A Methodology to Analyze Self-Reflection in E-Portfolios

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Abstract—**This Research to Practice Work-In-Progress offers an approach toward assessing self-reflections in e-portfolios written by undergraduate student-Scholars in a Grand Challenge Scholars Program within the College of Engineering at the University of Maryland, Baltimore County. The proposed approach applies two existing frameworks—Robert Grossman's levels of reflection and the Reflection and Self-Assessment criterion in AAC&U's Integrative Learning VALUE Rubric—to develop a methodology that could facilitate the assessment of self-reflections as instruments of students' learning. Preliminary analysis of portions of the e-portfolios submitted by Scholars in the first two cohorts to complete the program shows that the Scholars did not reach high levels of self-reflection when guided only by a generic prompt that asked them what they learned about themselves and how it changed or broadened their perspectives. Our analysis of portfolios is ongoing as additional Scholars graduate from the program, and we expect to see evidence of deeper levels of self-reflection and greater transformation in these newer portfolios as a result of the changes in expectations and prompts.**

Keywords—E-portfolio, self-reflection, Grand Challenge Scholars Program, assessment, program evaluation

I. INTRODUCTION

E-portfolios are a means for documenting and authentically assessing student learning across diverse experiences [1]. The process of selecting which artifacts of their experience to include in a learning portfolio and, perhaps more importantly, writing reflective interpretations of those experiences has also been shown to have multiple benefits for learners [2]. When it is well supported, the metacognitive work involved in such reflection on experience can help students become more independent learners through monitoring their own learning processes [3]. It may also help them to construct new personal and professional identities as they synthesize their achievements across diverse and complex projects and experiences [4, 5]. That is, they may experience a transformation in their self-perception and sense of self-efficacy [4]. One of the barriers for educators to adopt e-portfolios has been the lack of guidelines for analyzing them as representations of student learning. This WIP outlines a methodology for analyzing and evaluating students' written reflections in e-portfolios prepared as part of the requirements for NAE's Grand Challenges Scholars Program (GCSP). Our goal is to share and receive feedback on our developing methodology and analytical approach.

II. E-PORTFOLIOS AS TOOLS FOR SELF-REFLECTION

A. Use of E-Portfolios in Engineering

The use of e-portfolios in undergraduate engineering programs has not been documented as extensively as in other disciplines. Additionally, the majority of efforts in this area has been limited to the use of e-portfolios to demonstrate the attainment of course objectives [6] or for data collection and evaluation of ABET student outcomes [7, 8]. Interesting studies have centered around analysis of the processes for supporting students' development of e-portfolios [9] or as a means to understand student's experiences in project-based courses [10]. Another relevant study presents the concept of preparedness portfolios, in which students use specific experiences to demonstrate evidence of their engineering preparedness [11]. It also discusses the use of e-portfolios as argumentation and their link to the evolution of knowledge through writing. Demetry et al. [12] report the use of e-portfolios as mechanisms to foster reflection and integrative learning among students participating in a Grand Challenge Scholars Program.

B. Assessment of E-Portfolios

To the extent that e-portfolios have been implemented in engineering programs, methods for assessing self-reflection in e-portfolios have received very little attention in the research literature. This may be due to the fact that in engineering programs, e-portfolios have primarily been used as a means for students to document, or showcase [13], their work. We found two studies that documented approaches to analyzing or assessing engineering students' e-portfolios in which self-reflection or self-understanding was at least one of the goals for assigning the portfolios and which used the writing in the portfolios themselves as evidence of students' engagement, or not, in self-reflection. Bhattacharya and Hartnett [14] analyzed engineering students' reflections in e-portfolios using a rating scale that encompassed six categories, each dual-faceted: metacognition and progression, conceptualization and implementation, cooperation and collaboration, critical thinking and decision making, evaluation and modification, and creativity and innovation. Demetry et al. [12] assessed levels of reflection in students' e-portfolios using two criteria from two different American Association of Colleges & Universities' (AAC&U) VALUE rubrics: the "Reflection" criterion of the Foundations and Skills for Lifelong Learning rubric and the

"Connections to Experience" criterion of the Integrative Learning VALUE Rubrics.

While both of these studies provide glimpses into engineering students' self-reflection in e-portfolios, we are adopting two other existing frameworks in our study that align better with our understanding of the generative nature of self-reflection within the learning process. That is, we see self-reflection in writing as a crucial step in the learning process that helps learners to make connections among ideas and experiences and to articulate for themselves what has been learned and how the learning has changed their conceptual understandings as well as their understanding of their own roles and responsibilities in the world. The approaches we are adopting in this study are Grossman's Structures for Facilitating Student Reflection [4] and the Reflection and Self-Assessment criterion in AAC&U's Integrative Learning VALUE Rubric [1]. We chose these two frameworks for our study because they align with theories of reflective writing that anticipate learners' development of self-awareness and understanding as well as potential for self-transformation through the process of reflection in writing.

The research questions that we are beginning to explore attempt to characterize the forms of writing that GCSP scholars are doing in their e-portfolios, and more specifically, any types of self-reflective writing they engage in. The overarching purpose of this study is to begin to develop a methodology for assessing the learning experiences of GCSP Scholars. Thus, we have decided to focus initially on the e-portfolios as an artifact of Scholars' learning.

1) What is the nature of the writing that GCSP Scholars are doing in their e-portfolios?

2) What types of self-reflective writing, if any, do their e-portfolios exhibit?

3) What interventions (additional changes to the e-portfolio writing prompt or additional activities and scaffolding in the GCSP seminars) might foster deeper self-reflection and self-understanding?

4) Is the methodology that we are developing a valid way to begin to evaluate the GCSP?

III. METHODOLOGY

A. Context of the Study

The GCSP at the University of Maryland, Baltimore County (UMBC), was created in response to the National Academy of Engineering's (NAE) inquiry for pathway programs that educate students about the 14 Grand Challenges of Engineering [15]. The GCSP at UMBC was developed following NAE's guidelines to allow students to create a personalized framework around five program areas: research, entrepreneurship, service, interdisciplinarity, and global perspectives. Scholars complete experiences in these five areas that help them develop skills for shaping solutions to the Grand Challenges. At UMBC, GCSP Scholars spend the final two years of their undergraduate careers participating in three one-credit seminars, completing their chosen experiences, and documenting the process and outcomes in an e-portfolio.

The GCSP program at UMBC received its first cohort in the Fall of 2016 and the first group of scholars graduated in Spring of 2018. Although students' work is assessed at different points in the three seminars, the program directors are currently working on a plan to evaluate how different aspects of the program have facilitated the development of students' skills. Different approaches have been taken to evaluate the components of the program. For the current work, the authors of this paper are analyzing iterative drafts of the e-portfolios, as well as the final e-portfolio, as artifacts of the learning process that demonstrate how scholars have achieved the program's learning objectives.

The learning objectives were established as different parts of the program were developed. At the inception of the program it was decided that it would emphasize explicit learning objectives in each of the five GCSP areas (research, service, entrepreneurship, interdisciplinarity, global perspectives) as well as program-wide objectives. Additionally, a broad set of optional learning objectives were identified to allow students to personalize their learning. The program-wide learning objectives are centered around five of the affective functional competencies (AFCs) that have been proposed at UMBC for assessing applied learning experiences. Three additional AFCs are particularly related to specific program areas (research, service and global perspectives). The core learning objectives for the remaining areas (interdisciplinarity and entrepreneurship) are based on the Scholarship of Interdisciplinarity (SOI) curriculum at the core of UMBC's Individualized Study (INDS) program and drawn from assessments of existing entrepreneurship coursework and activities at UMBC. It is expected that all GCSP students achieve all core program-wide and area specific learning objectives. Students are asked to explicitly tie their program experiences to these core objectives in the reflections they will prepare as part of their e-portfolios.

B. Analytical Framework for Assessing E-Portfolios

As part of the evaluation of the GCSP at UMBC, the authors are developing an approach for assessing students' e-portfolios, beyond simple completion of the required experiences, to include their abilities to engage in self-reflection. Toward that end, the approach presented in this work draws on two existing frameworks for assessing self-reflection: 1) psychologist Robert Grossman's (2009) structures for facilitating student reflection [4], and 2) the Reflection and Self-Assessment criterion in AAC&U's Integrative Learning VALUE Rubric [1]. Both frameworks share, implicitly (the VALUE rubric) or explicitly (Grossman's Structures), assumptions of a developmental progression in learners' abilities to be self-reflective, ranging from making "simple connections among ideas and experiences" [1] to integrating learning in a way that learners experience as transformations of their selves/identities. Note that our purpose for developing an approach to assessing self-reflection in e-portfolios is not as a means for assessing students' completion of the portfolio requirement, nor to assign grades, but rather to inform the evaluation of the GCSP and to plan interventions that enhance future scholars' learning experiences in the program.

Grossman, a psychologist, defined his four levels of reflection over many years through an iterative process of

refining assignments that engaged his students in reflective writing designed to help them grapple with the relationship between theory and practice. Although he describes his approach as particularly helpful for students confronting emotionally dissonant experiences, he claims his structures may be applied in any discipline. Similarly, AAC&U's VALUE rubrics are meant primarily for assessing students' work products from integrative and applied learning projects or assignments in which they are supposed to make connections between theory and practice toward a deepened understanding. Both approaches have similar aims, but Grossman's structures are written as definitions of four levels of self-reflection, whereas the VALUE criteria are written as descriptions of outcomes or benchmarks attained. Table 1 below outlines several other similarities and differences between Grossman's four Structures for Facilitating Student Reflection and the four levels of the Reflection and Self-Assessment criterion of the Integrative Learning VALUE Rubric.

TABLE I.   COMPARISON/CONTRAST OF GROSSMAN'S STRUCTURES AND AAC&U VALUE RUBRICS

Grossman's Structures for Facilitating Student Reflection (2009)	AAC&U's Integrative Learning VALUE Rubric: Reflection & Self-Assessment Criterion (2009)	Aspects of Congruence/ Divergence between the two Frameworks
Content-based reflection: Intentional consideration of an experience in the light of particular learning objectives.	**Benchmark 1**: Describes own performances with general descriptors of success and failure.	The baseline for both frameworks describes making simple connections among ideas and experiences.
Metacognitive reflection: Reports or descriptions of one's own thinking or thought processes.	**Milestone 2**: Articulates strengths and challenges (within specific performances or events) to increase effectiveness in different contexts (through increased self-awareness)	Grossman specifically discusses metacognition, which is a reflective ability that is related to self-regulated learning. AAC&U's framework does not explicitly describe metacognition, whereas Grossman does not explicitly reference articulation of strengths and challenges.
Self-Authorship reflection: Descriptions of becoming aware of one's inner state, including assumptions, biases, misconceptions, beliefs, and values.	**Milestone 3**: Evaluates changes in own learning over time, recognizing complex contextual factors (e.g., works with ambiguity and risk, deals with frustration, considers ethical frameworks)	AAC&U's Milestone 2 mentions self-awareness, which is the explicit focus of Grossman's Self-Authorship form of reflection.
Transformative reflection: The process of effecting change in frame of reference—i.e., the structures through which we understand our experience.	**Capstone 4**: Envisions a future self (and possibly makes plans that build on past experiences that have occurred across multiple and diverse contexts).	Both frameworks aim for a level of self-reflection that is transformative.

C. Analytical Methods

To date, we have assessed one of the five experience pages, the Research page, written by the scholars in their e-portfolio and plan to evaluate the remaining four experience pages while concurrently developing and improving our methodology. The analysis of student e-portfolios is divided into two cohorts based on the time of graduation from the program and the different e-portfolio reflection prompts they received during the program seminars. The first cohort consists of eight scholars who graduated in Fall 2018, prior to an update made to the reflection prompts. The second cohort of four scholars received the updated e-portfolio reflection prompt during their final seminar with the program; however, some of these scholars had already finalized writing about their Research experience. Thus, their writing responds to the original prompt. The third cohort received the updated prompt within all of the program's seminars and a newly integrated scaffolded support. Therefore, we anticipate our analysis may find a difference in the third cohort of students' reflective abilities, compared to the first two cohorts. Table 2 shows the two different prompts and which prompt each cohort received.

TABLE II.   PROMPTS FOR E-PORTFOLIO ASSIGNMENT

Prompt	Cohort

Original:
Experience Page should include:
• a personal reflection about the overall experience:
  o What did you learn about yourself?
  o How did it change/broaden your perspective?
	1 and 2

New:
Experience Page should include:
• a personal reflection about the overall experience:
  o What did you learn about yourself?
  o How did it change/broaden your perspective?
  o How do you plan to use the experience gained in your future aspirations?
  o What skills has this experience given you that can be used for your future career or goals?
	2 and 3

In conducting our preliminary analyses of the Research experience texts from scholars in the first two cohorts, each of the authors independently coded all twelve scholars' texts, applying both Grossman's structure and the four levels of the Reflection & Assessment criterion of the Integrative Learning VALUE Rubric to analyses of each text. Different passages in a single student's text were often coded differently by a single researcher, i.e., one passage in the text might be coded as exhibiting Level 1 and another, a Level 2, based on the VALUE Rubric. The same potential for a single text to exhibit more than one of Grossman's levels was also possible. Each text was then awarded a single score on Grossman's levels and a single score for the VALUE rubric, based on the highest level that text exhibited for each of the two approaches. After independently coding each text in this way, we conducted a norming session in which all three authors compared scores for all twelve texts and engaged in intensive group discussion to resolve any discrepancies by consensus [15]. Thus, all twelve texts received **two scores by consensus: one based on Grossman's levels and** one based on the VALUE rubric. Pseudonyms are used for students whose texts we use as examples in the Results section.

IV. ANALYSIS OF GCSP SCHOLARS' E-PORTFOLIOS

Preliminary analysis of the e-portfolios completed by eight graduating Scholars from the first cohort and four from the second cohort showed that most had reached only the first two levels of Grossman's structure and the first milestone of the VALUE rubric. All students were able to connect their experiences with the learning objectives (Grossman's content-based reflection) and with general descriptors of success (mostly) and failures (AAC&U Integrative Learning VALUE Rubric Benchmark 1 for Reflection and Self-Assessment). For example, one student, Laurel, wrote in her e-portfolio about her capstone study, in which she had analyzed viewers' interactions with two different types of display case exhibits in her university library, comparing a static, descriptive display with an interactive one. Describing how she had achieved program-wide learning objectives through this project, Laurel wrote:

> Persistence was an important part of this process, because I needed to *overcome some major set-backs*–from legal issues with object loans to installation delays. I also needed to be *flexible* when addressing these challenges. For example, when one of the object loans was not going to work out, I needed to move on and work around it. While I didn't necessarily work on a team, I still needed to interact with stakeholders in a clear respectful manner. *Having a realistic vision* was an important part of planning for the exhibits, and *integrity* was an important part of reporting my timing and tracking data. While developing the exhibits, it was important to *consider the views and experiences of other people*. (learning objectives italicized by the researchers)

In this excerpt of her e-portfolio, Laurel describes elements of her experience in this project that align with the learning objectives, but her annotations do not demonstrate increased self-awareness, nor does she articulate her thought processes, much less show awareness of having experienced a self-transformation nor a vision of a "future self." Laurel's writing exemplifies much of the writing in the e-portfolios of students in the first two cohorts of our study. Her descriptions of her experiences read like a "matching" exercise, whereby she chooses elements of her experience that align with program learning objectives and describes them concisely and unreflectively. To be fair, as we note in the Methods section, the assignment description and writing prompt Laurel and the other students in her cohort were responding to did not particularly encourage deeper reflection.

Some students' e-portfolios reported evidence of their own thinking or learning process, demonstrating a metacognitive level (Grossman's Level 2) of reflection. Eluma wrote:

> Being successful at this research required that I learn about diabetes, a disease I was barely familiar with before the summer

and

> In going through this process, I was able to further my knowledge of control engineering optimization techniques that can help solve real-world energy problems.

Eluma recognizes his limited knowledge of the topic of his research prior to the experience and explicitly describes having learned and developed his knowledge through the experience.

Jonathan is one of the few students who demonstrated any degree of transformation (Level 4, Grossman) through his reflection:

> I got to see both how open-ended research is, and how many different components go into a team in industry. Going into this experience I had very different preconceptions of both worlds, imagining research as being somewhat disconnected from practical concerns and industry as being stifling and money-obsessed. All that being said, I think the biggest revelation for me was how much I value a team environment. Previously, I had been always thought [sic] of myself as very independent, a self-teacher even; but in this experience, where most of the work was individual but there was a strong community to meet and discuss things with at lunch, it was not hard to tell which I preferred.

Elena briefly discussed a vision of her future self (AAC&U Integrative Learning VALUE Rubric Capstone 4 for Reflection and Self-Assessment) when she wrote:

> This experience not only gave me a taste for what research is like but also guided me to highly consider graduate school as a possible career path post-graduation.

Although Elena did not provide enough information to show evidence that this new self is present across multiple and diverse contexts, she is one of the few students that reflected on how the experience had helped her develop a sense of her new path.

V. DISCUSSION AND CONCLUSIONS

From the preliminary analysis of e-portfolios of students in GCSP, it is apparent that the majority of students are not familiar with demonstrating evidence of deep levels of reflection. As a result of these preliminary analyses, the directors of the GCSP at UMBC have more clearly articulated the expectations for the e-portfolio and revised the prompts provided to scholars. Our analysis of portfolios is ongoing as additional Scholars graduate from the program, and we expect to see evidence of deeper levels of self-reflection and greater transformation in these newer portfolios as a result of the changes in expectations and prompts.

It is important to note that the two students, Jonathan and Elena, who appeared to demonstrate "higher levels" of self-reflection in their descriptions of their research experiences did not demonstrate a "progression" through the AAC&U Integrative Learning VALUE Rubric or Grossman's levels. This may show the need for additional scaffolding to support students' reflection in a way that documents their progression. On the other hand, it may be evidence that what has been framed by Grossman and in the VALUE Rubric as a developmental progression—from making simple connections among experiences to the recognition of having been transformed by the experiences—may in fact be distinct forms of reflection that are not developmentally linked. In other words, perhaps metacognitive reflection, self-authorship, and self-transformation (Grossman's structures) are all distinct and valued forms of reflective activity, not stages in a developmental progression. As our work progresses, we continue to grapple with these conceptual issues, as well as the relationship between the two frameworks we have tested here.

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