ensure that whoever will be implementing it sees the value in it and it is your responsibility to convince them that your assessment plan is valuable. Like other product designs, it must be made for the audience you are working with."

In relation to constraints, an engineering team member explained that,

> "We tried to develop an ePortfolio that allowed for program assessment, but would not increase (and would perhaps actually decrease) the effort required by both students and faculty. We felt that at this point it was better to develop a tool that would actually be utilized (good assessments are used) than something that would be 'better' from an assessment standpoint, but not really used properly."

This comment points to the struggles the team members had in spanning the gap between research and practice. As an engineering education student observed,

> "...our discussions of the value of reflection, assessment, and continuous improvement were a lot farther away from the realities of 'traditional' engineering than we might have thought."

An engineering team member directly stated that,

> "This project showed constraints of trying to implement the theoretical concepts into realistic situations. I learned that motivating the need for a new assessment tool plays an important role in its successful design and future success."

These challenges of applying theory led team members to examine their own values, in some cases contrasting themselves to students in traditional engineering departments. As one team member explained,

> "the most shocking part of the experience was learning that the ONLY thing that mattered at all to them on just about any level was their research. They didn't care about assessing their program

> even though it could lead to improvements because any time taken to complete the assessment would be time taken away from their research and therefore a complete waste of time."

That same student commented, "I have never been more proud or felt more that engineering education is important." The team members also made connections between the research literature studied in class and the reality of creating an actual assessment plan. An engineering education student stated that "this project provided ample evidence of assessment being forced from the top down and encountering heavy resistance." Another tried to link Spurlin et al.'s five criteria of good assessment plans [20] to the project and had to admit that the team had not been able to fulfill each criterion.

The team members characterized these aspects of the project as "depressing" and "frustrating," yet in the final analysis described the assignment as challenging but valuable. An engineering education team member with a Master's degree wrote that the project was

> "easily the most challenging project I have participated in through my graduate career and definitely a positive experience to construct other learning experiences from."

She added that,

> "the influence and interest of the Dean added significant pressure to ensure that the project result was right the first time, and this enhanced the experience more than any class-simulated experience could have provided."

Another student commented,

> "It was a good experience for the class—it allowed us to work as a team and tackle a real problem with real customers. I'm certain the team members won't forget it."

Students cited lessons learned that included real-world assessment, client relationships, teamwork, functionality of ePortfolio, project management and leadership. An engineering student learned that "eportfolio is more flexible than I expected and can be utilized for assessment with many different levels of effort." All of the students recommended a similar type of assignment for future course offerings, commenting that "it would be interesting to see how other departments would like to use the ePortfolio tools" and that "dealing with people who are unfamiliar with our studies is a sobering and challenging design activity."

Within a compressed timeline of three weeks, the assessment team conducted focus groups with the client and created a prototype for implementation. All of the students observed that the challenges of meeting the client's constraints and incorporating reflective practice into the assessment plan was not possible right away. As one team member stated,

> "One of the running jokes within the assessment team was that we were making this a ninja assessment plan. This meant that for now the plan will collect the numbers they are looking for and do it quickly, but in a few years, they will be able to look back on what they have collected and really see trends in their program and have a complete assessment they didn't realize they had."

One of the major motivations the instructors used in presenting the initial project idea to the client (even before the semester began) was computerizing the Annual Reviews of Graduate Student Progress which are required by the Graduate School but still done primarily on paper by most engineering departments. Additionally, upcoming SACS regional accreditation emphasized the campus-wide need to implement assessment plans and collect assessment data. One student recalled that "from the [client] faculty perspective, it was merely a means for them to digitize their current forms. From the student perspective it meant more work." Yet, this student continued, "We attempted to integrate value that addressed both groups." The final plan enabled the client department to collect required quantitative data with increased efficiency, as requested. But they also incorporated places for the students to create resumes and critique their courses. Also, the ePortfolio design created a mechanism for faculty feedback, which the client students did not see in the current system. Although one student characterized the initial session with the client as "a nightmare," the same student noted that the client's "response to the final product was much more positive than the initial Q&A session." He added,

> "I was very happy with the final product. I thought that the group did what they had to do and with the time constraints and far too many opinions. I am happy with the results."

II. Student Focus Groups

In a focus group with the nine students who participated in the assessment team, students reiterated many of the themes that they wrote about in their reflections. Expanding on the differences between themselves and traditional engineering students, team members said that the client students "were not concerned" and that it was surprising to hear "how much they don't care, as the next generation of faculty, how they don't care." Several members of the assessment team said that they expected resistance from the client students but not to such a large degree. Others said that the resistance made them "fired up" to plan a good assessment.

The assessment team also talked more about how they worked successfully under constraints, one student noting that "we knew the 15 minute thing [about student time to complete the assessment] was unrealistic, so it was only superficially part of the design scope." Another student agreed, "We just needed to make it [as] efficient as possible for all the users."

The team also added detail about how they struggled with translating the possibilities of ePortfolios into a different context. In addition to the idea of a "ninja assessment" they also joked about their project as a "stealth assessment." They felt that the clients didn't understand assessment in the same way they did, and that they had tried

to "sneak in" assessment approaches that would pay off later. As one student explained,

> "Two or three years from now they will sit down and have data for a longitudinal assessment. For them it can't be overt. Right now it seems like a waste of time for them. They see some utility, but we have allowed for flexibility to have both."

The assessment team learned from the client students that they felt that their advisors knew their work well enough through frequent research discussions and presentations. Therefore, the client students did not see the purpose of an assessment tool. The assessment team was concerned about the clients' concepts of learning outcomes:

> "When we asked them what the learning objectives are in their program, they said to do good research and that their discipline is too varied and specific to have learning objectives that could work for everyone. They only wanted to become an expert in their own research concentration."

Furthermore, the client students could not think of any evidence of achieving this goal. However, the assessment team drew some encouragement from one of the faculty clients, who in the final presentation of the assessment plan began talking about the idea of a "virtual mentor" that would help mentor students in areas beyond research.

These experiences led to reflections about the role of differing values in designing and implementing assessment. The assessment team student who led the initial client meeting admitted,

> "I was disappointed in myself because I heard myself saying like, this is what *we* do so you should do it too. Instead, we should have been saying we're *all* engineers and this is something that we can do together."

Another student added that it was important for them to "understand the client's value system in terms of assessment. For example, [the Graduate Program Director] said that she wanted to hold people accountable for how they are funded and what percentages." Another student added that this person was "looking for quantitative assessment and we were thinking qualitatively—artifacts and reflections. How much funding, how many papers…" But the first student disagreed,

> "I don't think we were separating it that much, though. We weren't going to do qualitative only. We brought to them more of a qualitative way, but you can also get the information from the quantitative. We brought qualitative to it because we're more comfortable in that space."

Students were also asked to give feedback on what they would change about the assignment. They all agreed that they should have been more familiar with the ePortfolio technology sooner, that the project should be given a longer timeline, and that they should be split into smaller groups. Indeed, much of the literature on cooperative learning advises instructors to use small (2-4 person) groups in which leadership can rotate. Students complained about "social loafing" and offered suggestions such as setting up a competition or giving sub-assignments to each small group. There was disagreement about the difficulty of balancing the project as "a course assignment versus the real-world client aspect." Some students were primarily worried about getting a good grade while others focused on the client and believed that a good grade would follow. As facilitators, we gave students a rubric at the beginning of the project to communicate our expectations, but soon realized that client expectations were incompatible with it. Subsequently, we focused students on giving the clients a usable design that follows good assessment practice.

When asked what they had learned from the experience, students had a variety of answers, including one student who "learned about portfolios after not knowing anything going into it." Also, students said that they had not thought much about program outcomes beyond "just something the department was required to have." Several students said that the experience encouraged them to look more closely at their own portfolio work. They also reflected on having to give a "sales pitch":

> "I was totally shocked when [one of the instructors] came in here and said we have to give a sales pitch and convince these people. Weird assignment. But then the clients walked in here and it became more realistic, like a job. And then the importance of the sales pitch became much more apparent."

Other students agreed that they will know in the future how to talk about assessment to different people now that they have worked in an environment where "people didn't understand assessment in the same ways." Perhaps the most supportive comment for using problem-based learning was this: "Another thing we can say is that we don't just *pretend* but that we actually succeeded in creating an assessment plan that is consistent with accreditation."

DISCUSSION AND FUTURE WORK

Although the engineering education literature on ePortfolio, PBL, and assessment/accreditation tends to focus at the undergraduate level, we have presented one example of how they can be effectively used at the graduate level.

We began this project in 2008 by asking students in the assessment course to create an ePortfolio assessment plan for the PhD in engineering education. As the majority of students enrolled in the course were PhD students in the program, participatory design was a primary motivation.

In 2009, we expanded the project to a client traditional engineering department with a much larger and more established graduate program offering multiple Master's and PhD degrees. We had hoped to repeat some of the participatory design arrangements, but graduate students in the client department had few incentives to participate in more than one focus group to describe their perceptions of longstanding annual evaluation procedures in the department. Both we as facilitators and our students underestimated the degree to which we would need to "sell" ePortfolios to the client. We did some preliminary work in

securing the client, but we realized as the project progressed that our arguments for graduate-level assessment, professional development, and computerizing assessment data collection were not as clear nor as integrated as we initially thought. Client meetings and presentations within the structure of the class project served as rude awakenings.

However, there is promising evidence from the final design presentation and ongoing work that ePortfolios and the less quantifiable meta-cognition and professional development they afford are being accepted in our College of Engineering. For example, our clients have asserted that providing the structure of student reflection and electronically-routed faculty feedback can counteract some of the effects of less proactive advisors. Some of the ways we are continuing this work are to help the client department implement the system our students proposed and working through committees to educate other engineering Graduate Program Directors about the value of ePortfolio. For example, we have collected annual review forms from most engineering departments in an effort to create a common form to enable data collection across engineering departments.

In this second offering of the class project (2009), the role of our students as change agents emerged as a much stronger framework than participatory design. Practical impact is a powerful value within the field of engineering education [21, 22], as the results of engineering education research are frequently held to a standard of having clear implications for practice. It only follows then, that future leaders in engineering education (earning PhDs and certificates) should be able to help others put the results of educational research into practice. In the case of an assessment class, this means designing assessment plans that both follow quality assessment practice *and* are used by students, faculty and administrators in the program [20].

We have obtained internal funding to continue this project by expanding to more engineering departments. As our students learned, even in an environment in which client participation is challenging, using a participatory design approach can lead to user-centered and practicable assessment designs. Therefore, we will be cognizant of both participatory design and action research/change agent perspectives to include graduate students, faculty and administrators in the process of designing and implementing ePortfolios for assessing graduate programs. Through this process, we will increase engagement in assessment, develop future leaders in engineering education and contribute to the literature on ePortfolios and assessment of graduate education.

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