

AC 2007-2010: WHAT PORTFOLIO CONSTRUCTION EFFORTS REVEAL ABOUT STUDENTS' SEARCH FOR ENGINEERING IDENTITY

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What portfolio construction efforts reveal about students' search for engineering identity

Abstract

With the desire to contribute to both the research and practice of improving engineering education, we set out to explore portfolios as a curricular intervention to help students integrate engineering content knowledge. Unexpectedly, our data have been helping us see the significance of the identity work students do in creating portfolios. Students built their portfolios through a semi-structured curriculum. Each week students sought to further describe their preparedness as an engineer and we gathered data, primarily interviews, from participants. After undergoing coding and inter-rater reliability tests, three themes of identity work emerged: portfolio construction impacting students' engineering identity, skills and abilities as a prominent basis for determining engineering affiliation strength, and how portfolio construction may provide students moments of fruitful uncertainty in terms of their personal agency in managing their own identity. This paper illustrates those three themes through two students as cases in identity work. We articulate our understanding through a framework provided by Gee that categorizes identity in four ways: affinity, institutional, discourse, and natural.

Introduction

A subtle activity for emerging engineers is the formation and integration of their identities as engineers. Not only must their content knowledge cohere into expertise, they must understand themselves to be the kind of person who can and should possess that expertise. They must think of themselves as engineers. In recognition of this, identity is emerging as a promising lens for engineering education research. For example, the issue of identity is one of three threads in an ongoing multi-institutional NSF-funded study of the engineering student learning experience^{1 2 3}. Researchers in engineering education are drawn to issues of identity because of the hypothesized link between identity development and retention in engineering. Having students build professional portfolios in which they describe their preparedness to function as an engineer represents one approach for studying students' efforts to consider and assert their identity as engineers.

In our professional portfolio program, students created portfolios of their past work and experiences intended to represent their fitness as emerging engineers. Students performed a series of tasks to accomplish this goal. Those tasks included writing a professional statement about their chosen engineering discipline, collecting and assessing artifacts of past work, choosing artifacts that best represented what students wanted to illustrate about their engineering acumen, annotating the chosen artifacts, and connecting the artifacts together in an online portfolio building tool or in a web site of their own design.

The purpose of this paper is the preliminary creation and introduction of themes of identity work seen in engineering students' activities. The themes are preliminary, as is the analysis that produced them. This paper does not publish a new theory, but asserts the potential fruitfulness of an analytical direction – the work engineering students do to create their engineering identities. We will articulate each theme and provide examples from our data. It is important to remember that we will not simply recount what kinds of identities we saw, but the kinds of work students

did in creating their engineering identities. We believe our ability to show these kinds of identity work from our data suggests portfolios hold great promise as a curricular intervention in engineering and that identity work is important to research in engineering education.

Background

Identity is a concept explored by many researchers for many different purposes. Some researchers have focused on the kinds of identities formed specifically within professional practice. Even within this area, multiple researchers offer a wide variety of potential theoretical lenses^{4 5 6 7}. At a broad brush, identity deals with the ways in which people are characterized and classified, including issues such as how the classification comes to be (e.g., who gets to label someone as an engineer, how such a label gets reinforced) and how the classification gets its authority. In the case of engineering students and engineers, relevant questions include how students come to think of themselves as engineers, how others come to think of those students as engineers, and what it means to be an engineer.

For our purposes in recognizing and understanding the identity work engineering students do during portfolio construction, we have found the framework provided by Gee to be useful for bringing out the complexity of this issue^{8 9}. This framework categorizes identity in four ways: affinity, institutional, discourse, and natural. Affinity identities result from a person's participation in specific practices and sharing of common experiences with others in a group (what Gee calls an "affinity group"). This identity is entirely voluntary. While a person could be forced to adhere to certain practices, a person can not be forced to see that performance as part of who they are. Institutional identities grow from the authorization of an institution. Lawyers, professors, and convicts are all examples of institutional identities. Gee specifies that an institutional identity can be thought of as positive (a "calling" such as a minister) or negative (an "imposition" such as a convict). Gee also states that people can often choose how actively they fulfill their institutional identity. Discourse identities come from the dialogue between and amongst people. People may consistently describe someone as "funny" or "smart." These are individual traits of a single person. Unlike institutional identities, no tradition or officialdom requires people to recognize these discourse identities. These kinds of identities are recognized through the discourse between people who think it rational to recognize and interact with someone as if he was "funny" or "smart." Gee also states that people can often choose how actively they pursue or maintain their discourse identity. Natural identities result from forces of the natural universe. Being a twin or tall are examples of natural identities. Gee maintains that even these natural traits become and remain identities only because people and institutions sanction them as such through discourse.

Juxtaposing these categories with the notion of engineering identity leads to the observation that an identity as an engineer may actually represent more than one of these categories. For example, an institutional engineering identity comes from having an engineering degree or being hired into an engineering position. An affinity engineering identity would represent someone believing themselves and their preferences to align well with the practices of engineering (e.g., the mathematical core of engineering, the types of problems engineers solve). A discourse engineering identity could come about by someone talking about himself or herself, or by others talking about the person, as an engineer. It is even possible that, in some instances, people think of engineering as an innate, natural ability.

A focus on portfolio creation is interesting from an identity perspective because the portfolio task invites students to explain why they identify themselves as engineers (or perhaps why others should identify them as engineers), rather than simply whether they consider themselves to be an engineer. In our instantiation of the portfolio task, the students also determine the basis for their explanation based on the type of engineering identity they wish to support (e.g., affinity, institutional). Further, this framing of the portfolio task suggests personal agency concerning their identity in that they are asked to make an argument about their identity (i.e., provide discourse). What is unknown is whether this process of making an argument about their preparedness as an engineer simply provides a window into how the students see this process of affiliating with engineering and the strength of students' identities as engineers, or whether it actually affects (positively or negatively) their sense of themselves as engineers. We believe that our data suggests evidence of the latter.

Methods

The work presented here is part of a study in which we tracked the portfolio activities of six students as they developed their professional engineering portfolios over the duration of one academic term. Students built portfolios through a semi-structured curriculum with each week of the course focusing on one of the previously mentioned portfolio elements (artifacts, annotations, etc.). Each week students worked to achieve the goal of describing their preparedness to function as an engineer. During this portfolio work, students sought to portray themselves as engineers and to provide evidence of their preparedness. The six students from whom we collected data were the ones who agreed to work with us on our research. Our data include weekly written reflections from the students about their activities and the challenges they were experiencing, periodic interviews with the students focused on the same issues, and pre and post-portfolio construction interviews in which the students talked about their experiences with portfolios and their sense of themselves as engineers. The excerpts presented in the findings section come from these data sources.

We engaged the gathered data first by simply reading the transcripts through from beginning to end. We saw that in their portfolio work students consistently grappled with a wide variety of issues. We conceptualized these issues as problems and reduced the disparate data sources into a collection of over 500 problems. We then sought to organize the problems, focusing on four different types: identity, experience, conceptual knowledge or portfolio construction (and also "other"). We created a codebook operationalizing definitions for these four kinds of problems and coded each instance of problem. We double coded a random sampling of the problems according to accepted practices in order to confirm the reliability of our coding¹⁰. The coders agreed 90% of the time, confirming sufficient inter-rater reliability. In the analysis reported in this paper, we focused solely on the problems coded as "identity." Identity problems dealt with issues around who the student was or wanted to be. Having isolated data reliably coded as identity problems, we then sought themes amongst these identity problems.

Findings

In the findings section below, we focus on examples of the identity work of two of the participants. These students represented two different disciplines (electrical engineering, usability engineering) and two academic levels (senior, masters), and their portfolios were quite

different. More to the point of the paper, these cases were selected because they each illustrate variants in all three of the following themes that have been emerging in our analysis:

1. The portfolio construction impacting, not just revealing, students' sense of their engineering identity in terms of the strength of their affiliation with engineering (as revealed in the data through self-reports of changes in confidence).
2. Skills and abilities as the prominent basis for determining strength of affiliation with engineering, and thus the primary referent against which to make an argument about being an engineer (i.e., because I have these skills, I deserve to be called an engineer).
3. While having personal agency is key to how portfolio construction can affect (not just reveal identity (theme 1 above), accepting this agency in the process of identity management can bring awkwardness).

In the descriptions below whenever we present excerpts, "Q" marks the interviewer speaking and "A" is the student answering the question.

Student 1

Student 1 was a graduate student focusing on usability engineering in the Technical Communication department. As the quote below shows, she doesn't mince words when she claims that the portfolio process had a profound impact on her confidence.

Q. I'm just wondering, I mean if you had to pick a couple of things ... that you said [you] have taken away from it, and this could be in just the last couple weeks or just overall, what would you say?

A. Uh, kind of a low-level thing is the the things that are important, get them up there first, make them make them one of the first things a person would see, that's real basic, but but, boy am I feeling but really high-level here is boy am I feeling confident that I'm ready for a job as a usability engineer.

Q. And just sort of very explicit, why do you feel like you're ready?

A. Um, well, I feel the whole process of naming these experiences that I have and and spelling out that landscape of usability engineering and what do they do, um, I I see that I'm a fit for the job, for the field. And and then I think writing about it has built my confidence in how I can portray myself.

Here, the student states very plainly that the portfolio process helped her feel ready for a job in her chosen profession and further that the tasks in the portfolio process had a significant role in that assessment of readiness. In particular, she points to the processes of naming her experiences, spelling out the landscape of the discipline, and simply writing about these issues as core mechanisms leading to the increased confidence.

This passage also points to a significant aspect of how the portfolio construction affects identity. Rather than affecting identity by giving students new experiences, the portfolio construction activity focuses on helping students make sense of prior experiences in engineering terms. The

student alludes to this when she talks about the way she, “can portray,” herself. She aims to not just prove who she is through a listing of appropriate skills or prior experiences, but rather to use her skills and experiences to portray herself as a professional. She wishes not simply to list her skills, or even her experiences using those skills (“...the whole process of naming these experiences”), but to actively situate those skills in a functional identity as a usability engineer (spell out the landscape...see that I’m a fit for the job). Put another way, the student links her confidence to how she represents her work and experience; not to content knowledge or academic performance *per se*, but to how well she is able to use all that to show others that she can fit in professionally.

The central role of skills in asserting an engineering identity is illustrated through the quote below. In the quote, the student draws a distinction between conveying a professional philosophy and illustrating professional skills. In the second to last line (“seemed like it would get in the way...”) the student suggests that illustrating her skills was more important than sharing a professional philosophy. She wants to concretize her professional image by offering examples of her abilities. Her separation of her professional image from a professional philosophy suggests that to her a professional identity is more about goal or product oriented knowing and doing than holding a vision of how the profession as a whole operates.

A. You know, maybe if I had maybe along the lines of other websites, if I had something like a the equivalent of, um, "about us" page, um, where I had a little a little bit more, um, unstructured, uh, freedom to to just sort of go on and on about my attitudes.

Q. Right. Right. But you but you didn't you didn't put that in?

A. No.

Q. All right.

A. No.

Q. And that's because?

A. It just didn't seem to, it almost for me to talk about my philosophy, it almost seemed like it would get in the way of my trying to convey that I have certain skills.

The lack of certainty (“It just didn’t seem,” and, “it almost seemed like”) in the student’s response suggests an anxiety or apprehension about who and what should be illustrated in the portfolio. This suggests uneasiness about what constitutes the knowledge and practices necessary to affiliate with that profession, or at least the best aspects of knowledge and/or practices to make a persuasive portfolio. Her articulation of her process (“It just didn’t seem,” and, “it almost seemed like”) illustrates the student’s desire to move towards a strong argument of a professional identity in the portfolio, but uncertainty as to how to make that happen. This can be considered as part of the challenge associated with taking charge of the discourse associated with one’s own professional identity.

The issue of agency and the discomfort it can create is latent in the above passage, in that the student is finding she needs to make a choice about how to best represent the strength of her

affiliation with engineering. The passage below suggests a different type of discomfort, a discomfort that stems from asking a difficult question.

Q. Just generally how did you make your portfolio? I mean you've got a concept map there about processes, what was the process that you went through in making your portfolio?

A. Uh, I I started with, um, what understanding the goal of my portfolio.

Q. Okay.

A. And so the goal was to show that I had these skills. So then, um, I started figuring out the what the what skills do I have. What the hell am I good for?

Above, we can see how the portfolio provides a mechanism whereby the student considers not just what skills and abilities engineers are expected to have, but how well hers fit those expectations. For this student, it was about figuring out what she could do in terms of what those in her profession are expected to know and be able to do (“What the hell am I good for?”). Generally, being a student is about others assessing you and helping you understand what you are “good for.” In the case of the portfolio task, students have the chance to make the argument for themselves and this can lead to uncomfortable, yet central questions. Because the passage represents an interview with this student from early in the term and because we know that she ultimately reported significant gains in confidence, we infer that this question and the discomfort it suggests played a significant role in the overall process.

Student 2

Student 2 was a senior in Electrical Engineering. Again, the student expresses increased confidence that was associated with the portfolio construction activities.

Q. And so this is sort of a two part question, so I'm just going to ask it in two parts, and the first part is about sort of the impact that the portfolio had on you, and that could be sort of anywhere along the line of building it. Did it have an impact on how you understand or look at anything in your discipline?

A. It's given me confidence...By going back I'm able to see what worked, what didn't, where I spent lots of time treading my wheels, and what methods or techniques that just clicked and worked really well, and hopefully by the time I graduate I'll have so many more projects that I'll have a very broad base to or background to pull off of.

Here, the student talks about looking back at what his past provides him in terms of making an argument that he is prepared to function as an engineer. Further, the student does not limit his thinking to the present, but rather is positively anticipating a future in which he will have even more resources to support an argument that he is prepared to function as an engineer. For him, these activities did more than just provide documentation but rather increased his confidence that he is becoming an engineer.

The sense of increased confidence is also echoed in the passage below. What is more pronounced in this passage relative to the previous one is the students' sense of surprise. As he points out, he expected to articulate his abilities but he did not expect that articulating his abilities would boost his confidence to assert a professional engineering identity.

Q. And in terms of the portfolio you made for this course that's now that's now over, can you walk me through sort of your recall of sort of how you made the whole thing, just sort of soup to nuts of where it started and where it ended in making a portfolio, assuming that, you know, ending is sort of where we are now.

A. So the process itself?

Q. Yeah, so the process you went through.

A. My process was two tiered. I had my intention going into this course was to, one, get some reflection and some definition of what it is to be an engineer, okay? So that was a I wanted to know what my abilities were, some I wasn't really thinking of confidence booster, but that just happened.

This same passage helps to support the general notion of skills and abilities as the preferred way to support an argument of preparedness for engineering. The student explicitly states that one of the things he wanted out of the portfolio experience was a better understanding of his own engineering abilities. Probing further, in the first four lines of the last paragraph he creates an equivalence between knowing what his skills/abilities are and finding, "some definition of what it is to be an engineer." His statement that he feels more confident in his engineering identity after articulating his skills/abilities suggests that through this identity work he found he indeed had what he considers requisite abilities for an engineering identity. Thus, we see that for this participant, an assertion of engineering skills is the same as, or at least a very significant part of, his engineering identity.

As with the previous participant, the process was not without difficulties and the issue of agency represents one aspect of these difficulties. In the passage below, which also supports the central role of skills, the student notes (in the first paragraph) how he had listed probable skills of an electrical engineer, but then notes (in the third paragraph) how he somehow left himself out of that description ("didn't discuss myself at all"). This overt mention of himself, or lack of himself, in his portfolio indicates a concern that in order for him to move towards a professional identity he must not only show skills, but show how those skills belong to him. It also suggests that such a focus on self may be a challenge.

Q. So talking about sort of putting it somewhere and it just sort of falls into place. Can you give me an example of that?

A. I have all these paragraphs, so I wrote originally these paragraphs, each describing kind of defining skills that an electrical engineer would possess, a successful one.

Q. Right.

A. And then in that I didn't discuss myself at all, so I went back and added kind of a paragraph to each section about, um kind of describing what I have done that shows I have these skills and where I've learned the skill, and then so that it just it got longer and longer.

This passage also suggests the trajectory students may need to take in order to construct the portfolio, a trajectory from being a student understanding their engineering discipline in the abstract, “I didn’t discuss myself at all,” and describing skills an electrical engineer as a person would have, “I wrote originally...describing the skills and electrical engineer would possess,” to a professional articulating his own professional standing, “what I have done that shows I have these skills.” Further, this identity work of moving from a student towards a professional identity is associated with different features of the portfolio construction. Specifically, the student is talking about writing paragraphs that were at first paragraphs in his professional statement, but that he later deduced were skills he asserted every electrical engineer should have. Thus, he moved to writing about himself with the annotations of his portfolio artifacts in the, “have these skills,” portion of the quote. This shows how the portfolio annotations offer a mechanism for enabling identity work. In moving from the general (professional statement) to the personally specific (annotations), the student is able to see his own identity evolution and point to concrete examples of it.

Discussion

This paper has focused on one of the many potential educational benefits of portfolio construction—the ways in which portfolio construction helps students grapple with the issue of their identities as engineers. In the previous section, we introduced three themes that are emerging from our analysis of the data and illustrated the themes through the voices of two participants in our study. Below, we revisit and provide additional thoughts on each of the themes.

First, we argued that portfolio construction impacts, not just reveals, students’ sense of their engineering identity. In this paper, we used reports of impacts on confidence as markers of positive impacts on engineering identity. What was interesting was seeing students’ surprise at the positive impacts of portfolio tasks. In the passages, the students also highlighted the ways in which the portfolio construction led to these impacts (e.g., “naming experiences”, “by going back”). It is also significant that the students experienced these changes without additional new (and costly) experiences since often efforts to positively impact students sense of themselves as engineers focus on giving students new engineering-like experiences (e.g., more authentic capstone projects, service learning efforts).

Collectively, these observations suggest that the portfolio process engenders identity work in the form of students consciously linking their past studies to their present state of professional readiness and on forward to their ability to succeed in their future engineering work. This brings up the idea of the portfolio creation making visible a process that is often hidden, the process of students evolving from students towards professionals. The portfolio helps students see their progress to date, interpret it as current readiness, and project their abilities confidently into their working future. In Gee’s terms this could be thought of as an evolution from a primarily institutional identity of student to a primarily affinity-group based identity as a professional engineer. This professional development is a long-term process. Quotes like the ones above

illustrate that the portfolio creation explicates professional development for students, and perhaps even demystifies it. Their growth into practitioners is not a mystery, but an observable, discernable process they can articulate and analyze with their professional goals in mind.

Second, we argued that skills and abilities were the prominent basis for students determining their strength of affiliation with engineering. There are many potential ways for engineering students to assert or seek affiliation with the engineering profession. For example, the students did not speak of affiliation to their profession in terms of personal values, career goals, or as a desire to be like a mentor. Rather, they spoke of the affiliation in terms of skills. What must they know and be able to do? Do they possess those skills? Is that enough to assert a professional identity? Probing further into this, one of the tasks in the portfolio intervention is students writing a professional statement detailing their understanding of their profession and their philosophy of it. But in their portfolios and in the interviews students did not focus on core values of engineering—rather they focused on articulating their affiliation in terms of the skills and knowledge they believed engineers should have. Why is this? Part of the reason could be that the portfolio as an intervention lends itself to illustrating concrete, discrete skills and not as easily or as much to identify with a role model. Perhaps this is also a reflection of the discrete or disconnected way skills are taught in many current engineering schools. Presently, we have only sporadic, suggestive indications that is true. Future research will explore this as we have larger student cohorts build different kinds of portfolios and assess the differential impacts, as well as analyzing the portfolios themselves over time.

Third, we argued that the personal agency required in portfolio construction can lead to student uncertainty. The type of portfolio we have been asking the students to construct leaves a great deal of freedom to the student. Put a different way, while the professional portfolio is a genre with certain “rules” about what should be included and how it should be put together, the students are still encouraged to make their choices based on fundamental decisions of audience and purpose. As a result, the portfolio task requires a great deal of agency on the part of the student. Our data suggests that with such agency comes uncertainty (and maybe problems) such as asking oneself uncomfortable questions (“what the hell am I good for”), having to make difficult decisions (is it better to highlight my skills or my attitudes), and remembering to put oneself into the center of the writing. Of course, there is a range of reasons why these challenges might exist such as students having little experience exercising such agency, being unfamiliar with the portfolio genre, or not being very strong writers. Further, one might even question whether it is realistic to think that one really has such control over of one’s identity. Nevertheless, the data suggests it is fruitful to have students try.

Conclusion

This paper suggests interesting findings about students searching for a professional engineering identity. It does not require a large leap to see how these findings are relevant to understanding the lived experience of engineering students or to student-centered engineering curriculum design, especially at a time engineering educators seek ways to increase retention and attract more students to engineering. We believe our findings, in addition to some of our previous work^{11 12}, suggest that engineering students already seek to make connections between coursework content, between their academic learning and their intended engineering profession, and even between their engineering learning and their life experiences. Perhaps providing students a data-driven curriculum to guide their efforts at making connections would help students see

themselves as engineers. We assert portfolios are one way to satisfy our obligation as educators to design an engineering learning experience focused on the student and not the content.

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