

Engineering Student Development: Supporting Self-Authoring Engineers

Brook Andrea Sattler

A dissertation

submitted in partial fulfillment of the
requirements for the degree of

Doctor of Philosophy

University of Washington

2012

Reading Committee:

Jennifer A. Turns, Chair

Cynthia J. Atman

Gene Sharratt

Program Authorized to Offer Degree:

Human Centered Design & Engineering

University of Washington

Abstract

Engineering Student Development: Supporting Self-Authoring Engineers

Brook Andrea Sattler

Chair of the Supervisory Committee:
Dr. Jennifer A. Turns
Human Centered Design & Engineering

In this study, engineering undergraduate students constructed a preparedness portfolio in a portfolio studio—the pedagogy at the center of this study. To explore and understand this pedagogy, the construct of self-authorship was used. Through a constructivist grounded theory approach, this study explored the applicability and usefulness of the construct of self-authorship to engineering education. The purpose of this study was to (1) demonstrate the applicability of self-authorship to engineering education; (2) connect this perspective with an actual pedagogy (i.e., preparedness portfolios in a portfolio studio); and (3) offer implications for educational practice.

The study findings indicate that students described their participation in the pedagogy in terms of self-authorship, which suggests that this pedagogy supports students' development toward self-authorship. Through connecting these findings to implications for educational practice, this study demonstrates the broad applicability and usefulness of self-authorship as a perspective to guide educational practice.

Acknowledgements

A heartfelt thank you to three of my biggest cheerleaders—Mom, Dad, and Ninad. Mom and Dad—my continued academic and personal success has only been possible with your never-ending support. You two have provided me with a listening ear in challenging circumstances and a loving home that provides security. Ninad, my dear husband, words cannot even begin to express my deepest gratitude to you. As my amazing life partner, you have gone above and beyond to support me throughout my entire graduate program by being a sounding board, providing advice in challenging situations, proofreading endless documents, and listening to practice talks. I am so grateful for your endless support. I look forward to the quickly-approaching next chapter in our lives!

A sincere thank you to my reading committee—Jennifer, Cindy, and Gene—for their complete understanding along my academic and personal journey. Collectively and individually you have pushed me intellectually, while also supporting me.

Many dissertation drafts were read by a variety of readers. Each of these readers provided insight about how to improve my dissertation. Furthermore, their continued excitement about the study provided motivation throughout my process. Thank you, Ninad Dalal, Alexandra Coso, Drew Paine, and Jim Borgford-Parnell.

To my study participants, thank you for participating in the preparedness portfolio and portfolio study, which provided the context for this dissertation. Each of you contributed insightful

information about the concepts under investigation. I wish each of you a successful journey from college into the “real world”!

Table of Contents

Abstract	ii
Acknowledgements	iii
List of Figures	viii
List of Tables	ix
Chapter 1: Introduction	1
Research objectives and questions	9
Study significance	9
Dissertation overview	10
Chapter 2: Conceptual framework	13
Self-authorship	13
Knowledge	20
Identity	25
Relationships	27
Summary of the developmental dimensions	31
Socialization and self-authorship	31
Markers of self-authorship	33
Theoretical challenges	35
Challenge 1: Situating the study in the communities' philosophy	35
Challenge 2: Evaluating movement towards self-authorship	37
Challenge 3: Exploring current practices in higher education and engineering education ...	39
Summary of the conceptual framework	41
Chapter 3: Supporting self-authorship	44
Pedagogy	44
Connecting the pedagogy to self-authorship	51
Knowledge	53
Identity	57
Relationships	60
Summary of supporting self-authorship	62
Chapter 4: Methodology and methods	64
Methodology	65
Participant demographics	66
Data collection instruments	68
Post-survey	69

Post-interview	69
Data analysis	70
Identified meaningful units of data	70
Labeled units of data	71
Sorted labeled units of data into themes	71
Data analysis rigor.....	71
Credibility	72
Dependability	72
Transferability.....	73
Study limitations	74
Measuring change	74
Self-reporting bias	75
Summary of the methodology and methods	76
Chapter 5: Empirical findings.....	78
Introducing the participants and their experiences	79
Faith.....	80
Ben.....	81
Eric	81
Anna	82
David	82
Carl.....	83
Summarizing the participants and their experiences.....	84
Unpacking self-authorship.....	84
Developmental dimensions.....	84
Knowledge	85
Identity	93
Relationships	100
Socialization and self-authorship	108
Summarizing unpacking self-authorship	111
Summary of the empirical findings.....	112
Chapter 6: Discussion of the empirical findings.....	114
Developmental dimensions.....	115
Knowledge	116
Identity.....	118

Relationships	119
Summary of the discussion & future questions	120
Chapter 7: Implications for educational practice	123
Implications Analysis Method	123
Summarize findings	124
Select agents	124
Craft implications	124
Summary of implications analysis method	127
Implications for educational practice	127
Educators	127
Students	131
Summary of implications	134
Chapter 8: Conclusion	135
References	142
Appendix A: Facilitator Guide	155
Appendix B: Session Materials	168
Appendix C: Survey & Interview Questions	194
Appendix D: Codebook for identifying meaningful units of data	197
Appendix E: Students' Portfolio Artifacts	199

List of Figures

Figure 1. Evolution from a socialized to a self-authoring mind	15
Figure 2. In session feedback forms.....	47
Figure 3. Portfolio example	50
Figure 4. Students' individual development	109

List of Tables

Table 1. Types of learning along each developmental dimension	52
Table 2. Participant demographics	68
Table 3. Study context	73
Table 4. Overview of students' experiences	79
Table 5. Implications for educational practice	126

Chapter 1: Introduction

While the cognitive demands of modern life, such as complex thinking and problem-solving, connect to the overall objective of higher education, often, other types of learning outcomes are prioritized in service of more concrete and immediate issues. In engineering education, this problem is particularly salient. For example, in an effort to align undergraduate education to professional practice in as little as four years, engineering educators often emphasize engineering fundamentals and theory over professional development, such as leadership or communication (Sheppard, Macatangay, Colby, & Sullivan, 2009). While this focus on engineering fundamentals and theory is critical, such an emphasis results in a missed opportunity for holistic student development.

In working towards this objective of higher education—holistic student development—the goals of this dissertation are to (1) demonstrate the applicability of *self-authorship* to engineering education; (2) connect this perspective with an actual pedagogy (i.e., preparedness portfolios in a portfolio studio); and (3) offer implications for educational practice. In achieving this aim, the contributions of this work are:

- an explanation of self-authorship, and what perspective it offers (Chapter 2),
- a theoretical connection between the pedagogy and conceptual framework (Chapter 3),
- an empirical demonstration of students' reports of the pedagogy (Chapters 4, 5, & 6), and
- an application of findings for educational implications (Chapter 7).

To motivate this study and situate the study within both higher education and engineering education, three areas are discussed in this chapter: (1) the importance of self-authorship; (2) the state of engineering education, and (3) the perspective of self-authorship situated in the state of engineering education.

Acknowledging the importance of self-authorship. Historically, developmental theories and scholars have focused on child development for various reasons, including the obvious and visible rapid changes children experience (Merriam, Caffarella, & Baumgartner, 2007). More recently, developmental scholars have noted continual development throughout the lifespan, which has contributed to the need for adult development theories (e.g., Piaget). In relation to education, scholars have recognized differences in the ways in which children and adults learn and therefore, have begun exploring how educational practices should address these differences (Knowles, Holton, & Swanson, 2011). This call for theories about the ways in which adults learn has contributed to the need for scholars to address and construct theories about college student development (e.g., Perry)—theories about the ways in which college students grow and mature (Merriam et al., 2007). As scholars have recognized that individuals continue to develop throughout their lifespans, college student and adult development have emerged as prominent fields in order to characterize and understand these phenomena.

Self-authorship is a developmental construct, which is defined along the three dimensions of knowledge, identity, and relationships (Baxter Magolda, 2001; Kegan, 1994). Movement from socialization (another developmental construct) towards self-authorship represents a fundamental shift along these three dimensions—a shift which changes the ways in which individuals makes

sense of their world. This shift involves developing a more complex way of making meaning of the world. Kegan (1994) describes movement toward self-authorship in terms of a transformation in which individuals grow from being “had” by their experiences (i.e., socialization) to “having” their experiences (i.e., self-authorship). Along the knowledge dimension there is growth from viewing knowledge as right or wrong and dependent on an authority figure to recognition of knowledge as complex and contextual, and viewing the self as able to contribute to the construction of knowledge. One’s identity shifts from externally defined to internally defined. Relationships change from dependent to more interdependent and become defined by mutuality (i.e., the ability to see others’ perspective).

Attributes of self-authorship, such as thinking critically, recognizing the complexity of knowledge, relying on personal values and beliefs, and engaging in relationships with others, connect to the mental demands of modern life. For example, an individual who thinks critically can consider multiple perspectives when reasoning. The title of Robert Kegan’s (1994) book—“In Over Our Heads: The Mental Demands of Modern Life”—reflects a dedication to exploring and understanding why individuals *must* increasingly move towards self-authorship to be prepared for world complexities. In a world that is increasingly becoming defined by intercultural communication (P. M. King & Baxter Magolda, 2005) and globalization (Jarvis, 2007), there is a need for leaders, both present and future, to be modern citizens—individuals who can “manage complexity and engage multiple perspectives” (Baxter Magolda & King, 2004, p. xviii). Considering current and emerging world issues, these qualities of a modern citizen represent the ability to address such problems in light of one’s personal and professional values and beliefs. These abilities are fundamental to being self-authoring.

More specifically, self-authorship connects to many of the attributes higher education aspires to impart to learners (Baxter Magolda, 2000, 2003, 2004b; Kegan, 1994, 2000; P. M. King & Baxter Magolda, 2005). For example, a goal of higher education is to instill in future leaders the ability to solve complex problems, deal with ambiguity, self-initiate, be responsible for their own experiences, participate in interdependent relationships, and participate in groups (Baxter Magolda, 2008). Furthermore, these objectives of higher education link to concerns about the transferability of academic skills to a professional context. While initially constructed more broadly as a construct in adult development theory (Kegan, 1982, 1994), self-authorship has primarily been researched and applied within college student development (Baxter Magolda, 2000, 2001, 2003, 2004a, 2004b, 2008; Haynes, 2006; Pizzolato, 2003, 2004, 2005, 2007; Torres, 2003; Torres & Baxter Magolda, 2004).

Connecting to the state of engineering education. Concerns about one's ability to engage in complex thinking and problem-solving are particularly important in professional education, such as engineering (Sheppard et al., 2009). Most forms of professional education (e.g., medicine and law) require advanced degrees to certify professional readiness. Engineering, on the other hand, educates emerging engineers for professional practice at the bachelor's level, rarely requiring advanced formal education. It is important to recognize that engineering education is preparing our world's future engineers to solve complex problems that may challenge their fundamental values and beliefs, which are related to self-authorship development. For example, engineers will face ethical dilemmas related to the environment in service of advancing human life-style. Such challenges are evident in the rapid rate of technology advancement. For example, as technology

quickly becomes outdated, the world has struggled to develop and maintain sustainable means for disposing of outdated technology. So, in educating our future engineers, the community must ask challenging questions about how student development is related to student readiness to engage in professional practice. While the potential risk from ignoring such topics (e.g., values and beliefs) is high, these topics are rarely explicitly addressed in education.

Scholars, policy makers, and industry leaders have continued to challenge the engineering community to reconsider the ways in which it recruits, retains, and educates future engineers. The National Academy of Engineering (NAE) explored this area through envisioning what engineering practice would look like in 2020 as an opportunity to align education with this vision of the future of engineering (National Academy of Engineering [NAE], 2004). The Royal Academies of Engineering (2006) examined this topic through the perspective of industry; the National Research Council (NRC) (2009) investigated the state of engineering education from a policy perspective of maintaining U.S. competitiveness in science, technology, engineering, and mathematics (STEM) fields. Coupled together these policy documents paint a broader picture of the need for change. At some level, all of these institutions (i.e., NAE, NRC, and the Royal Academies of Engineering) agree that the engineering community must change the ways in which it educates future engineers; in order to implement such change they highlight the need for a better understanding of *how* we currently educate engineers. While these calls for change do not explicitly connect to self-authorship, the attributes of a self-authoring individual (such as thinking critically, recognizing the complexity of knowledge, relying on personal values and beliefs, and engaging in relationships with others) are fundamental to the core of this

transformation. Connections between the engineering education research community and self-authorship will be further drawn out in Chapter 2.

One important similarity between these policy documents is the characterization of the rapid changes in engineering practice—changes that motivate a call for transformation in engineering education in order to better align engineering education and practice. For example, engineering practice includes new and different problem types and problem solving techniques, and a shift in the role of the problem solver, knowledge, and collaboration (Jonassen, Strobel, & Lee, 2006; NRC, 2009; Sheppard et al., 2009). These rapid changes in engineering practice are due in part to advances in technology and globalization (Fouger, 2008; Gabriele, 2005; Mailhot, 2008; Sheppard et al., 2009; Vest, 2008). For example, in engineering practice, problem solvers (i.e., engineers) can no longer position themselves as neutral when solving problems (Sheppard et al., 2009); rather, engineers need to be keenly aware of unintended consequences and ethical dilemmas (NRC, 2009). Further, views about the nature of knowledge have changed from simple factual knowing of principles, concepts, and theories—“knowing that”—to include also “knowing how” (i.e., the when, where, and why of applying principles, concepts, and theories) (Sheppard et al., 2009, pp. 31-38). Fundamental changes to engineering education that better maps it to practice are necessary in order to adequately prepare future engineers to solve tomorrow’s problems. A focus on self-authoring engineers aligns with the kinds of educational transformation proposed by engineering leaders, such as thinking critically, recognizing the complexity of knowledge, relying on personal values and beliefs, and engaging in relationships with others (NAE, 2004; NRC, 2009; The Royal Academy of Engineering, 2006).

Situating the perspective of self-authorship in engineering education. While many communities touch on the call for change in engineering education, the engineering education *research* community is deeply committed to this agenda, as seen through national discussions, strategic plans, and journal forwards, editorials, and commentaries ("The Engineering Education Research Colloquies," 2006; Fouger, 2008; Gabriele, 2005; Lohmann, 2005, 2008, 2011; Mailhot, 2008; "The Research Agenda for the New Discipline of Engineering Education," 2006; Sheppard, Pellegrino, & Olds, 2008; Vest, 2008). In recent years, the *Journal of Engineering Education* (JEE), the premier scholarly journal of the discipline, has continued to dedicate special issues to this topic through discussions such as—"Building a Community of Scholars: The Role of the *Journal of Engineering Education* as a Research Journal" (Lohmann, 2005); "A Rising Global Discipline" (Lohmann, 2008); and "JEE and its Second Century" (Lohmann, 2011). Furthermore, engineering education research has also addressed these issues in community endeavors, such as the Engineering Education Research Colloquies ("The Engineering Education Research Colloquies," 2006). The goal of the colloquies was to articulate synergy between the need for change in engineering education and future research agendas for the community of engineering education. In the report on the colloquies, the steering committee charged the engineering education research community to conduct research in five areas: engineering epistemologies, learning mechanisms, learning systems, diversity and inclusiveness, and assessment ("The Research Agenda for the New Discipline of Engineering Education," 2006). Research specified by the colloquies would help the community better understand *how* we currently educate engineers.

Aligning this dissertation with the research agenda outlined by the colloquies provides one opportunity for exploring connections between this dissertation work and the broader efforts of the engineering education research community. While the conceptual framework of this study, and specifically the knowledge dimension of self-authorship, aligns with the research on “engineering epistemology,” the conceptual framework is even more saliently linked with the “learning mechanisms” research area because in addition to connecting to the knowledge dimension, the learning mechanisms research area also includes more explicit links to the other developmental dimensions (i.e., identity and relationships). According to the colloquies, the research area of learning mechanisms is—

Learning to engineer will require three major strands of inquiry that centers on understanding: 1) learners acquisition, comprehension, and synthesis of domain specific knowledge to achieve contextual goals; 2) the learning progressions of learners and their educational experiences that develop this knowledge and identity necessary to be an engineer, and 3) the variance of knowledge, skills, and attitudes of a diverse population of learners ("The Research Agenda for the New Discipline of Engineering Education," 2006, p. 206).

The learning mechanisms research area connects to student development in multiple ways. First, this research area points to the need for understanding how students learn with respect to their prior experiences (related to the knowledge dimension of self-authorship). Second, the research area emphasizes the importance of identity development in one’s becoming an engineer (related to the identity dimension of self-authorship).

Research objectives and questions

The objectives of this research are to (1) explain the construct of self-authorship to engineering education; (2) connect this perspective with an actual pedagogy—preparedness portfolios in a portfolio studio; (3) explore students’ reports of the pedagogy through the lens of self-authorship; and (4) provide implications for educational practice. These objectives are guided by the following research questions:

1. In relation to educational activities, what perspective does the lens of self-authorship offer? (Chapter 2)
2. In what ways could the preparedness portfolio and portfolio studio pedagogy connect to supporting student development? (Chapter 3)
3. If and in what ways did students report experiencing the construction of a preparedness portfolio in a portfolio studio as an opportunity to develop into self-authoring individuals? (Chapters 4, 5, & 6)
4. How does this work translate into implications for educational practice? (Chapter 7)

Study significance

According to Stein, Wanstreet, and Trinko (2011), “adult learners aged 25 and older account for approximately one-third of higher education enrollments in the United States, and the demand for higher education is expected to increase among this group” (U.S. Census Bureau, 2009) (p. 68). To better accommodate the needs of this rapidly changing population, higher education must consider and make better use of adult learning and development theories. In order to meet students where they are, it is important to understand their current development. For example, the rapid increase of non-traditional students equates to individuals with a variety of lived experiences. Using traditional pedagogical approaches, how do educators leverage such

experiences in the classroom? Furthermore, for traditional college students, college may be the first time they will encounter circumstances that require them to examine their values and beliefs critically. But how does an educator support growth along such personal areas?

In answering the research questions, this study begins the critical steps in bridging the gap between engineering education research and student development research. Work on the first two research questions lays the foundation of this bridge through describing the construct of self-authorship, connecting the perspective to current engineering education practice, and exploring how one engineering education pedagogy can support student self-authorship development. Work on the third research question results in evidence related to how students reported experiencing one engineering education pedagogy (i.e., preparedness portfolios in a portfolio studio) in relation to student development. Finally, work on the final research question addresses the translation of the findings of this research into practice, completing the research-to-practice cycle.

Dissertation overview

Chapter 2 outlines the construct of self-authorship, connects it to engineering education, and demonstrates its applicability to and usefulness for the engineering education community. This examination provides a foundation for answering research question one—*in relation to educational activities, what perspective does the lens of self-authorship offer?*

Chapter 3 examines why it is expected that one pedagogy—preparedness portfolios in a portfolio studio—has the potential to support engineering undergraduates' development toward self-authorship. These connections are made using suggestions about how to engender student

development. In demonstrating how this pedagogy aligns with supporting and challenging student development towards self-authorship, research question two is answered—*in what ways could the preparedness portfolio and portfolio studio pedagogy connect to supporting student development?*

Chapter 4 describes the methodology and methods of the empirical study conducted as part of this dissertation. This chapter explains how the methodological assumptions of the communities (i.e., engineering education and student development) addressed in this research impact the overall research design. More specifically, this research was situated in constructivist grounded theory in order to honor student's individual experiences and to understand students' collective experience. The purpose of this chapter is to articulate the data collection, analysis, and rigor.

Chapter 5 presents the empirical findings. The findings presented in this chapter suggest that students reported experiencing the pedagogy along all three dimensions of self-authorship, and these students varied in their movement from socialization to self-authorship after participation in the pedagogy. Through empirical evidence, this chapter addresses research question three—*if and in what ways did students report experiencing the construction of a preparedness portfolios in a portfolio studio as an opportunity to develop into self-authoring individuals?*

Chapter 6 discusses the empirical findings through summarizing the empirical findings, articulating the significance of the study, and proposing future research questions. Exploring the study significance is done through interpreting the data and acknowledging alternative

explanations, connecting the study findings back to engineering education, and situating the study in higher education.

Chapter 7 translates the findings into implications for education practice. The aim of this chapter is to explore how different agents within the engineering education system can use findings from the previous chapters to support student development toward self-authorship. Through providing explicit examples of these connections for a variety of agents, the primary purpose of this chapter is to complete the research-to-practice cycle. In offering potential implications for the reader, the goal is to encourage readers to make connections to their specific contexts and needs. Through implications for educational practice, this chapter addresses research question four—*how does this work translate into implications for educational practice?*

Chapter 8, the conclusion, reviews the main points of the dissertation. In relation to each research question, this review includes a summary of the research findings and an articulation of the contributions.

Chapter 2: Conceptual framework

The purpose of this chapter is to outline the conceptual framework of self-authorship and explore what perspective self-authorship offers in order to answer research question one—*in relation to educational activities, what perspective does the lens of self-authorship offer?* This chapter first presents the origins of self-authorship, which are grounded in Robert Kegan’s (1994) theory of adult development. Further, connections between the developmental dimensions (i.e., knowledge, identity, and relationships) and engineering education research provide rationale for how engineering education is currently situated in this perspective, and how it can be further informed by self-authorship. Next, Baxter Magolda’s (2001) descriptions of the crossroads (i.e., a period of disruption in how one makes meaning of the world) and triggers (Baxter Magolda, 2008) alongside Pizzolato’s (2007) skill sets provide a strong foundation for identifying markers of self-authorship. In concluding, this chapter includes an in-depth examination of challenges associated with this perspective: (1) situating the study in higher education and engineering education; (2) evaluating movement towards self-authorship; (3) implementing in higher education; and (4) engendering in educational practices.

Self-authorship

In his work, Kegan (1984, 1994, 2000) highlights how adults are continuously dealing with the hidden curriculum of life in domains such as work, relationships, and parenting. He explores these domains as an opportunity to suggest the importance of how people make meaning of the world around them. More specifically, in his work he demonstrates the importance of continued development throughout the lifespan. Without such development, Kegan (1994) describes how individuals are unable to deal with demands of the modern world, leaving them “in over their heads” (p. 5). This perspective is situated in constructive developmental theory: “natural

evolution of the forms of our meaning-constructing (hence ‘constructive developmental’)” (Kegan, 2000, p. 53). In other words, how do individuals make meaning of the world around them, and how does their meaning-making process evolve?

Since the construct of self-authorship is grounded in adult development theory, it is important to understand the tenants of adult learning theory: adults are internally motivated and self-directed; adults bring life experiences and knowledge to learning experiences; adults are goal-oriented; adults are relevancy-oriented; adults are practical; and adult learners like to be respected (Knowles, Holton, & Swanson, 2011). In connecting to self-authorship, adult development theory emphasizes that adults bring life experiences and knowledge to learning experiences, which are critical for their learning. Self-authorship draws attention to how people make meaning of their experiences, which connects broadly to adult learning theory about the role life experiences play in learning. Through this discussion, it is important to recognize how these two are related and impact each other.

While Kegan (1994) initially suggests self-authorship as a component of adult development, Baxter Magolda (2001) further examines this phenomenon over the course of a longitudinal study of undergraduates into adulthood. While her research begins in the college years, she suggests that there is little evidence that students progress towards self-authorship during college. Rather, her research provides strong indication of the evolution toward self-authorship as college students graduate and are faced with ambiguities of life, asking questions such as, who am I and what are my contributions to the world? Self-authorship offers a perspective that is connected broadly to people’s lives beyond formal education.

Within his model of adult development, Kegan (1994) describes fundamental shifts in how people make sense of the world around them. This model represents the development of ever more complex ways of making meaning of the world: increasingly changing the ways in which people interact with and interpret their experiences. While the entire process is important to development throughout the lifespan, for the purposes of this dissertation, the focus will be on the journey from socialization and self-authorship (see Figure 1).

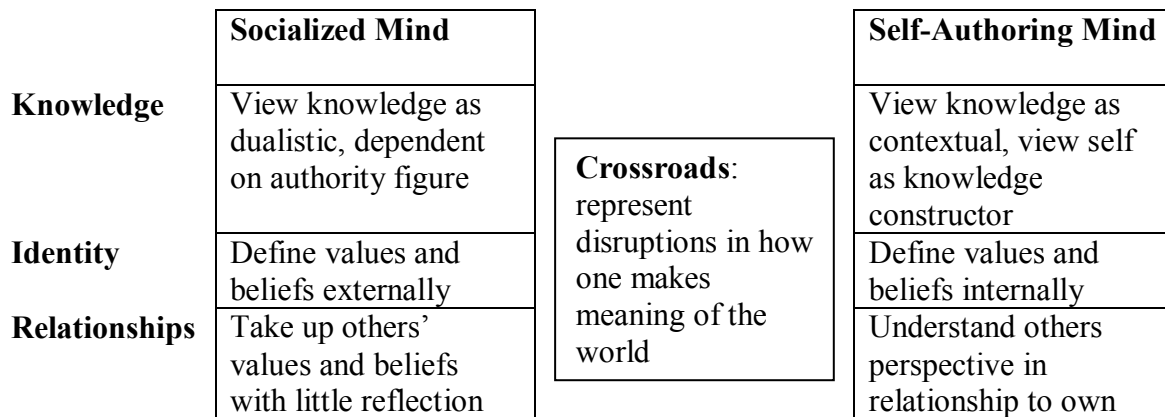


Figure 1. The evolution from a socialized mind to a self-authoring mind along the developmental dimensions of knowledge, identity, and relationships.

While Kegan (1994) emphasizes the importance of the journey to and achievement of self-authorship, he recognizes this process as challenging because an individual's sense of the world is disrupted. These changes are often laden with emotions. In the movement from a socialized mind to a self-authoring mind, the ways in which people engage with the world change, becoming more complex. At the socialized mind, individuals are said to be "had" by their experiences. As people move towards a self-authoring mind, they develop the ability to "have" their experiences. Kegan (1994) describes this transformation as

The idea that leaving the third order of consciousness [socialized mind] is akin to leaving the family religion does not mean that the move to modernity of necessity requires us to leave the family or the religion. What it requires is that we construct a new relationship to the family or the religion. Like all such metaphors sent in to aid the remaking of mind, the new spaces it can create are not necessarily separations between people but distinctions within a person, differentiations within a relationship or a faith. The prospect of leaving the family religion can foster a host of such distinctions: the distinction between “having a religion” and “being had by one’s religion”; between “believing as my parents believed *because it is how my parents believed*” and “believing some of what my what my parents believed because I have come to find it is also what I believe”; between “finding *my own way* of practicing what is still a form of the family religion” and “leaving the faith altogether”; between “leaving behind some of what my parents believed” and “leaving behind my precious sense of connection to them.” The creation of such distinctions builds a trembling bridge from the third [socialized mind] to the fourth order of consciousness [self-authoring mind] (p. 270).

This evolution is defined by a shift from being externally defined to being internally defined, as well the capacity to make things that were once subject into object. Kegan (1994) says

‘subject’ refers to those elements of our knowing or organizing that we are identified with, tied to, fused with or embedded in... ‘object’ refers to those elements of our knowing or organizing that we can reflect on, handle, look at, be

responsible for, relate to each other, take control of, internalize, assimilate, or otherwise operate upon (p. 32).

Self-authorship scholars (Baxter Magolda, 2001; Kegan, 1994) describe the movement from a socialized mind to a self-authoring mind along three dimensions of development: (1) cognitive, (2) intrapersonal, and (3) interpersonal. While Kegan uses these terms to describe development, this dissertation uses knowledge, identity, and relationships, which map to Kegan's (1994) terms. The language of knowledge, identity, and relationships better aligns with engineering education. The knowledge dimension relates to how individuals view knowledge and who they see as capable of constructing and disseminating knowledge (e.g., authority figure, self). The identity dimension involves an individual's values and beliefs and what or who these values and beliefs are based on. The relationship dimension describes how an individual interacts with others. Figure 1 depicts the journey from socialization to self-authorship along each of these dimensions. As seen in Figure 1, the crossroads represent disruptions to the ways in which an individual makes meaning of the world—disruptions that begin to catalyze one's movement towards self-authorship.

These developmental dimensions—knowledge, identity, and relationships—represent a complex and nuanced interaction within an individual's development. While Figure 1 may appear chronological or linear in nature, development towards self-authorship is more cyclical in nature. For example, in a situation that requires a person to act in socialized ways, a self-authoring individual can behave in such a manner that is conducive to the situation (Pizzolato, 2007). Furthermore, each of the developmental dimensions is highly connected to one another. The

development of one dimension has the potential to catalyze the development of the other two dimensions (Baxter Magolda, 2001). This complex interaction between these three dimensions is an individuals' journey toward self-authorship (Baxter Magolda, 2001).

While these dimensions define development more generally, each person's growth toward self-authorship is personal. There are many factors that impact one's journey toward self-authorship. For example, personal character plays an important role in how an individual deals with the crossroads. Other things that can influence an individual's development include past experiences, challenges encountered, and available support (Baxter Magolda, 2000, 2001, 2004b; Baxter Magolda & King, 2004).

Originally scholars believed that college students rarely develop into self-authoring individuals (Baxter Magolda, 2001; Kegan, 1994). These scholars (Baxter Magolda, 2001; Kegan, 1994) found that people moved toward self-authorship later in life when there were fewer formulas (i.e., external authority figure) to guide the ways in which people make meaning of their experiences. Self-authorship offers a perspective that is connected broadly to people's lives, beyond formal education. Recent research has suggested that specific groups of students may progress toward self-authorship earlier, as well, that certain types of experiences can better support student development toward self-authorship. Torres and Baxter Magolda (2004) suggest that underrepresented populations (e.g., Latino) may progress toward self-authorship because they encounter cognitive dissonance earlier in their academic careers. In recognizing that development toward self-authorship is possible in the undergraduate years, scholars have begun

exploring ways in which higher education can support students' development toward self-authorship (Baxter Magolda et al., 2007). (See Chapter 3 for a description of how one pedagogy—preparedness portfolios in a portfolio—has the potential to support student development.)

In connecting this dissertation to the construct of self-authorship, it is important to acknowledge the larger discussion in adult development within which this perspective is grounded. Broadly, self-authorship is situated in developmental psychology. In this community, a major debate is whether development is continuous or discontinuous. Continuous developmental theories represent a gradual process like evolution (e.g., Skinner, Bandura). Discontinuous developmental theories represent movement from one discrete stage to another (e.g., Piaget, Erickson) (Keenan & Evans, 2009). Kegan (1994) does not explicitly name the evolution from socialization to self-authorship as either discontinuous or continuous. Rather, the use of subject-object may move beyond this discussion in a new way, adding an alternative way of thinking and talking about development. The subject-object perspective positions self-authorship as a more cyclical process, rather than linear either continuously or discontinuously. According to Kegan (1994), as individuals develop into self-authors they have the capacity to move between self-authoring and socialized ways of engaging with experiences in order to better handle life circumstances (i.e., if a situation requires socialized behavior in order to succeed, then the individual will exhibit socialized behaviors for the situation). While this dissertation does not hinge on solving or even addressing this area of debate, it is important to acknowledge community challenges within which this discussion is situated.

In the following sections, each developmental dimension (i.e., knowledge, identity, and relationships) is described in more detail and then explored in relation to current practices in engineering in order to better understand if and in what ways engineering education is addressing self-authorship or components of self-authorship. These sections connect broadly to related research and concerns in engineering education. Then, one of these connections to engineering education is explored in more detail. The purpose of this discussion is to outline what the perspective of self-authorship offers that is (1) grounded substantially in theory; (2) explored and understood empirically; (3) presented holistically and multi-dimensionally; (4) connected broadly to people's lives; and (5) linked to engineering and higher education.

Knowledge

The knowledge dimension represents how one views and constructs knowledge. Socialized individuals perceive knowledge as right or wrong. As individuals develop into a self-authoring mind, they begin to recognize the complexity of knowledge and are capable of seeing knowledge as contextual to the given situation. Furthermore, this dimension signifies who individuals view as capable of constructing knowledge. Socialized individuals depend on an authority figure (e.g., educator, parents, scientists, professionals, or the media) as the source of their knowledge. At the self-authoring mind, individuals recognize themselves as capable of constructing knowledge, and contribute to the process of co-constructing knowledge with others, such as peers and authority figures.

According to Baxter Magolda (2001), along the knowledge dimension in a journey toward self-authorship, there are four ways of knowing: absolute, transitional, independent, and contextual knowing. These ways of knowing are similar to ones identified in knowledge development

models by Perry (1970), King and Kitchener (2002), and Belenky, Clinchy, Goldberger, and Tarule (1986). These models focus on one dimension of development—knowledge—while Baxter Magolda (2001) expands from these other models presenting a more holistic and multidimensional model of development along three dimensions (i.e., knowledge, identity, and relationships).

Absolute knowers view knowledge as right or wrong and as originating from authority figures, such as educators and parents. Within the absolute knowers category there are two types: (1) receiving knowers who learn through an internal process of listening and recording; and (2) mastery knowers who learn through an external process of demonstrating learning. Next, transitional knowers begin to recognize the uncertainty of knowledge. Within transitional knowers there are two approaches:

- “*Interpersonal pattern* students were involved in learning through a collection of others’ ideas, expected interaction with peers to hear their views and provide exposure to new ideas, wanted a rapport with the instructor to enhance self-expression, valued evaluation that takes individual differences into account, and resolved uncertainty by personal judgment”
(Baxter Magolda, 2001, p. 30, italics in original).
- “*Impersonal pattern* students wanted to be forced to think, preferred to exchange their views with instructors and peers via debate, expected to be challenged by instructors, valued evaluation that fair and practical, and resolved uncertainty by logic and research”
(Baxter Magolda, 2001, p. 31, italics in original).

Along the knowledge dimension, the next way of knowing is *independent knowing* in which most knowledge is viewed as uncertain. Furthermore, the conceptions about the knowledge source begin to shift: “[a]uthorities are no longer the only source of knowledge but instead become equal with students, who for the first time view their opinions as valid”

(Baxter Magolda, 2001, p. 32). Within independent knowing, there are two patterns:

(1) interindividual: recognized the importance of listening to others’ opinions and

(2) individual: listened to one’s own opinions. And finally, contextual knowers recognize the uncertainty of knowledge and the possibility that they themselves and others can be contributors to the construction of knowledge; contextual knowing is part of self-authorship.

Connecting to Engineering Education. Undergraduate years are a pivotal time in engineering students’ development. For example, for traditional-aged college students, college may be the first time they will grapple with what they believe, rather than relying on beliefs formed from by others (e.g., parents). In attending to student development, educators, including engineering educators, have focused on how students’ acquire and access knowledge (Felder & Brent, 2004a, 2004b; Miller, Olds, & Pavelich, 1998; Pavelich, 1996; Pavelich & Moore, 1993, 1996).

Pavelich and Moore’s (1993 & 1996) application of the Perry Model to engineering education is historically notable in the community because it crosses disciplinary boundaries by informing engineering education research with research from student development. Furthermore, Pavelich and Moore's work is foundational to the work of Marra, Palmer, and Litzinger (2000) in which they extended the earlier research by adding empirical depth. Collectively, these studies are significant to the engineering education community because they contributed to the community’s

understanding of the Perry Model; presented empirical data in relation to the Perry Model; and built the foundation for future research in this area. According to Marra et al. (2000), in response to the calls for change to engineering education, Penn State implemented a new approach to their first-year-engineering course. To better align engineering education with practice, Penn State transitioned their first year program to a team-based, project-learning model. At an important time for the community, Marra et al. (2000) empirically evaluated the program, which contributed to the community's growth from anecdotal and exam-like evaluations. They used "measures that examine[d] the qualitative changes in students' thinking processes" (Marra et al., 2000, p. 39). Engineering students, who had participated in this first-year engineering program were interviewed via a protocol based on the Perry Model: "Interviewers asked students, amongst other things, about their opinions on the ideal college education, their preferences for learning, their definitions of knowledge, how they solve open-ended problems, and their encounters with people who held views different from themselves" (p. 41). The data from these interviews was analyzed in order to understand the state of students' cognitive development (i.e., knowledge). Their findings suggested that "[d]esign experience was positively related to enhanced intellectual development. Honors status, gender, and academic ability were not significantly related to Perry rating" (p. 39). Interestingly, no students were at or above a position 5 on the Perry Model, which represents viewing knowledge as contextual (aligns with a self-authoring mind along the knowledge dimension). Their research connects with the knowledge dimension of self-authorship and demonstrates how self-authorship aligns with engineering education. As well, their research demonstrates how self-authorship can be a valuable evaluation tool.

In addition to the work of Marra et al. (2002), Sheppard et al. (2009) and Felder and Brent (2004a, 2004b) offer instructional design principles aimed at supporting students' development along the knowledge dimension. For example, Sheppard et al. (2009) offer these pedagogical suggestions: help students realize cognitive potential; position students towards reflective thinking and actionable practice; balance levels of complexity with scaffolding; and increase complexity and decrease scaffolding over time. While these suggestions are strong starting points, these approaches are quite general in nature. In their discussion about ways in which educators can support knowledge development, Felder and Brent (2004b) encourage educators to “adopt an approach to teaching that has the following five features: *Variety and choice of learning tasks; Explicit communication and explanation of expectations; Modeling, practice, and constructive feedback on high-level tasks; A student-centered instructional environment; and An attitude of respect and caring for all students at all levels of development*” (pp. 288-289, italics in original). While such pedagogical approaches highlight empirically-grounded best practices, they are grounded exclusively in an exploration of supporting knowledge development.

While knowledge growth is a primary goal of teaching and learning, there are merits to integrating other dimensions of development (i.e., identity and relationships) into teaching practice. A more holistic approach to student development couples knowledge development with both identity (i.e., securing and trusting an internal compass) as well as relationship development (i.e., maintaining one's internal compass, while engaging in mature relationships). While it is promising that some engineering education research work is grounded in student development and begins exploring knowledge development (Felder & Brent, 2004a, 2004b; Marra et al., 2000; Pavelich & Moore, 1993, 1996; Sheppard et al., 2009), there is an opportunity to use a

development framework, such as self-authorship, that is more encompassing by including the developmental dimensions of identity and relationships.

Identity

Along the identity dimension individuals examine their personal values and beliefs and contribution to the world, asking questions such as, who am I, why am I here, and what is my place in the world? The identity dimension represents the foundation of one's character—"how we view ourselves" (Baxter Magolda, 2001, p. xix). At the socialized mind, one's beliefs and values are externally based. For example, one may hold certain beliefs and values because of an authority figure. This mindset represents little to no reflection on one's internal values and beliefs. As one moves toward self-authorship, these values and beliefs become internally defined; individuals grapple with what they believe and value. While these values and beliefs may be similar or the same as previous externally defined ones, self-authoring individuals have reflected on internally defined these values and beliefs as their own (i.e., not because an external authority figure told them to). Through a process of gaining perspective about self, people can begin to move from defining themselves through others (i.e., external definition) to choosing their own values (i.e., internal definition), and then begin securing those values through living their lives defined by those internal values.

Connecting to Engineering Education. Engineering education has been interested in identity, but the community often approaches the subject through a belonging lens with an emphasis on how the community can help emerging engineers belong to the community (McNair, Paretto, & Kakar, 2008; Stevens, O'Connor, Garrison, Jocuns, & Amos, 2008; Tonso, 2006a, 2006b; Wilson, Bell, Jones, & Hansen, 2010)? For example, in their three dimensional model of what

entails “becoming an engineer,” Stevens et al. (2008) highlight a belonging identity as a key component of becoming an engineer. Wilson et al. (2010) explore the importance of community belonging on students’ construction of their identity as an engineer. Tonso (2006a, 2006b) uses students’ conceptions of the “engineering identity” to understand team interactions. McNair et al. (2008) explore the influence of student’s identity construction of self and others on design collaborations.

While engineering identity is often explored in terms of belonging to the community and the impact of one’s identity on collaborations, others have explored engineering identity in relation to students’ motivation for choosing engineering (Matusovich, Streveler, & Miller, 2010) and within specific pedagogies: portfolios (Eliot & Turns, 2011), service learning (Dukhan, Schumack, & Daniels, 2008), problem-based learning environments (Du, 2006), and formative experiences (Meyers, Ohland, Pawley, & Christopherson, 2010).

The details of one study can help illustrate how identity is being studied in engineering education. Karen Tonso’s (2006a) research on “Student Engineers and Engineering Identity: Campus Engineer Identities as Figured World” is foundational and widely used in the engineering education research community when addressing engineering student identity. The purpose of her research was to better understand how engineering students “talked about the kinds of people recognized as engineers on campus” in relation to how students conceptualized themselves as engineers (Tonso, 2006a, p. 273). To understand this phenomenon, Tonso (2006a) used a quasi-longitudinal ethnographic approach to observe the interactions of engineering student teams. In this research, Tonso (2006a) operationalizes identity in terms of campus

engineer identities, specifically Nerds, Academic-achievers, and Greeks (or social achievers). “Two other aspects of campus engineer identities also became clear: (1) students associated different forms of engineering practice with Nerds than with Over-Achievers, and (2) campus engineer identities seldom referred to women and when they did it was often in a pejorative way” (Tonso, 2006a, p. 284). In relation to development from a socialized mind to a self-authoring mind, Tonso (2006a) does not explicitly align identity with either socialization or self-authorship. However, this characterization represents more of a socialized identity because the research emphasizes how the campus culture positions students into an engineering identity, which relates more an externally defined identity.

It is promising that current research endeavors and educational practice attend to identity; however, the community could broaden how it conceptualizes engineering identity. For example, the community could work towards supporting more of an internally defined identity, which is consistent with self-authorship. The work of Eliot and Turns (2011) about engineering students’ professional identity through an external and internal lens provides a promising first step in this direction.

Relationships

The relationship dimension represents exploring the question—“how [do] we construct relationships with others” (Baxter Magolda, 2001, p. xix)? When individuals are a socialized mind, they define themselves within the context of others’ terms. If an internal voice has been secured, it is pushed to the background within the context of relationships. In relationships socialized individuals seek approval and are easily influenced by others’ opinions and beliefs. As individuals become self-authoring, their interactions with other people are reframed to more of a

partnership, and their internal voice transitions to the foreground within relationships. According to scholars (Baxter Magolda, 2001; Kegan, 1994), relationships become more genuine and authentic because the self-authoring individual can be true to his or her self within the relationship; Baxter Magolda (2008) emphasizes how relationships become more authentic—

The longitudinal stories demonstrate that self-authorship refers to shifting the source of one's beliefs, identity, and social relations from the external world to the internal voice and foundation. Doing so initiates a reframing of relationships that become more authentic because they honor one's internal commitments.

Connections based on these internal commitments results in interdependence in which parties to the relationship act authentically and support each in doing so.

Thus, self-authorship strengthens relationships and enduring ties with the external world (p. 282).

Connecting to Engineering Education. While the community does not explicitly address the relationship dimension in the same terms as self-authorship, there is evidence of concern about it in research that highlights the importance of peer interactions in pedagogies of engagement, such as cooperative learning (Smith, Sheppard, Johnson, & Johnson, 2005). Even further, concern about issues related to the relationship dimension is evident in research about how students interact in teams, such as the CATME Team-Maker (Ohland, Layton, Loughry, & Yuhasz, 2005).

With the integration into engineering education of a variety of pedagogies that encourage peer interaction, such as problem-based and cooperative learning, scholars have been studying

generally how engineering student teams work, often with an eye towards optimization (i.e., what works, what does not work). One prominent strand of this research includes understanding how to support students as they interact in groups, specifically through building teams based on specific criteria (Ohland et al., 2005).

Building on prior work about engineering students' experiences and pathways (Atman et al., 2010), there is synergy between student development (especially relationship development) and students' motivation to pursue an engineering degree. Atman et al. (2010) found that student motivation to study engineering was often initiated by an authority figure (e.g., parents or high school mentors). They found that students who switched from engineering to another degree path grounded their engineering motivation in their parents, while students who persisted in engineering found their motivation from high school mentors. In connecting to student development, self-authorship could provide a conceptual framework for understanding ways to explore the fundamental differences in these relationships that help motivate students toward engineering (e.g., level of support, control, power). Such a study would contribute to a better understand of the role of "others" in students' motivation to pursue and complete an engineering degree.

Cooperative learning is an area of research that has been particularly prominent in engineering education and an area that can be connected to self-authorship. Karl Smith, a prominent scholar in engineering education, has dedicated his research to connecting cooperative learning to higher education more generally and then specifically to engineering education (Johnson, Johnson, & Smith, 1991, 2006; MacGregor, Cooper, Smith, & Robinson, 2000; Smith & Imbrie, 2005). This

historical work connects engineering education research with the larger body of work on student engagement and has paved the way for implementation of cooperative learning in engineering education, and further, rigorous research about this area of study. In bringing this work to engineering education, Smith et al. (2005) connect cooperative learning to calls to pedagogies that support student engagement. In summarizing Christensen's *Education for Judgment*, they say "engaging students in learning is principally the responsibility of the teacher, who becomes less an imparter of knowledge and more a designer and facilitator of learning experiences and opportunities" (p. 88). Through this exploration, they detail the framing of this perspective and how such a pedagogy can be implemented into practice. They discuss how historically and even currently much practice aligns with a "pour it in" model that positions the educator as the disseminator of knowledge. Through cooperative learning, they suggest an alternative approach—the "keep it flowing" model—in which "information passes not only from teacher to student, but also from students to teacher and among the students" (Smith et al., 2005, p. 88). This model "emphasizes that the simultaneous presence of interdependence and accountability are essential to learning, and their presence is at the heart of a student-engaged instructional approach"

(Smith et al., 2005, p. 88). In connecting back to self-authorship, the perspective of cooperative learning aligns well with supporting students' *interdependence* within relationships.

The abovementioned work demonstrates the community's commitment to understanding aspects that are related to the relationship dimension, such as teamwork and cooperative learning. This collective body of research provides a foundation for this study, which explores relationships through a different perspective.

Summary of the developmental dimensions

The purpose of the previous three sections—knowledge, identity, and relationships—was to outline each of the developmental dimensions and explain what socialization and self-authorship look like along each dimension. Further, these sections connected to related research and concerns in engineering education. In each section, to provide further links to engineering education, one of these connections was explored in more detail.

Socialization and self-authorship

In the collegiate years, markers of socialization and self-authorship are evident, which impacts how students engage with different activities that are expected of them in higher education. An understanding of developmental information can be used as an analytical tool to help educators better understand why students may encounter specific struggles, such as constructing mutual engagement in team-based activities. This discussion begins the process of highlighting why students' particular state of development—socialization or self-authorship—may contribute to specific opportunities or challenges faced by educators. While such information can be valuable generally to all educators, it can be particularly useful in engineering as the community strives for transformation.

Scholars emphasize the use of self-authorship-related information as an analytical tool to better understand students (Baxter Magolda, 2000; Tinberg & Weisberger, 1998). For example, at the socialized mind students may ask the educator if an answer or an approach is “right.” While such a question aligns with this students' current development of socialization along the knowledge dimension (i.e., view knowledge as dualistic, dependent on authority figure) such a question may be frustrating for educators when they are trying to cultivate learners who can deal with

ambiguity, approach problems from different perspectives, and understand the contextual nature of knowledge. While such questions may continue to cause frustration, when educators understand why students are asking these types of questions, they may be better prepared to respond in more understanding ways. Through using self-authorship-grounded approaches, educators can work to make student development visible, which is often an invisible process. By making development visible, educators have the opportunity to adjust to students' current development, which lends itself to a more dynamic educational experience (i.e., meeting students where they currently are). In her work, Baxter Magolda (2000) emphasizes that *meeting students where they are* is important in higher education in order to provide a more supportive environment. While in principle this practice is respectful, it is often less clear exactly where students currently are in the development process. Through using both information about student development and mechanisms for supporting and challenging student development, educators can work toward making student development more visible.

In engineering education, the types of pedagogies being encouraged, such as team-based pedagogy (e.g., Smith & Imbrie, 2005; Tonso, 2006b), problem-based pedagogy (e.g., Prince, 2004; Prince & Felder, 2006; Smith, Sheppard, Johnson, & Johnson, 2005), and design-based pedagogy (e.g., Dym, Agogino, Eris, Frey, & Leifer, 2005; Harvey Mudd College, 2012; Sheppard et al., 2009), support students growth along the National Academy of Engineering Grand Challenges, such as advance personalized learning (National Academy of Engineering [NAE], 2012). An awareness of student development may help us better understand how students will engage in various pedagogies, which has the potential to impact their development towards self-authorship. For example, educators could ask questions like, what happens when

students at the socialized mind encounter problem-based learning. This awareness could help educators be more understanding for why students behave in specific ways. Even further as educators design educational activities, they could implement purposeful scaffolding to support and challenge students' development towards self-authorship.

Markers of self-authorship

Attributes of a self-authoring individual include, but are not limited to, the ability to critically analyze and evaluate problems, formulate an identity, independently learn, engage in interdependent mature relationships, embrace and value diversity, consider multiple perspectives, collaborate, self-initiate, be responsible for own experiences, and handle ambiguity (Baxter Magolda, 2001, 2008; Kegan, 1994). While scholars provide a variety of characteristics of self-authoring individuals, the work in this dissertation is grounded primarily in three specific markers of self-authorship—crossroads (Baxter Magolda, 2001), process elements (Baxter Magolda, 2008), and skill sets (Pizzolato, 2007).

Self-authorship crossroads. According to Baxter Magolda (2001), triggers that encourage development towards self-authorship happen at the crossroads: a place in which individuals may encounter disruptions in the ways in which they make meaning of the world. Crossroads are an important aspect of one's journey toward self-authorship in that they initiate the evolution toward self-authorship. At the crossroads, individuals find that either one significant life event or several smaller life events do not fit into their structure of how they make sense of the world. The crossroads, related to concepts such as “disjunctures” (Jarvis, 2007), “disorientating dilemmas” (Mezirow, 2000), and “provocative moments” (Pizzolato, 2005), include situations that are described as emotional, difficult, or result in change.

Self-authorship process elements. Baxter Magolda (2008) demonstrates “one possible portrait of the evolution of self-authorship” (p. 273) through narratives of college students as they progress into adulthood. Her research suggests that one’s journey toward self-authorship involves the elements of trusting the internal voice, building an internal foundation, and securing internal commitments. As individuals *trust their internal voice*, there is a growing awareness of confidence in one’s self, and one’s capacity to have an internal voice. As individuals begin to trust their internal voice, they have the ability to recognize that while world experiences and activities may be out of their control, the ways in which they react is within their control. Once an internal voice is developed, one can *build an internal foundation*. The internal foundation is a life philosophy that guides the foundation and commitments one lives by daily. This internal foundation impacts how individuals react to world experiences. As described by one of Baxter Magolda’s (2008) participants, the internal foundation represented the ‘core of one’s being.’ (p. 280). Baxter Magolda (2008) goes on to describe this phrase—‘core of one’s being’—as, “represent[ing] the enduring nature that the internal foundation acquires when all of the dimensions of one’s development become integrated into one cohesive entity” (p. 280). Once an internal foundation is developed, individuals can move toward living by this foundation or as Baxter Magolda (2008) describes it—“living their convictions” (p. 280). In *securing their internal commitments*, individuals moved past simply “understanding their internal commitments to living them” (p. 281); these convictions become “second nature” (p. 277).

Self-authorship skill sets. In an effort to construct a quantitative measure of self-authorship, Pizzolato (2007) describes skill sets that are further indicators of self-authorship. According to

Pizzolato (2007), growth of the skills within these skill sets occurs within each of the developmental dimensions (i.e., knowledge, identity, and relationships). More specifically, “if an instrument measures subsets of skills underlying a particular developmental construct, then assessment should speak to movement toward the goal outcome in way that identifies which skills need improvement” (Pizzolato, 2007, p. 34). These skill sets provide further ways of identifying capabilities of development from socialization to self-authorship: (1) problem-solving, (2) relationships with authorities, (3) volitional (competence) efficacy, and (4) self-regulation in challenging situations.

Theoretical challenges

Three challenges that are particularly salient in studying self-authorship are: situating the study in the communities’ philosophy; evaluating movement towards self-authorship; and implementing in higher education and engineering education.

Challenge 1: Situating the study in the communities’ philosophy

Since the research in this dissertation is situated in two different communities—higher education, specifically student development, and engineering education—it is important to understand if and in what ways each of these community’s underlying perspectives can influence the research endeavor that is this dissertation.

Historically, the study of student development has been informed by a positivistic perspective—an objective reality exists (Denzin & Lincoln, 2005). This work is typically grounded in the seminal work of epistemological development by Perry (Hofer & Pintrich, 2002), which situates epistemology as a construct to explore through quantitative methods. In this research area, scholars recognize an evolution from a positivistic perspective toward a constructivist

perspective. Currently, most researchers studying student development, and more specifically self-authorship, are guided by a constructivist perspective (i.e., view realities as being constructed and co-constructed by interactions with experiences (Guba & Lincoln, 2005)). For example, Baxter Magolda (2004a), a prominent self-authorship scholar, describes her academic journey as a progression from positivistic perspective to post-positivistic, and then to a constructivist perspective. On this evolution toward a constructivist perspective, Baxter Magolda (2004a) recognizes her scholarly growth as parallel to her participants' journey toward self-authorship. While this shift has influenced the ways in which scholars approach research, it is important to recognize the theoretical roots and to understand what impacts these can have on the research.

Within engineering education, self-authorship is not widely researched; however, it is a powerful tool in constructing and understanding educational practice. In working towards introducing self-authorship to the engineering education community, understanding and considering both the traditions of self-authorship and engineering education research will significantly impact the research outcomes.

To introduce the concept of self-authorship to engineering education, it is important to consider the traditions of the engineering education community. While there has been a shift in the engineering education perspective, engineering education is deeply rooted in science, technology, mathematics, and engineering (STEM) related fields, which often means research is grounded in a positivistic perspective (i.e., objective reality (Denzin & Lincoln, 2005)). Informed by this tradition, engineering education researchers are more likely to ask questions that can be

explored and answered through quantitative methods (Case & Light, 2011). The engineering education community recognizes the “lack of qualitative studies in engineering education literature” (Case & Light, 2011, p. 187), but, at the same time, the community notices “reviewers’ preference for quantitative methods” (Case & Light, 2011, p. 187). In working towards introducing a self-authorship framework to the engineering education community, it is important to be aware of, and sensitive to these issues. In considering the deep-rooted traditions of the field, it is necessary for the research methods to be transparent through systematic approaches to data collection, analysis, and rigor (discussed in Chapter 4: Methodology and methods).

Before discussing data collection, analysis, and rigor (see Chapter 4: Methodology and methods), it is important to remember the impact of the communities’ perspective and complexities associated with studying student development. The philosophical grounding in the constructivist perspective guides self-authorship research towards more qualitative methods. The data collection and analysis methods used in this study are grounded in the constructivist perspective, thus qualitative methods are used.

Challenge 2: Evaluating movement towards self-authorship

The nature of development—internal, personal, and evolutionary—makes it quite challenging to observe and research. “As King (1990) noted, assessment is complicated because individuals often use more than one meaning-making structure at a time, and prefer (recognize as better) statements using reasoning structures that are more complex than what they are able to produce independently” (Baxter Magolda & King, 2007, p. 495). This endeavor requires researchers to explore avenues through which to make the invisible visible. In these methods, researchers rely

on asking students to self-report how they experienced a phenomenon (Baxter Magolda & King, 2007). Two widely used interviews are Baxter Magolda's (2001) Longitudinal Self-Authorship Interview and the Wabash National Study of Liberal Arts Education Interview (Baxter Magolda & King, 2007). In these interviews, students are asked questions to probe at self-authorship through asking about such things as experiences (Baxter Magolda & King, 2007).

Pizzolato (2007) found that asking students about decisions was one promising window into students' development because decisions represent a space in which students may grapple with alternative choices that have the potential to catalyze them into the crossroads and towards self-authorship. However, Pizzolato (2007) found that students often struggle with articulating decisions that they are responsible for and they will often talk about decisions that someone else made on their behalf.

Individuals can report actions that seem self-authoring, but are not based on self-authoring reasoning. In other circumstances the same individuals may describe self-authoring reasoning, but choose an action that is not self-authoring because the circumstances require such a behavior.

Pizzolato (2007) describes a prime example of these differences

For example, a student who makes a decision to reject her parents' desire for her to be a math major and instead pursue a journalism major may or may not be self-authoring in this decision. If the student makes this decision because she truly wants to be a journalist, has thought out the implications of this decision, and, following some reflection on the implications of this decision, has gone through

the process of switching majors, she may be self-authoring. If, however, the student makes this decision purely to be rebellious, then it is not a self-authored decision. Without knowledge about the motivation behind the decision, actions may be labeled self-authoring when they are not (p. 40).

Challenge 3: Exploring current practices in higher education and engineering education

In higher education, self-authorship has primarily informed work in Student Affairs (e.g., dorm life, academic advising, counseling, interventions related to experiential learning and extra-curricular activities) (Merriam et al., 2007). While it is important to attend to student development, there has been little application of the theory to formal educational practices. Where such connections have been made, they have historically focused on knowledge development—ways in which one constructs meaning about the world and gains knowledge (Felder & Brent, 2004a).

While it is still important to attend to knowledge development, there are merits to integrating other domains of development (Haynes, 2006), such as identity development and relationship development: “Advocates of educating the whole student have argued for years that emotional, social, and cognitive development are equally important aspects to consider in creating effective learning environments” (Haynes, 2006, p. 17).

To improve the professional education of future engineers, researchers have explored how to align education with practice (Sheppard et al., 2009). Research suggests that higher education in general has focused on a narrow view of outcomes based education, which often leads to an emphasis on specific skill development (Hirt, 2009). Mezsaros (2007) strongly encourages

higher education to “go considerably beyond mere knowledge of subject matter and require a new lens to view learning and teaching in higher education” (p. 5).

Often, the foundational STEM courses are taught outside of engineering and are taught using traditional absolute ways of knowing (i.e., knowledge conveyed as “black and white” or dualistic and dependent on an authority figure) and little integration with engineering practice. This approach fosters and reinforces students’ development as socialized along the knowledge dimension. Theory to practice primarily takes place in lab settings in which students work in groups on structured problems in a linear process. Again the highly formulaic ways of knowing encourage a socialized mind, rather than a self-authoring mind. In an effort to encourage professional development, engineering students are required to take 36% of their credits from the humanities; however, these courses “are not treated as integral to the business of becoming an engineer” (Sheppard et al., 2009, p. 14).

More specifically, engineering education primarily engages students in the acquisition of technical knowledge through a linear model, which includes four curriculum building blocks (Sheppard et al., 2009): (1) fundamentals (Science Technology Engineering Math (STEM) courses); (2) theory to practice; (3) design practice; and (4) from student to professional. Even though all four curriculum building blocks are equally important for student development, they are disproportionally emphasized in the engineering curriculum. Foundational skills are prioritized in an overloaded curriculum. Furthermore, the curriculum is deductive in nature with theory presented before practice. Sheppard et al. (2009) emphasize this imbalance does a disservice to the development of future engineering leaders—“opportunities for the kind of deep

learning and understanding that allows students to become, over time, sophisticated, independent learners are lost in effort to teach everything” (p. 31). Sheppard et al. (2009) suggest moving to a networked curriculum in which *all* building blocks are integrated throughout the degree program.

Summary of the conceptual framework

This chapter defines and outlines the assumptions of the conceptual framework of self-authorship. A presentation of the three developmental dimensions—knowledge, identity, and relationships—alongside current engineering education research endeavors provides connections between the two communities. More specifically, this chapter provides mechanisms for identifying self-authorship markers through the crossroads (Baxter Magolda, 2001), process elements (Baxter Magolda, 2008), and skill sets (Pizzolato, 2007). This exploration highlights three salient challenges: situating the study in the communities’ philosophy; evaluating movement toward self-authorship; and exploring current practices in higher education. From this discussion it is evident that self-authorship offers a perspective that is grounded substantially in theory; explored and understood empirically; presented holistically and multidimensionally; connected broadly to people’s lives; and linked to engineering and higher education.

In recognizing the importance of student development, scholars at the intersection of psychology and education have explored epistemology—the nature of knowledge (Hofer & Pintrich, 2002). Much of this work is grounded in a developmental approach, specifically Perry’s examination of student development of male students at Harvard (Hofer & Pintrich, 2002; Moore, 2002). Other approaches have examined student development as a system of beliefs (Schommer-Aikins, 2002). The work on epistemology provides a strong foundation for the knowledge dimension of self-authorship. Baxter Magolda’s (2001) longitudinal study of college student development

began with the examination of epistemology. As more complex narratives emerged from her study, she explored a different approach to student development, which prompted her to integrate identity development and relationship development into her examination of epistemology (Baxter Magolda, 2001, 2004). Other scholars recognized this need for broadening the study of epistemology. For example, in their exploration of epistemology, King and Kitchener (2002) encourage scholars to broaden their examination of student development to include other dimensions of development—“[n]ew lines of research should more explicitly examine Kegan’s (1994) claims that adults trying to cope with the mental demands of modern life often find ourselves ‘in over our heads’ when our mental capacities do not match the complexities of the challenges we face” (p. 54).

There is a strong relationship between these three dimensions of development. Baxter Magolda (2001) describes this relationship as

Despite variation in which questions and developmental dimensions were in the foreground, the move toward self-authorship in any dimension brought the other driving questions into play. Just as gaining perspective on the self initiated a revisioning of relationships, making relationship choices often sparked from self-reflection. Similarly, deciding what to believe sometimes necessitated self-reflection whereas self-reflection was often essential in living one’s beliefs.

Living one’s beliefs also led to renegotiation of relationship with others (p. 154).

Kegan (1994) agrees with Baxter Magolda’s (2001) description of the interrelationship of these developmental dimensions.

Connecting to Engineering Education. In engineering education, few researchers have studied the relationship between knowledge, identity, and relationships. Stevens et al. (2008) and (Turns, Sattler, & Kilgore, 2010) have examined similar relationships, using a framework that includes accountable disciplinary knowledge (ADK), identity, and navigation—and, although their components align well with those of self-authorship, these researchers do not explicitly articulate a connection to self-authorship. There is an opportunity to introduce the concept of self-authorship to the engineering community and explore ways in which engineering educators can support student development toward self-authorship. Research on engineering student development is absolutely fundamental as we re-think the ways in which we educate our future engineers. However, to catalyze this process a systematic approach to identifying makers of self-authorship is needed in order to operationalize this internal and often invisible process.

Chapter 3: Supporting self-authorship

The purpose of this chapter is to connect the pedagogy—preparedness portfolios and portfolio studios—to suggestions for supporting and challenging student development, which in turn, will demonstrate why the pedagogy has the potential to foster student development. This chapter answers research question two—*in what ways could the preparedness portfolio and portfolio studio pedagogy connect to supporting student development?* This chapter begins with a description of the overall pedagogy, which includes a discussion of the elements of both the preparedness portfolio and the portfolio studio. Next, key types of learning supported in the pedagogy are explored alongside each of the developmental dimensions. The purpose of connecting learning to the developmental dimensions (i.e., knowledge, identity, and relationships) is to demonstrate why the construction of a preparedness portfolio in a portfolio studio can contribute to students' development towards self-authorship.

Pedagogy

This pedagogy is the result of research funded by the National Science Foundation over the course of many years. The pedagogy is composed of two components: (1) preparedness portfolios and (2) portfolio studios. The key elements of the preparedness portfolio are *preparedness* statements in the form of *arguments* in written explanations (i.e., *statements, artifacts, and annotations*). Within the portfolio studio, the dedication is to scaffolding learning in *sessions*; validating students' *process*; and understanding students' *reactions*. (See Turns et al., 2012 for more details about these six elements.)

Invited engineering undergraduate students (see Chapter 4 for participant selection) construct an argument about their preparedness for a future activity in the form of a portfolio. Typically,

students choose to make claims about their preparedness for industry; some students use the portfolio as an opportunity to demonstrate their preparedness for undergraduate and graduate school programs. While the portfolios can differ in the scope of their claims and also the source of their content, much of the research on this pedagogy has focused on students creating a life-wide engineering preparedness portfolio—students are encouraged to draw portfolio content from a life-time of experiences (e.g., classroom, work, co- and extra-curricular, and personal). Scaffolding for this activity is provided in the context of a portfolio studio—an interactive social environment in a semi-structured environment with the goal of facilitating students through the process of creating a portfolio. The portfolio studio was offered as a co-curricular activity (i.e., not for credit and in addition to degree related requirements). In the portfolio studio, small groups of students (~10-20) meet with a facilitator for five two-hour sessions (see Appendix A: Facilitator’s Guide for suggestions on how to facilitate the portfolio studio). The studio consists of a series of semi-organized and facilitated group activities (e.g., brainstorming, peer reviewing, reflecting on experience) as mechanism to support students through the process (see Appendix B: Session Materials for the materials used in the studio that was studied in this dissertation):

- “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” (Turns et al., 2012, p. 8).
- “Session 2: Students share their experiences creating the professional statement, brainstorm ideas about effective peer review, use these ideas while reviewing each

other's statements, and prepare for the upcoming task of finding and annotating one artifact" (Turns et al., 2012, p. 8).

- "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" (Turns et al., 2012, p. 8).
- "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" (Turns et al., 2012, p. 8).
- "Session 5: Students deliver their presentations, provide feedback on their peers' presentations, and revisit the overall experience" (Turns et al., 2012, p. 8).
- Every session: Facilitator begins and concludes each session by asking students to fill out a feedback form—an opportunity for students to reflect on their experience working on the portfolio on their own and their experience participating in the session (see Figure 2 for the feedback form). In sessions 2-5, the facilitator provides a summary of students' feedback. This summary allows students to see how peers' are experiencing the activity, which has the potential to validate their own experience.

	...Working on your portfolio over the last weeks	...Participating in the session today
What was your most rewarding experience?		
What caused the most frustration for you?		
What surprised you the most?		
Were there any “aha” moments ? Please describe.		

Figure 2. In sessions feedback forms used to check-in with students throughout the process of building a portfolio.

As described by Turns et al. (2012), there are three main elements of the preparedness portfolio: (1) preparedness, (2) arguments, and (3) statement, artifacts, and annotations. The emphasis on preparedness represents an emphasis on having students think about their readiness for a future activity (in this case engineering industry or graduate school); their ideas about their readiness may involve thoughts about their character and personality in relationship to their definition of engineering. The emphasis on arguments represents an emphasis on having students go beyond just thinking about their own preparedness; the emphasis is on having students identify specific claims that they personally can make about their preparedness and also identify the evidence from their experiences that they can provide to support their claims. Finally, the emphasis on a statement and annotations represent one embodiment of a preparedness argument. For example, if a student argues that she is a strong leader, she would make this claim in the statement and then she could include artifacts from an experience as a project manager for a group project in order to provide evidence for her claim. Each of these elements is an important factor for this

pedagogy in that they work together to provide a balance of guidance and structure, while allowing room for students to grapple with ambiguity.

Turns et al. (2012) describe the purposeful use of arguments as “an e-Portfolio involves claims that are substantiated by evidence” (p. 3). In this pedagogy the portfolio is characterized as an argument or set of arguments, but it could also be analogous to a formal paper in that each element of a formal paper (i.e., thesis statement, topic sentence(s), and supporting paragraph(s)) could map to the elements of a portfolio. While this alternative explanation makes sense, because of the specific context (i.e., engineering), the argument perspective may resonate more with engineering students. Furthermore, a focus on arguments provides an alternative pathway to reflection (i.e., engages student in reflection without specifically asking them to reflect). Framing the portfolio activity as an argument is intentional because previous research about preparedness portfolios suggests that students can have difficulty with the language of reflection (Turns et al., 2011).

In characterizing engineering education as a professional degree program, such as medicine or law, “[t]he 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” (Turns et al., 2012, p. 5). Framing the activity as a preparedness portfolio further supports students as they examine past experiences in light of their future goals. Research suggests (Sattler et al., 2011) that engineering students rarely assess and monitor their goals throughout their engineering education. An activity, like the preparedness portfolio, provides a designated time and safe space for students to engage in such a personal activity.

Through thinking about preparedness, students may recognize misalignments between their experiences and future goals. This knowledge may afford students an opportunity to address this misalignment through such things as pursuing specific experiences that align more with future goals.

Coupled together the statement, artifacts, and annotations are one mechanism to scaffold the writing aspects of the preparedness portfolio. While the preparedness portfolio could be constructed in various forms, these specific elements provide room for creativity within a given structure. When inviting students to make a preparedness portfolio, students are encouraged to construct claims about their preparedness in a three forms:

- *A professional statement*: Articulation of one's beliefs about the field, as well as claims about personal preparedness for the chosen field.
- *Artifacts*: Products and by-products from experiences that represent the evidence supporting the claims made in the professional statement (e.g., class projects, internship projects).
- *Annotations*: Connection between an artifact and claims made in the professional statement.

Students create and present their preparedness portfolio in the form of an online portfolio via a simple website tool (e.g., Google sites). While some students with more advanced web development skills easily construct a more sophisticated portfolio site, most students who have participated in the research efforts over the past several years have developed a simple site for their portfolio (see Figure 3 for example portfolios).



Figure 3. Example portfolios.

In prior research, researchers have articulated how students have grappled with a variety of issues—identity development, goal setting and monitoring, and meaning making—within the context of constructing a preparedness portfolio (Kilgore, Sattler, & Turns, 2011, 2012; Sattler, Thompson, Turns, & Kilgore, 2011; Sattler, Turns, & Kilgore, 2010; Sattler, Turns, & Mobrand, 2012; Thompson, Sattler, & Turns, 2011; Turns & Sattler, 2012; Turns, Sattler, et al., 2012; Turns et al., 2010).

In exploring these specific areas, research suggests the powerful impacts of this pedagogy, such as students' engagement in goal setting and monitoring and life-long learning growth. For example, Sattler et al. (2011) explored how, within the context of the pedagogy, students set and monitor their goals. Sattler and her colleagues discuss findings concerning how students often set an initial distal goal (e.g., earn an engineering degree), but seldom monitor progress towards that goal. The portfolio activity encourages students to examine their distal goal, and even begin setting more intermediate proximal goals beyond simply passing the required coursework. In

addition, Sattler et al. (2010) explored how portfolio construction had the potential to support students' development towards life-long learners.

At a higher level, these researchers have explored how students make sense of their experiences, which suggests that constructing a preparedness portfolio contributes to students better understanding their experiences (Kilgore et al., 2011; Kilgore et al., 2012). This work on how students make sense of their experiences lays a strong foundation for understanding the impacts of preparedness portfolios in a portfolio studio. However, each research endeavor explores only one aspect of the student experience in the pedagogy. For example, researchers (Eliot & Turns, 2011) explored how the pedagogy under investigation in this dissertation supports students' engagement in identity work, which is one dimension of self-authorship development. Turns et al. (2010) explored the knowledge dimension through a link to the Stevens et al. (2008) model of becoming an engineer. Self-authorship along the three dimensions of knowledge, identity, and relationships provides a lens to examine the student experience more broadly and holistically.

Connecting the pedagogy to self-authorship

To use self-authorship as a lens to explore the pedagogy, it is important to align the pedagogy with suggestions for how to support the development of self-authorship. According to scholars (Baxter Magolda, 2001; Kegan, 1994), a balance of support and challenge is critical when helping students develop towards self-authorship. In an environment with such scaffolding, students may begin on a journey towards self-authorship, such as the one outlined by Baxter Magolda (2008):

- *Trusting the internal voice:* Becoming aware of one's ability to have an internal voice
- *Building an internal foundation:* Creating and having an internal voice

- *Securing internal commitments:* Living by this internal voice

The discussion that follows demonstrates why the combination of constructing a preparedness portfolio in a portfolio studio provides students with the necessary support and challenge to potentially catalyze their development towards self-authorship.

Connecting the pedagogy with the developmental dimensions provides one way to explore if the pedagogy has the potential to help students develop into self-authoring individuals. Students making a preparedness portfolio in a portfolio studio, can be imagined to have the opportunity to engage in at least two types of learning—surface and depth learning—within each of these dimensions. Surface learning is engendered in the nature of the activity, and is easily observable through deliverable products (e.g., portfolio). On the other hand, depth learning is more subtle because it is internal to the individual, and thus would be more challenging to observe directly. Table 1 outlines one surface and depth learning for each developmental dimension. It is important to recognize alongside these types of learning that other learning could be occurring; Table 1 represents a range of obvious and provocative learning outcomes.

Table 1. Types of learning along each developmental dimension

	Surface Learning	Depth Learning
Knowledge	Making a portfolio	Understanding what counts as engineering
Identity	Presenting self as an engineer	Internalizing self as engineer
Relationships	Giving and receiving portfolio feedback	Interacting with other engineers through feedback

The sections below provide an explanation of how surface and depth learning align with balancing support and challenge for each dimension. The systematic process of exploring each type of learning includes: (1) describing pedagogy activities that connect to learning along the dimension; (2) defining the learning; (3) exploring socialized and self-authoring ways of learning; (4) detailing how the pedagogy guides this types of learning; and (5) outlining a

trajectory of socialization to self-authorship through Baxter Magolda's (2008) description of trusting, building, and securing internal commitments.

Knowledge

As described in Chapter 2, of the three developmental dimensions, knowledge is the most widely researched in both higher education and engineering education. This focus makes sense because the knowledge dimension aligns with the commonly understood purpose of education. Because the fundamental activity is constructing a portfolio, students may report learning about how to make a portfolio. A major aspect of learning that takes place within the pedagogy is likely to be learning how to make a portfolio, which includes logistical (i.e., portfolio structure) and technical aspects (i.e., web authoring tools). It is interesting to see how at first the pedagogy is about learning to make preparedness portfolio, but it has the potential to engage students in grappling with what counts as engineering.

Learning to make a portfolio. In connecting to the pedagogy, the knowledge dimension is elicited through the main activity of making a portfolio. How might socialized individuals learn to make a portfolio? Socialized individuals would desire that an authority provide instructions on how to construct the portfolio, asking the question—what is the “right way” to make a portfolio? There is the potential that students would look for “the right ways” to develop a portfolio because society defines social norms in quite specific ways (i.e., students live in a world of “right ways”), which significantly influences the ways in which people learn. So, while initially it may not seem challenging to engage students in activities in which the boundaries are less defined, from a young age students have been socialized these rigid norms of education (i.e., “right ways”). On the other hand, how might self-authoring individuals learn to make a portfolio? Self-

authoring individuals would approach the task through a more open perspective, suspending disbelief about exactly how to make the portfolio. While the world is often defined by quite rigid boundaries, the world also engenders creativity through encouraging people to push the edge, especially in non-traditional settings (e.g., arts). Because of this mindset, it is possible that self-authoring students would view learning to make a portfolio more from a contextual perspective: rather than “right ways” there are better ways depending on the situation (e.g., audience and purpose).

The activity of making an argument about one’s preparedness is defined by ambiguity—there is no “right way.” To address this, the pedagogy provides “liberating constraints” (Davis & Sumara, 2006) that provide students a structured, yet flexible work environment. The purpose of “liberating constraints” (Davis & Sumara, 2006) is to support students’ “capacity to choose from among multiple alternatives” (Baxter Magolda & King, 2004, p. 42). While there is no “right way” to construct a portfolio, students on given guidance on various aspects, such as word count and format. The purpose of such guidance is to catalyze students’ engagement with the activity of making a portfolio, which can help students focus on more depth issues (rather than logistics). While students are not told exactly how to construct the preparedness argument, the written documents (i.e., statements, artifacts, and annotations) provide students with scaffolding. This ambiguity removes the comforts afforded by external formulas (i.e., being told exactly what to do and how to do it by an authority figure), and requires students to grapple with such ambiguity—

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 (Turns et al., 2012, p. 6).

In the context of the knowledge dimension, , the goal of portraying knowledge as complex and socially constructed is to help students move from seeing knowledge as “black and white” to complex and contextually based (i.e., journey from socialization to self-authorship along the knowledge dimension). When students are in a safe environment in which they have to deal with ambiguity, they may begin trusting the internal voice, building an internal foundation, and securing internal commitments. More specifically, trusting the internal voice can be seen when students convey their own ideas about a portfolio; building an internal foundation is evident when students choose among alternative approaches to the portfolio; and securing internal commitments occurs through the portfolio construction and presentation.

Learning what counts as engineering. A second potential type of learning, which is more embedded in the activities, is learning how to be an engineer. How would socialized individuals learn to be an engineer? Socialized individuals would learn through the community’s definition of engineering. Adding to this community definition, society, more generally, has clear connotations of what it means to be an engineer (e.g., “good” at math and science). Even young

children are socialized to this way of thinking about engineering. For example, when they show aptitude in math and science, authority figures often encourage them to pursue engineering.

These perspectives position strong math and science skills at the center of what it means to be an engineer, which have the potential to influence how students learn to be an engineer. How would self-authoring individuals engage in learning how to be an engineer? Self-authoring individuals may initially recognize societal definitions of engineering; however, they have the capacity to approach learning how to be an engineer through a more open perspective. While there are strong socially defined ideas of what it means to be an engineer, especially related to math and science, recent engineering diversity initiatives have aimed to broaden the engineering perspective and have contributed to initiatives to recruit and retain a diverse engineering student body. Valuing more than just “good” at math and science has the potential to help students more broadly define what it means to be an engineer.

The process of constructing arguments about one’s preparedness for the purposes of a portfolio may encourage students to grapple with which arguments are most important and how to organize these arguments. The artifact scavenger hunt, a specific activity in the studio, asks students to think broadly about *all* their experiences and to connect them to claims about their engineering preparedness. Through systematically thinking about these experiences, students may have to address deep rooted conceptions about what counts as engineering knowledge.

While students may initially value technical experiences, they may broaden their conception of what counts as engineering knowledge. Through this activity it is possible for students to begin moving towards self-authorship. Trusting the internal voice is possible when students explore all their experiences equally; building an internal foundation may happen when students connect

these experiences to their skills; and securing internal commitments may occur through connecting these skills to their engineering preparedness claims.

Identity

While engineering education has been interested in identity, the community approaches the identity through an alternative perspective of “belonging.” Even though these efforts represent a move towards understanding the importance of students’ identities, there is room for a broader discussion. The nature of the pedagogy being investigated in this dissertation positions students’ identities at the center of the activity; the identity dimension may be invoked when students are asked to make an argument about their engineering preparedness. For various reasons (e.g., time constraints, little experience, etc.), this type of activity is rarely supported in classroom environments. Therefore, for most students the pedagogy may be the first time they are formally asked to look back on prior experiences in light of future goals in a structured environment. It is interesting to see how at first making a preparedness portfolio is an exercise in presenting self as an engineer, but it has the potential to engage students in grappling with their beliefs about their own engineering story.

How to present self as an engineer. Since the activity asks students to make an argument about their engineering preparedness, the pedagogy may engage students in learning how to present themselves as engineers. How would socialized individuals approach learning how to present oneself as an engineer? Socialized individuals may view this activity as a simple writing and presenting exercise. Because engineering has strong definitions of the field, the activity may be defined in terms of what one “should” write based on these community expectations. In this case, learning to present self as an engineer becomes an audience analysis exercise in which one then

tells a story about oneself that aligns with community standards. On the other hand, how would self-authoring individuals engage in this learning? Whereas socialized individuals may view it in terms of writing and presenting, a self-authoring individual might use more rhetorically sophisticated ways because they have the capacity to see the activity as more than story-telling for a specific audience. Students may bring a self-authoring perspective to this learning because the digital age continuously provides opportunities to present one's self (e.g., Facebook profiles).

The nature of the preparedness portfolio—make an argument about self as prepared for engineering—may encourage students to think about how to present themselves as an engineer. Specifically, students are asked to write a professional statement in which they argue their engineering preparedness:

Prepare a 400-500 word statement describing your understanding of your engineering discipline, your experiences, and the connection between the two.

This statement is the backbone of your portfolio and is your opportunity to showcase and sell your knowledge and skills – you will link everything else in your portfolio to this statement (assignment description).

Through this activity, it is possible for students to begin moving towards self-authorship. As they bring trusting the internal voice, they may recognize that they have the potential to have an engineering story. In building an internal foundation, they may acknowledge all possible engineering stories they can have. In securing internal commitments, they may understand that their engineering story can be a belief (which has the potential to catalyze the depth learning of internalizing self as an engineer).

Learning how to internalize self as an engineer. A type of deeper learning that the pedagogy has the potential to support is the process of students learning to internalize themselves as engineers, which is engendered in the nature of the activity. A self-authoring way of learning how to present self as an engineer (i.e., surface learning) can catalyze this deeper learning. How would a socialized individual learn to internalize self as an engineer? As with learning how to present self as an engineer, socialized individuals would look to the community for definitions of what it means to be an engineer. An approach like this one may align with students' current perspective because they are continually being socialized to what it means to be an engineer. On the other hand, how would self-authoring individuals learn how to internalize self as an engineer? Self-authoring individuals have the capacity to engage in this learning through a broader perspective; they can begin the process of grappling with their values and beliefs as engineers. The engineering community often engenders a specific way of thinking about what it means to be an engineer. Therefore, self-authoring students may grapple with their values and beliefs at a deeper level.

Connecting to the pedagogy, the portfolio is about one's personal preparedness for a future endeavor, which situates one's experiences and future goals as central. The process of looking back in service of the future has the potential to encourage students to grapple with what it means to be an engineer and how their values and beliefs align with their sense of what it means to be an engineer. Furthermore, students are then asked to articulate this information in the form of written arguments (i.e., statements, artifacts, and annotations). When students have yet to define such values and beliefs, they either must take up what the community tells them they should do (i.e., socialization to the engineering community) or begin to grapple with their own

values and beliefs (i.e., may begin their journey toward self-authorship). Through this initial understanding, there exists the opportunity to begin the process of catalyzing students on a journey of self-authorship. First, as students believe they can have an engineering story, they begin trusting the internal voice. As they grapple with their engineering story, they may begin the process of building an internal foundation. Finally, in believing their engineering story and externalizing that story through the portfolio, students may secure internal commitments.

Relationships

Supporting students' development along the relationship dimension may seem familiar and dissonant at the same time because the engineering education community does not conceptualize relationships in the same terms as self-authorship. For example, in engineering education, the discussion focuses on what works within teams (see Chapter 2 for more details). In the pedagogy being studied here, students' development along the relationship dimension may be supported through peer review. At first, peer review may appear as a simple exercise in giving and receiving feedback (surface learning), but it has the potential to also be about how one interacts with others (depth learning).

Learning to give and receive feedback on a portfolio. A significant aspect of the pedagogy is engaging students in peer review of the portfolio content. How would socialized individuals learn to give and receive feedback on a portfolio? It is possible that students may participate in peer review through a socialized perspective, which would include agreeing with the peer, not challenging the peer, and easily taking up the peer's perspective. Students at the socialized mind may engage in peer review at a more cursory level, in which comments address grammar, style, and tone issues, rather than deeper topics. Students may use this method because of prior

experiences (i.e., the way they have always done peer review). Furthermore, maybe they have been given cues (intentionally or unintentionally) that this is the fashion in which one should conduct peer review. On the other hand, how would self-authoring individuals give and receive feedback on a portfolio? Because self-authoring individuals engage in mutual and respectful relationships, the individual would first understand the personal nature of the content. Then, the person would evaluate his or her beliefs about the content alongside the other person's values and beliefs in order to mutually construct meaning of the content and ultimately help the author strengthen the content. Students may be positioned to participate in peer review in such a manner because increasingly there have been changes to higher education to include more collaborative work. These changes stem from the idea that more perspectives can help strengthen work.

In the pedagogy being studied here, students individually and collectively grapple with what constitutes a "good" portfolio. Before students participate in peer review, there is an in-depth discussion about the goals of peer review; factors contributing to effective peer review; and what expectations students have about peer review. The purpose of such discussion is to help lay the foundation for students to be better prepared to engage in meaningful peer review. As individuals move towards self-authorship along the relationship dimension, there is a fundamental shift in how people interact with others. Relationship become defined by an equal partnership (i.e., interdependence), rather than dependence. Peer review makes it likely that students can begin the process of trusting, building, and securing internal commitments (Baxter Magolda, 2008). As students understand they can have a perspective alongside others' perspective, they may begin trusting the internal voice. As students identify their own perspective while respecting others' perspective, they may move towards building an internal foundation. It is possible through peer

review that students may secure internal commitments as they begin appreciating and incorporating others' perspective alongside their own perspective.

Learning to interact with other engineers in terms of feedback. The surface learning related to peer review discussed above may to prepare students for learning to interact with other engineers in terms of feedback. There is also potential that the pedagogy is helping students learn how to interact with engineers because interactions with each other may prepare them for future workplace relationships.

Summary of supporting self-authorship

Fundamentally, scholars emphasize the importance of balancing support and challenge when focusing on student development. The goal is to “propel students toward self-authorship by creating contexts whereby formulas for success are not readily available” (Pizzolato and Ozaki, 2007, p. 198). Contexts built on these suggestions require students to depend on their own secured internal voice and have the potential to disrupt students' current ways of making meaning. In these situations, students will either fit the disruptions into their current ways of making meaning or adjust to more sophisticated ways of making meaning (i.e., self-authorship). In supporting students' development along the knowledge dimensions, educators should portray knowledge as complex and socially constructed. In scaffolding activities that encourage student engagement in identity work, educators must position students at the center of knowledge construction activities. To help student develop along the relationship dimensions, educators should share authority and expertise in the mutual construction of knowledge. In conclusion, in principle the pedagogy elements align well with supporting and challenging students' development towards self-authorship. Further, the specific ideas represented in this chapter—

ideas which address research question two (i.e., in what ways could this pedagogy *connect* to supporting student development)—make it possible to begin exploring the empirical question of this study: If and in what ways did students report experiencing the construction of a preparedness portfolio in a portfolio studio as an opportunity to develop into self-authoring individuals?

Chapter 4: Methodology and methods

A goal of this research is to explore the empirical research question: if, and in what ways does constructing a portfolio in a portfolio studio support engineering undergraduate students' development toward self-authorship? The methodology and methods presented here provide a structure through which this empirical research question can be explored.

This study is a component of a multi-year research endeavor funded by the National Science Foundation (NSF). The purpose of the larger study is to examine the usefulness of students constructing preparedness portfolio as a mechanism for helping students develop life-long learning competencies, integrated knowledge, and an engineering identity. Based on the larger study, results indicate that students report experiencing the construction of a preparedness portfolio in a portfolio studio in terms of identity development, goal setting and monitoring, and meaning-making (Kilgore et al., 2011, 2012; Sattler et al., 2011; Sattler et al., 2010; Sattler et al., 2012; Thompson et al., 2011; Turns & Sattler, 2012; Turns, Sattler, et al., 2012; Turns et al., 2010). Since the study presented in this dissertation is part of a large-scale effort, it is grounded in a rich history of assessing preparedness portfolio impacts. Situating this research within the larger study allows for a two pronged approach combining inductive and deductive activities. Such an approach enables the triangulation of the findings, which in turn contributes to the overall reliability of this study.

This chapter provides a description of the methodology, participant demographics, data collection techniques, and data analysis. The chapter begins with a conceptual outline of the methodology—constructivist grounded theory—and an articulation of why this methodology

was chosen. Selection of participants and their demographics are discussed. Finally, data collection, analysis, and rigor are outlined. The presentation of the data collection instruments illustrates how these instruments are fundamentally grounded in theory in order to target self-authorship. The discussion of data analysis includes a specific coding scheme in order to illustrate one mechanism for identifying self-authorship in self-reports. The section on rigor includes how these methods were held to a high standard in order to remain true to the data, while also exploring the topic at hand.

Methodology

The research questions explored in this study are particularly well examined and answered through qualitative research methods. Specifically, these methods in this dissertation work are situated in constructivist grounded theory, with a specific emphasis on how participants individually and collectively ascribe meaning to the experience (Charmaz, 2000). This methodology represents a commitment to understanding participants' individual experiences constructing a preparedness portfolio in a portfolio studio. This approach impacts the ways in which the data is presented in order to align with the students' individual reports about their experience. (e.g., "David *described* being surprised by how other life experiences connected to his engineering preparedness.") Furthermore, this methodology is used because the study elaborates on a stable construct (i.e., self-authorship); presents the construct to a new discipline (i.e., engineering education); and applies it to a new pedagogy (i.e., preparedness portfolios and portfolio studios). According to Charmaz (2000), constructivist grounded theory acknowledges researchers' prior conceptions and is more flexible in nature. For example, constructivist grounded theory recognizes the importance of the researcher's prior knowledge as critical to the overall study design. Additionally, constructivist grounded theory represents an opportunity for

data analysis to be both deductive and inductive, while also being situated in and informed by the conceptual framework of self-authorship. While in most cases the empirical results (see Chapter 5) represent collective themes across these participants' experiences, some themes also highlight the outlier experiences.

Participant demographics

Ultimately, this study was based on the experiences of six engineering undergraduates who participated in the pedagogy. In compliance with human subjects protocol, an email solicitation was sent out to all engineering undergraduates at a large public research institution, inviting them to participate in a portfolio activity (i.e., construct a preparedness portfolio in a portfolio studio over the course of five sessions). Students interested in participating in the portfolio activity filled out a screening survey (n = 151).¹ This survey provided demographic information about the students, and this demographic data was used in selecting participants.

Seventeen participants were selected based on three criteria: (1) a range of engineering disciplines; (2) a range of life experiences (i.e., entering status to the university as a returning or traditional student); and (3) diverse ethnic backgrounds. The first criterion represented a commitment to diversity in participants' academic backgrounds. Each department may have a unique approach to teaching and learning, which has the potential to support and challenge students' development differently. For example, if a significant portion of a department's curriculum was guided by a specific pedagogy, such as problem-based learning, students may be more familiar with that type of learning environment; therefore, they may thrive in similar environments in the future. The second criterion represented a dedication to exploring how this

¹ n = 151 represents the number of potential participants who completed the screening survey.

pedagogy works with students who have a range of life experiences, which aligns with research that indicates people are more likely to move toward self-authorship later in life because life experiences have required them to develop (Baxter Magolda, 2001; Kegan, 1994). The third criterion aligned with research that suggests underrepresented students may progress towards self-authorship earlier because life experiences have required them to adapt the ways in which they make meaning of the world (Abes & Jones, 2004; Pizzolato, 2003, 2004; Torres, 2003; Torres & Baxter Magolda, 2004). Of the 151 of interested students, 17 were chosen and agreed to participate. Pseudonyms were given to each participant.

Over the course of the fall 2011 academic quarter, 17 engineering undergraduate students participated in developing a life-wide preparedness portfolio—a portfolio in which claims are drawn from all life experiences (see Chapter 3 for more details about the pedagogy). These junior and senior-level engineering undergraduates represented a range of academic disciplines (with some students double majoring): Aeronautics and Aerospace; Chemical Engineering; Civil & Environmental Engineering; Computer Engineering; Electrical Engineering; Human Centered Design & Engineering; Industrial Engineering; Material Science & Engineering; Mechanical Engineering; and Psychology.

While data was collected from all 17 participants, six participants were chosen for the in depth analysis presented in this dissertation. Choosing six participants was intentional in order to explore a select number of participants in more detail.² Using data from six participants was a way to begin modeling how to use a concept such as self-authorship to understand and evaluate a pedagogy. These participants were chosen because an initial analysis of the data from all 17

² A-F pseudonyms were chosen as a mechanism to easily track students through the data.

participants revealed that these six participants reported a range of experiences constructing a preparedness portfolio in a portfolio studio. The empirical findings represented in this study (presented in Chapter 5) resulted from analysis of the experiences of these six participants. In Table 2, participants' self-identified demographics are presented.

Table 2. Demographics of six study participants

Participant	Department	Year	Race	Gender	Entering Status	Immigrated
Faith	Applying to ME & MSE	Junior	White	Female	Traditional	No
Ben	ME	Senior	White	Male	Returning	No
Eric	MSE	Senior	White	Male	Traditional	No
Anna	HCDE	Senior	Multi-racial	Female	Traditional	Yes (9 months)
David	ChemE	Junior	White	Male	Traditional	No
Carl	CE	Senior	White	Male	Traditional	No

Data collection instruments

The data collection and analysis in this work were grounded in prior work on self-authorships. For example, both Baxter Magolda's (2001) Longitudinal Self-Authorship Interview and the Wabash National Study of Liberal Arts Education Interview (Baxter Magolda & King, 2007) provided strong foundations for developing the data collection instruments used to explore the pedagogy. In an effort to target the developmental dimensions (i.e., knowledge, identity, and relationship), data collection questions were formed with an eye towards a specific dimension. Other data collection questions targeted the concept of self-authorship as a whole (see Appendix C: Survey & Interview Questions for a mapping of data collection questions to targeted developmental dimension(s)). The questions in the instruments represented a range of questions probing at movement toward self-authorship (e.g., the crossroads) and/or markers of a self-authoring individual. Each of the following areas included questions that either directly link the developmental dimensions (i.e., knowledge, identity, or relationships) or represented getting at

the journey of self-authorship (movement through the crossroads): (1) general experience; (2) learning environments; (3) interactions with others; (4) decision-making; (5) dilemmas; (6) thinking process; and (7) comfort levels (see Appendix C: Survey & Interview Questions).

The post-survey and post-interview were purposely designed to include the same questions. By using the same questions in the post-survey and post-interview, participants had an opportunity to grapple with the topic area on their own in the post-survey (i.e., a personal time and space to respond to such personal questions). The post-interview allowed a space for the interviewer to explore further answers provided on the survey, as well as explore new issues that arose during the interview. This design provided an opportunity for triangulation across these data points.

Post-survey

In the fifth and final session, all participants completed a post-survey. The post-survey consisted of a variety of open and close-ended questions that targeted participants experience in the pedagogy more generally, as well as more specifically in regards to development toward self-authorship (see Appendix C: Survey & Interview Questions). Within the context of the larger study in which this study is situated, the survey also allowed an opportunity to continue data collection on previously asked research questions (i.e., increase sample size for specific questions). Further, the survey was a starting point to probe into areas that might prove productive for discussion in the interview.

Post-interview

Within a month of constructing a preparedness portfolio in a studio setting, all 17 participants were interviewed generally about their experience developing the portfolio. Through a semi-structured interview protocol, fixed questions provided grounding to start the conversation and if

necessary, re-start the conversation. The flexible format allowed the researcher to probe into emerging areas not covered by the fixed questions.

Data analysis

The purpose of the data analysis was to characterize students' experiences with the portfolio activity in relationship to their development toward self-authorship. First it is important to acknowledge, examine, and understand students' individual experience; then it is critical to identify themes across these students. To make sense of the data, a constructivist grounded theory method to data analysis was used to (1) define what is happening in the setting; (2) narrate participants' individual experiences; (3) compare stories of the research participants; and (4) acknowledge and test assumptions, which aligns well a data analysis approach suggested by Baxter Magolda and King (2007)—“identify meaningful units of conversation; label the units to convey their essence in terms of meaning making; and sort labeled units into themes” (p. 504).

Identified meaningful units of data

To establish meaningful units of data in both the post-survey and post-interview, potential triggers for students' engagement with self-authoring behavior were identified using a codebook (see Appendix D: Codebook for identifying meaningful units of data), which were based on three categories: (1) Baxter Magolda's description of the crossroads (2001), (2) Baxter Magolda's description of a process towards self-authorship (2008), and (3) Pizzolato's articulation of self-authoring skills sets (2007). According to Baxter Magolda (2001), crossroads are instances in which individuals may encounter disruptions in the ways in which they make meaning of the world. Baxter Magolda (2008) describes one process towards self-authorship as trusting the internal voice, building an internal foundation, and building an internal foundation. In identifying indicators of self-authorship, Pizzolato (2007) describes skill sets: (1) problem-solving, (2)

relationships with authorities, (3) volitional (competence) efficacy, and (4) self-regulation in challenging situations. These three categories guided the identification of meaningful units of data.

Labeled units of data

In order to characterize the nature of each meaningful unit of data (previously identified), key words and phrases were constructed and applied to the text—codes (Geisler, 2004). Saturate, an online qualitative coding tool, was used to facilitate the systemic approach of applying codes to the text. Each meaningful unit of data was labeled with at least one code; and where appropriate, multiple codes were applied. Through this process, a database of codes began to emerge. These codes provided a foundation from which thematic analysis could be conducted.

Sorted labeled units of data into themes

After each meaningful unit of data was labeled with a code, they were grouped into emerging themes. This process included re-adjusting the codes identified in the previous step or making larger categories within which other categories fit. Through this thematic analysis, themes presented in the findings emerged from the data (Creswell, 2008).

Data analysis rigor

To ensure a high level of rigor, it is critical to explore and determine criteria by which to judge this research. The criteria for judging this research are based on enhancing rigor, specifically credibility, dependability, and transferability (Devers, 1999). Below, the criteria for enhancing rigor are presented, and then how these research methods align with the suggested criterion is explored.

Credibility

Is the research credible (i.e., internal validity)? Using data triangulation and disconfirming evidence provided two mechanisms for exploring the credibility of this research. While the empirical research findings are primarily based on two data sources—post-surveys and interviews—other data sources (e.g., pre-surveys, portfolios, session slides, and feedback forms) provided corroborating evidence about background information about the participant and further information about participants' experience developing the portfolio. In an effort to test themes, cases that do not fit within the themes were explored in order to acknowledge any disconfirming evidence.

Dependability

Is the research dependable (i.e., reliable)? The above mentioned systematic approach to data collection and analysis serves as a means to archive the process. Through the data collection and analysis processes, opportunities to enhance rigor were tracked and evaluated, constantly monitoring aspects that had the potential to contribute to and detract from the overall rigor of the study. Through this process, a chronology of all decisions was recorded. Activities that further contributed to the reliability, such as developing a strong codebook, engaging in research group discussions about biases, and continuing the sharing of information with skeptical peers, were used. Additionally, skeptical peer review—review of the empirical findings by an educated peer in order to evaluate the reliability of the findings—provided an additional source of reliability. The study findings were questioned by two independent peer reviewers. One skeptical peer review took place through the entire course of this analysis. This ongoing skeptical peer review consisted of several sessions to review and discuss the findings. During these sessions, the peer questioned the findings in terms of their relationship to the evidence and their organization. The

second one-time skeptical peer review (with a different peer) was conducted when the findings were semi-finalized. After the peer had read the findings chapter and shared electronic comments with the author, both met via phone to discuss the findings. This peer also questioned the findings and their organization. These deliberate choices contributed to the systematic nature of the data collection and analysis, which is critical because of the complex and internal nature of the topic.

Transferability

The qualitative nature of this work indicates that generalizability is not an appropriate criterion against which to evaluate the work. However, in exploring external validity, it is possible to ask the question: is this research transferable? In analyzing the transferability of these findings, it is important to remember the specific context when working towards transferring to a new context. Table 3, which provides high-level details about the study context, as well as other material throughout the dissertation provide the information necessary for a reader to make judgments of transferability. From the detailed descriptions provided, it is imperative that readers analyze this information in relationship to their own specific context in order to determine transferability.

Table 3. Study context

Context	Study
Institution	Research intensive
Discipline	Engineering
Pedagogy	Preparedness portfolios in a portfolio studio
Participants	Engineering undergraduates

Study limitations

In general, it is important to recognize challenges associated with studying and measuring self-authorship (Baxter Magolda, Creamer, & Meszaros, 2010; Baxter Magolda & King, 2007; Pizzolato, 2007). Baxter Magolda and King (2007) attribute these challenges to the complexity of the construct, “[t]he complexity of this evolution requires a complex approach to assessment” (p. 494). In order to begin the study of self-authorship, scholars must recognize and understand the complex nature of development more generally and then more specifically in relation to the journey from socialization to self-authorship. Additionally, the study of self-authorship is challenging to observe because it is an internal process—a process researchers strive to make visible through either asking individuals about life experiences or observing behaviors.

According to Baxter Magolda and King (2007), this type of study is even more challenging because “[a]s King (1990) noted, assessment is complicated because individuals often use more than one meaning-making structure at a time, and prefer (recognize as better) statements using reasoning structures that are more complex than what they are able to produce independently” (p. 495). This discussion acknowledges concerns about the limitations of this study by focusing on three areas for potential limitations associated with the data collection instruments, process, and analysis: (1) measuring change; (2) self-reporting bias; and (3) describing self-authoring reasoning that misaligns with self-authoring action.

Measuring change

Since development is associated with a fundamental change in how one interacts with and makes meaning of the world, when studying development it is important to understand the role of change. Attending to change is particularly important when working to understand if and in what ways a pedagogy supports development, especially development towards self-authorship. And

yet, it is challenging to measure change, especially measuring change in an area of study that is an internal process. For example, within the context of this study, it is important to note that while data collection instruments target understanding the impact of the pedagogy, there are no explicit questions that address the change of one's development (i.e., students are not asked if their development changed as a result of their participation in the pedagogy).

In this research, it is only possible to acknowledge how students self-reported experiencing the portfolio activity and then to explore how such comments align with markers of a socialized or self-authoring mind. In order to remain true to students' descriptions, the methods are constructed to attend purposefully to how students described experiencing the portfolio. In order to probe at change, some of the survey and interview were worded in order to target change as a result of students' participation in the portfolio activity. For example, when targeting the relationship dimension, an initial question probed at the topic more generally and a follow-up question asked about change related to this topic as a result of the students' participation in the pedagogy:

1. *Initial question*: How do you deal with encounters with people who hold different views from yourself?
2. *Follow-up change question*: Do you think you handle these types of situations (encountering people with different views) differently since participating in the portfolio studio?

Self-reporting bias

While self-reporting is commonly used in social science research, there is the potential limitation of self-reporting bias. When students are asked to reflect on an experience and describe it, data

may be susceptible to various response biases. For example, students may exaggerate their answers, be too embarrassed to share the truth, or simply forget the details of the experience. Self-reporting biases are plausible because whenever someone is removed in time and space from an experience, they may think back on it and remember things differently.

One potential bias that is of particular interest in this study is students' desire to respond in socially desirable ways (M. F. King & Bruner, 2000). "Social desirability is the tendency of subjects to respond to test items in such a way as to present themselves in socially acceptable terms in order to gain the approval of others" (M. F. King & Bruner, 2000, p. 81). It is possible that students who participated in this study may respond in socially desirable ways for several reasons: (1) receiving compensation and (2) desiring experience to sound more positive in nature. As a result of participating in the study, students received compensation for their time and effort, which may have influenced how students responded when asked about their experience in the pedagogy. Furthermore, as they reflect on and then reported about their experience, they could have wanted their experience to sound more positive than it actually was in order to please the researchers. While it is possible that students may have responded in socially desirable ways, two aspects of this data collection process helped mitigate against this study limitation. First, participants were interviewed within a month of their participation in the pedagogy. Second, for students to respond in socially desirable ways, they must recognize those types of responses, which is quite unlikely.

Summary of the methodology and methods

The purpose of this chapter was to demonstrate the mechanism used to answer this study's empirical research question. This chapter provided descriptions of the methodology, participant

demographics, data collection techniques, and data analysis methods. First, this chapter described why the methodological approach of constructivist grounded theory (Charmaz, 2000) was chosen. Second, the participant demographics provided further information about these participants. The process of developing and implementing the survey and interview was described in order to explain data collection techniques. The data analysis process that guided this research was detailed as a means for the readers to understand the overall making-sense-of-the-data process. Finally, both areas of rigor and limitations were addressed. In concluding, coupled together these approaches provide a way to explore and answer the study's empirical question—if and in what ways did students report experiencing the construction of a preparedness portfolios in a portfolio studio as an opportunity to develop into self-authoring individuals?

Chapter 5: Empirical findings

This chapter explores and answers research question four—*If and in what ways did students report experiencing the construction of a preparedness portfolios in a portfolio studio as an opportunity to develop into self-authoring individuals?* In order to answer this research question, the following sub-questions provided guidance:

- A. How did students generally characterize their experience of constructing a preparedness portfolio in a portfolio studio?
- B. How did students report experiencing the pedagogy along the three developmental dimensions—identity, knowledge, and relationships?

These findings demonstrate a cross-sectional view of movement towards self-authorship. While many of these themes represent all six participants' experiences constructing a preparedness portfolio in a portfolio studio, it is important to remember that these participants only represent a small number of participants' (n = 6) experiences.

Based on students' self-reports about how they experienced constructing a preparedness portfolio in a portfolio studio, the findings suggest that the ways in which students characterized the pedagogy aligns with supporting their development toward self-authorship along all three dimensions of self-authorship. Against the backdrop of this general finding, it is important to recognize how each student's developmental journey is impacted by a different experience with each developmental dimension. In order to contextualize the findings within each student's background, it is necessary to understand the students individually and what they brought to the experience. This information, coupled with how students generally describe their experience in

the pedagogy, is provided in the form of narratives for each student. These narratives are presented in the next section.

Introducing the participants and their experiences

This section introduces context about each of the participants. Table 4 provides information about the types of experiences each of the participants chose to include in his or her portfolio. This information is part of the students' overall stories of how they reported experiencing the construction of a preparedness portfolio in a portfolio studio. Furthermore, it is important to remember the critical role of prior experiences in one's development towards self-authorship (Baxter Magolda, 2001; Kegan, 1994).

Table 4. Overview of students' experiences used as artifacts in the portfolio

	Faith	Ben	Eric	Anna	David	Carl
Coursework (individual)	0	1	3	0	1	1
Coursework (team project)	1	0	2	2	1	0
Engineering co-curricular	0	0	0	0	0	1
Other co-curricular	0	0	0	0	0	1
Research group	0	0	0	1	1	0
Academic Transcript	0	2*	0	0	0	0
Dean's List Letter	1	0	0	0	0	0
Internship	1	0	0	1	0	1
High school	1	0	0	0	2	0
Personal	1	2	0	1	0	1

*Ben included his transcripts from both his previous community college and current university.

The narratives presented below provide details about the individual students that can be used to understand the breadth of backgrounds they brought to their participation in the pedagogy. The narratives are presented in first person. The order of these students is purposeful and suggests subtle differences among these students, which will be more thoroughly addressed throughout the findings. Across the students, we can see the range of experiences these students chose to

include in their portfolio. As seen in Table 4, all students included at least one experience from coursework, either individual or team projects. Two students (Eric and Anna) included more than one experiences from coursework, and one student (Eric) only included coursework as evidence of his engineering preparedness. Students did not draw all engineering preparedness evidence from coursework; rather, they used a range of academic and personal experiences (see Table 4 and Appendix E: Students' Portfolio Artifacts). The use of a range of experiences suggests students' dedication to representing their lives more holistically.

Across the participants, they described the pedagogy as a positive experience. While there were times when they were frustrated, or grappled with deep personal issues, overall they reported seeing the value of both their participation in the pedagogy, as well as creating and having a portfolio.

Faith

Described the portfolio as an opportunity to tell her story

Faith reports liking that she now knows how to make a portfolio. One distinct thing between her characterization of the portfolio and other students' accounts is that she characterizes the portfolio as potentially giving her an edge over others in job interviews because it tells a more holistic story about her as a professional. She expresses a liking for her final product because it includes *all* her engineering evidence. Similar to other students, she reports initially struggling with what and how she could present content in the portfolio; through the process, and specifically the support of her peers, she describes overcoming this challenge. Overall, she explains how the structure of the portfolio studio afforded her a lot of interaction with her peers, which was a good opportunity to receive feedback from a variety of other people.

Ben

Learned to connect personal experiences to engineering preparedness

While all students talk about broadening their conception of what counts as engineering knowledge (result presented in the knowledge finding), Ben focuses on his new understanding of how to connect elements of his broad background, such as raising a family and construction work, to his claims about his engineering readiness. According to Ben, when he finally understood how these experiences demonstrate his engineering preparedness, it was challenging to identify artifacts. Since most of these experiences were in non-traditional settings, he describes a lack of documentation. While peer review was a major component of the portfolio studio, unlike other students, Ben characterizes his peer interaction as minimal—he liked to keep to himself. Like other students, he describes struggling with what type of feedback to provide because the situation was uncomfortable. As reported by Ben, while he is committed to giving constructive criticism, he does not like discussing such information in person, so instead he often wrote comments on the document.

Eric

Constructed a communication portfolio

Even though Eric initially set out to build an engineering portfolio (as encouraged by the facilitator), he reports that his final portfolio is more of a communication portfolio. It is also interesting to note, that four out of five of Eric's artifacts were communication-focused.

According to Eric, his reasons for building a communication rather than an engineering portfolio stem from his need for more technical experiences. Even though he has professional experiences (such as managing others), he focuses on a desire to only represent his engineering preparedness through experiences that demonstrate technical skills. He also attributes this shift in the focus of

the portfolio to his early stage in engineering preparedness—having just started engineering core courses. In his interview, he even characterizes how the portfolio would better support his engineering preparedness claims now since he has just finished some engineering coursework. Like some of the other students, he describes the portfolio process as a good opportunity to take the time and reflect on past experiences, which really helped him understand what he had learned in his courses. He characterizes his experience in peer review as generally positive; he reports that he likes that there is no competition between peers, as there usually is in traditional coursework—in the portfolio pedagogy, everyone actually wants everyone else to succeed. Overall, like the other students, when characterizing his experience constructing a preparedness portfolio in a portfolio studio, Eric uses positive language to articulate this experience.

Anna

Integrated a DIY project into her portfolio

According to Anna, the pedagogy is a good opportunity to practice making a portfolio before encountering a department requirement to build one. While she reports being generally pleased with her final product, she notes areas for future improvement, particularly in the visual presentation. When describing peer review, she says that her peers gave her good feedback, but, like Ben, she was not always confident in the feedback she gave others. Throughout constructing the preparedness portfolio, she reports beginning to understand how her diverse background has prepared her for engineering.

David

Derived engineering preparedness evidence from multiple high school experiences

When describing his chief take-away from the experience, David articulates that the portfolio provided him with a mechanism to connect his classroom learning with his engineering

preparedness. According to David, it is a “nice” change to actually have take-ways from his courses. As other students described, David says that he would have liked more editing of his work from his peers. With that being said, he describes being appreciative of peer review because often his closeness to the portfolio reduced his ability to improve it. He characterizes peer review as including more general high-level comments, and less specific editing of sentences. Like other students, he reports that giving feedback was an opportunity to see how others' approached the activity, as well as improve this skill.

Carl

Emphasized the importance of showing a holistic background

In alignment with the other students' general impressions of the pedagogy, the ways in which Carl describes his experience in the pedagogy are generally positive in nature. Carl reports appreciating the broadness of the life-wide portfolio because he thought it was important to emphasize a holistic background, especially since he did not have many technical experiences. He describes finding value in being able to make claims about other skills, such as professional abilities (i.e., leadership, communication, and teamwork). As an individual actively involved in a variety of activities, Carl reports that the broad nature of the portfolio provided him a space to connect all of his experiences to his engineering preparedness. Unlike many of his peers, Carl describes easily recognizing and connecting these experiences to his engineering preparedness. When Carl talks about peer review, he initially describes the interactions as negative because peers mostly provided positive feedback with little guidance on how to improve the portfolio. While he acknowledges that such positive feedback is flattering, he describes a desire for deeper, more "meaningful" feedback to help him improve the effectiveness of his portfolio. Like other

students, even when receiving feedback that was not always beneficial, he noted how giving feedback provided him with an opportunity to see how others approached the activity.

Summarizing the participants and their experiences

The students all reported the pedagogy as a positive experience. While all students characterized their participation in the pedagogy as positive, each student described resonating to different parts of the experience. Some students reported more about aspects of peer review, while other students focused on the types of experiences they included in their portfolio.

Unpacking self-authorship

To explore answers to research question three—if and in what ways did students report experiencing the construction of a preparedness portfolios in a portfolio studio as an opportunity to develop into self-authoring individuals—a deconstruction of the individual developmental dimensions provides more in depth information about students’ development. Through this information, we can begin to characterize the ways in which students described their portfolio experience along the spectrum of socialization to self-authorship. The findings in this section convey how the students collectively reported experiencing the portfolio activity, and helps make their process more visible.

Developmental dimensions

In exploring student development within the context of preparedness portfolios and portfolio studios, it is important to examine each of the developmental dimensions. The purpose of this in-depth observation is to understand better how each of these dimensions is supported through students’ construction of a preparedness portfolio. While the dimensions are highly interrelated,

such an exploration allows a more fine grain examination of each individual dimension, which provides a richer picture of the phenomena of study.

Self-authoring individuals view the world through a broader perspective, and are capable of stepping outside one's current view of the world along the dimensions of knowledge, identity, and relationships. Movement toward self-authorship along the *knowledge* dimensions implies a fundamental shift in how one perceives knowledge. This evolution is marked by a movement from viewing knowledge as dualistic to viewing knowledge as dependent on context, and a movement from relying on authority figures as the disseminator of knowledge to viewing self as capable of constructing knowledge. A self-authoring mind has an ability to grapple with *identity* work by engaging with internal complexities through self-reflection, which leads to an internal definition. Within *relationships*, a self-authoring mind can respect and understand others' perspective, engaging in mutually respectful relationships. Along these three dimensions—knowledge, identity, and relationships—Baxter Magolda characterizes one journey towards self-authorship as trusting the internal voice, building an internal foundation, and securing internal commitments. (Chapter 1 and 2 include more details about this conceptual framework.)

Knowledge

Along the knowledge dimension, scholars outline a fundamental shift in how one views and constructs knowledge (Baxter Magolda, 2001; Kegan, 1994). As individuals develop into a self-authoring mind, they recognize that knowledge cannot simply be described in dualistic terms, rather it is contextually based. Furthermore, as individuals develop into a self-authoring mind, they develop the capacity to see themselves as able to construct knowledge in contrast to the socialized perspective in which knowledge is based on an authority figure.

All students discussed at least one pedagogy experience that related to the knowledge dimension. These findings suggest that students engaged with two types of knowledge: (1) learning how to make a portfolio and (2) exploring what counts as engineering knowledge. In learning to make the portfolio, several students explained how they expected the portfolio studio facilitator to tell them how to make the portfolio. All students reported dealing with what counts as knowledge that demonstrates one's engineering preparedness.

Students reported learning how to make a portfolio. When reflecting on their experiences related to constructing a preparedness portfolio in a portfolio studio, some students commented on generally learning how to make a portfolio. For example, when describing her chief take-aways, Anna characterized the importance of learning how to make a portfolio—

Well, I guess I didn't really know how to put a portfolio together, I mean kind of had an idea of what a portfolio was, but I think the organization in terms of like having a personal statement and then having your artifacts and annotations kind of strengthen that, like I didn't think about that before, and just like having, I don't know, I guess the types to include in a portfolio.

Faith echoed this attitude when commenting about learning to make a portfolio, “It was really good to like learn how to make one, because that's not something I had ever done before.” Some students described the process of learning to make a portfolio through a yearning to understand the “right way” to create a portfolio. This mindset connects to a socialized mind because at this development individuals are committed to constructing knowledge in formulaic ways (i.e., follow instructions provided by an authority figure).

Some students reported initially anticipating clear directions from the facilitator about how to build a portfolio. This mindset aligns with a socialized approach to constructing knowledge based on information provided by an authoring figure. For example, David described a misalignment between his initial presumptions about the activity and the actual activity—“I expected a very detailed overview of our requirements and lots of long talks and lectures. There was more in-class review and discussion than I expected.” As Ben reflected on what he anticipated from his participation in the pedagogy, he portrayed connections between his expectations about the activity and cultural norms of how students should participate in traditional classrooms,

I expected to learn how to make a portfolio. The experience did teach me that, but how it did it was quite a bit different than how I thought it would. I expected it to be more like a lecture class where we would take notes during a lecture and make the portfolio as homework. The way it actually worked had a lot of peer review. I didn't expect as much writing so I didn't expect peer review.

After completing the portfolio, some students described being uncertain about the portfolio content. These students reported questioning if the portfolio said the “right things.” This way of thinking aligns with a socialized mind because when faced with ambiguity, socialized individuals will look to others for guidance. When evaluating which part(s) of her portfolio she liked the least, Faith says,

Um, I guess I like well, I guess I do, but it's hard to think about, because sometimes because like when I go back and look, I don't know if I like my

professional statement, because *I don't know if it's like saying the right thing*. I guess I can go back and edit that, but just maybe some of the writing isn't as good as I want it to be. (Italics added for emphasis.)

Students' reported exploring what counts as engineering knowledge. The ways in which a socialized mind views and constructs knowledge align with how students reported grappling with what counts as engineering knowledge. In arguing their engineering preparedness, all students reported focusing on representing their claims through evidence connected to technical experiences (e.g., internships and co-ops). For example, Eric expressed a desire to construct the portfolio later in his academic career, so that he would have more technical artifacts—

Um, I almost wish that I had done this project one year later, because then I'd have more *engineering artifacts*. Um, you know, like I said, when we started this project, I was three weeks into my first quarter in engineering, so it was more or less, um it was really hard for me to find anything that would suggest that I was a materials engineer yet. (Italics added for emphasis.)

In grappling with what counts as engineering knowledge, students often reported gravitating towards certain forms of engineering preparedness, such as internships and research assistantships. While students explained initially wanting to use technical experiences to demonstrate their engineering preparedness, they described starting to think about the importance of representing professional skills, such as leadership and communication. While students characterized an initial desire to emphasize technical skills, like Carl, most students reported easily finding experiences that supported claims related to professional skills—“I had difficulty finding really good technical artifacts, while leadership and personal artifacts were easy to find.”

The ways in which these students described grappling with what counts as engineering knowledge aligns with a socialized mind's perspective of a dualistic understanding of the world. This clear distinction between technical and professional artifacts represents a more dualistic view of what counts as engineering preparedness.

The ways in which some students described their experience suggests that participating in the pedagogy helped with broadening their conception of what counts as engineering knowledge. This broadening connects to a transition from a socialized to a self-authoring mind. A broader conception of what counts as engineering knowledge represents a self-authorship mind because self-authoring individuals can draw connections to different contexts. For example, when asked about her most important portfolio decisions, Anna reported including a specific artifact as engineering evidence—

My most important decision was to include the t-shirt design. I was unsure of how it would be received because it was totally not engineering related. I was going to scrap it and use another artifact. I received lots of good feedback from my peers and included the t-shirt design. I am so happy with the decision!

David even described how constructing the portfolio helped him in the process of connecting his experiences, such as courses, with his engineering preparedness—

It was kind of nice to see it come together. It was nice to have, um it gave me some takeaway from my classes. Um, I didn't quite know how to connect what I was doing to the outside world yet and what maybe I could use to showcase what I've done so far beyond just a resume, and that was kind of helpful. I'll probably

keep the portfolio and use it when the time arises. Um, I guess at this point mainly for me it was just nice to make the connections.

As he continued through the interview, this area was a prominent theme—

Um, it was in my classes so far it's been I haven't seen the application or the importance of what I've been doing necessarily, but it's kind of interesting to take an assignment that I did in a class and put it together, and it actually looks like I could show that to somebody, and they would they would have a sense for what I'm capable of, and it could apply very much to the real world...Um, just being... being able to connect my classes and my outside life and it gave me a...it helped give me a sense of direction, not in terms of where I'm going necessarily but where I've already come, and it helped to connect the dots.

Eric also described how constructing the portfolio helped him better understand his coursework,

Yeah, um, as far as in the past, you know, HCDE 231 and 333, you take them and then they're over and you don't really think about them anymore, but when you're looking for artifacts, you go back, and you're like, wow, you know, this it's good, you know, my sustainability project, my memos, all of those things that (Unintelligible) things like that, the things I did that were relevant. They were good, and they were really solid and empirical evidence that suggested that I can write.

In the passages above, students are expressing how their thoughts evolved as they progressed through the portfolio activities. In these passages, the ways they characterized their experience

represents a broadening of their conception of what counts as engineering knowledge. This progression suggests a shift in the ways in which they view engineering knowledge from a dualistic to a more contextual understanding.

When asked about his decision-making process for choosing artifacts, Ben depicted the process as initially easy because he did not have much to choose from—“I didn't actually eliminate any. I picked everything I could think of, which wasn't much. So I didn't have to decide.” Later in the interview, Ben reported that as he progressed through the pedagogy he was able to connect other experiences, such as construction work, to his engineering preparedness. Like other students, throughout the course of constructing a preparedness portfolio, he conveyed a continual struggle with thinking broadly about all of his experiences in relationship to his future in engineering.

Ben described the realization of having more engineering experiences—

Coming up with artifacts. It took me a long time to think around, like connect things, and I knew I had done stuff, but I didn't think it connected in any way to...to engineering in a way that like an employer might want to look at, so realizing that a lot of it could link up took a little bit of work.

He went on to describe this shift as positive, “I like the last artifact I found, my house remodel project. I realized that even though it wasn't an engineering project, working on a large project like that showed off some skills that are important for engineers to have.” He acknowledged how he now could recognize how remodeling a house provided evidence of his engineering preparedness—

So it ended up being a little over a yearlong project. We started in June of '06 and we finished, I think it was August of '07, so, um so, you know, when I was doing

it, I'm thinking I tear stuff apart, I put it back together, I get paid. *But now reflecting back on it, I see that was very much like an engineering project*, where you need to come up with timelines, and kinda connecting it to my 395 class, design process, where you where you have to come up with work flowcharts and things like that to make sure you meet deadlines and things get done, and then certain things can't be done until something else is done, so you...you know, you can't get the...can't get the insulation in there until the plumbing and the electrical is in there and things like that, so it was stuff I didn't have to think about too much on that project, because I had a more experienced partner. But...but I did learn a lot, and reflecting back on it I learned how much I learned and how similar it was, and then I'm applying things I'm learning now to how I could have done it better, more efficiently, and how I can use that experience in the future to...to plan projects that are going to be, you know, longer projects. (Italics added for emphasis.)

As students broadened their conception of what counts as engineering knowledge, they described being able to connect this knowledge to their engineering preparedness. Ben characterized this realization as, “It [portfolio] showed me that I have several accomplishments that are relevant to a career in engineering.” In broadening his conception of what counts as engineering preparedness, David described being surprised by how other life experiences connected to his engineering preparedness, “I didn't think I would have that many things to show at this point in time, um, it was it was surprising seeing it come together and have a final product that I can that, um, came together in just a couple weeks to showcase many different parts of my life...”

Summary of how students reported experiencing the pedagogy and the alignments with the knowledge dimension. In summary, students characterized their experience in the pedagogy as an opportunity to learn about how to make a portfolio and explore what counts as engineering knowledge. Some students described wanting to learn how to make a portfolio through guidelines provided by the studio facilitator. This initial mindset demonstrated students engaging with the socialized way of making sense of the world within the context of the knowledge dimension (i.e., student expected the authority figure to tell them how to construct the portfolio). Students reported initial ideas of representing their engineering preparedness through technical experiences, such as internships and co-ops. As students constructed their preparedness portfolio, they talked about connecting other experiences beyond engineering, such as DIY and construction projects, to their engineering preparedness. While the initial focus on technical experiences as engineering preparedness evidence represented a more unquestioning (e.g., “black and white” or dualistic) distinction of what counts as engineering knowledge, the shift to include other experiences connected to more of a contextual way of viewing what counts as engineering preparedness—a marker of a self-authoring mind along the knowledge dimension. It is worth noting that research suggests that development from socialization to self-authorship is cognitively challenging. The cognitive challenges associated with such a transition are evident in the language students use to characterize their experience (e.g., “I didn’t really know,” “it’s hard to think about,” “wish I had done,” “hard to me,” and “unsure”).

Identity

Scholars describe the journey toward self-authorship along the identity dimension as growth in one’s voice regarding values and beliefs (Baxter Magolda, 2001; Kegan, 1994). On the journey

from socialization to self-authorship, as individuals develop their internal compass, they depend less on external formulas for such things as their values and beliefs (see Chapter 2 for more details about this conceptual framework). A self-authoring mind is able to grapple with identity work by engaging with complex issues, which has the potential to result in the growth of one's internal voice. This growth has the potential to positively impact one's confidence because the individual feels validated.

Of the three developmental dimensions—knowledge, identity, and relationships—students reported most about identity. All students had multiple instances in which the ways they described experiencing the pedagogy aligned with the identity dimension. All students reported dealing with their professional identity. Several students described grappling with their professional identity alongside their personal identity. These findings suggest that how students characterized their experience developing a preparedness portfolio in a portfolio studio aligns with students' engagement with two types of identity work: (1) representing a professional identity and (2) exploring the role of personal identity within the context of professional identity. The ways in which students reported engaging with identity development aligns with markers of both socialized minds and self-authoring minds.

Students described grappling with ways to represent their professional identity. Students described the process of building a preparedness portfolio as contributing to their sense of pride in their past accomplishments and providing an opportunity to assess their engineering preparedness. It is important to note what preceded pride. Students did not acknowledge a lack of pride before their participation in the portfolio pedagogy, rather there was a lack of awareness

about their abilities (i.e., blind spot). All students described the portfolio as contributing to a growing sense of pride in their past accomplishments. Students characterized the process of looking back on their past experiences in light of their future goals as helping them realize the importance of their past accomplishments. For example, Carl described this sense of pride as developing from his accomplishments seeming more real, “I am also more proud of my accomplishments because they seem more tangible.” Another student, David, acknowledged how the process of building his preparedness portfolio contributed to his respect of past work,

Um, a couple of the artifacts I pulled off...I included a research paper I wrote about super conductivity for my chemistry class last year, and *it sort of it made me respect the work we did in class quite a bit more*. Just looking back on it and seeing what I accomplished was kinda cool. I didn't think much of it at the time.

(Italics added for emphasis.)

This transition maps to Baxter Magolda’s (2001) description of the process elements of journey from socialization to self-authorship—trusting the internal voice, building an internal foundation, and securing internal commitments. As students become proud of their past experiences, they can begin trusting their abilities as an emerging professional.

Some students reported how this growing sense of pride contributed to feelings of validation about their past experiences. Carl articulated this growing confidence when he said, “I was more confident that I could support claims about my abilities.” Faith specifically described how the process of writing about her experiences contributed to her self-esteem—“yes, I feel that writing about all of my experiences has helped me to be more confident that I have the skills to succeed in engineering.” Through this growing confidence in their abilities, there existed an opportunity

for development of their internal definition. Several students described how these feelings emerged from recognizing how non-traditional engineering experiences supported their claims as an aspiring engineer. When these students were able to support their claims, they described feeling more confident in their abilities as emerging engineers. This finding connects to the previous finding along the knowledge dimension about how students reported exploring what counts as engineering knowledge.

Some students described the pedagogy as an opportunity to assess their progress. According to the students, the pedagogy provided them with a time and space to assess where they have come and where they are going. Through this experiences, students described being able to recognize and articulate their personal growth. In connecting to self-authorship, the ability to assess one's progress is a marker of a self-authoring mind because it maps to ability to take something that once was subject and make it object. According to Kegan (1994), the ability to move something from subject to object represents the capacity to reflect on it, understand it, and have it rather than being had by it. In this case, students were able to take their engineering progress, which before participation in the pedagogy was subject, and shift it to object. Carl reported this assessment as, "it [portfolio construction] was a chance to assess my progress instead of blindly stumbling forward." Another student, David, described gaining a sense of direction, "it [portfolio construction] gave me a sense of who I am and where I am headed."

Eric described realizing how his artifacts represent a growth in his knowledge and ability—

While looking for artifacts, I found that my earlier coursework was indicative of an "elementary understanding" of basic academic principles. In contrast, my recent coursework demonstrates exceptional proficiency and comparison with my

"starting point" and really suggests tremendous academic improvement. From a retrospective standpoint my earlier coursework was just a "warm-up" for what I am currently doing in my courses. When retroactively looking through coursework from several years ago, an individual really begins to see their improvement on a personal scale.

How students reported experiencing the pedagogy as a support mechanism for them to make something that was once subject into object contributed to their ability to make meaning of their past experiences. The process of making subject into object can connect to students changing the ways in which they make meaning of their past experience. In these instances what was once subject are the experiences, which are now becoming object. This transformation aligns with the ways Kegan and Baxter Magolda describe the fundamental shift from a socialized mind to a self-authoring mind.

While thinking back on their experience related to constructing a preparedness portfolio and participating in the portfolio studio, some students reported that a significant benefit of building the portfolio was the opportunity to learn about one's self. For example, Eric described this process as an opportunity to trace his academic timeline—

It was a really introspective process, when I was trying to find artifacts, so I you know, I look at the essays and written reports that I had done during my earlier education, and kind of traced it through a timeline to figure out where I was now, and I guess as a person I never really saw myself learning. All these years in school I've just sort of, you know, done what the classes required and things like that, so to see the progression in a really linear fashion like that, to say this is

where I was four years ago, this is where I am now, *it really just helps kind of it was just surprising, you know, to see just how much progress you really make, I mean you don't notice it until you kind of look back and go wow.* (Italics added for emphasis.)

Again, this example aligns with students' growing ability to make their prior experiences into object.

Students reported trying to represent themselves professionally and personally. A few students reported grappling with ways to represent themselves in a more holistic manner. This approach connects to a self-authoring mind because at the self-authoring mind, according to Baxter Magolda (2008), individuals have gone through a process of trusting, building, and securing their internal identity. The last part of securing an internal identity represents a commitment to living such convictions through one's everyday actions, so a desire to connect one's professional and personal identity aligns with securing internal commitments. These students articulated trying to show both professional and personal attributes. In representing themselves holistically, these students reported struggling with portraying such things as character, values, and beliefs. For example, Carl even described how he was still unsure about a personal artifact,

I still have some concerns about the marriage artifact because it is so different than would be expected on a professional portfolio. However, it is one of the most important things to me and really speaks a lot about character when you think about it, so I'll keep it.

Carl went on to describe that what he liked the most about his portfolio was how it represented him holistically—

But also, I think just as far as picking, um, artifacts, and for the reasons picking them, just trying to make sure that there was a mix of artifacts from different areas of my life, so it wasn't all just schoolwork, you know, so it wasn't all just leadership activities that I was doing, it was kind of a mix that showed all these different areas of my life, but also like, you know, the technical side, where it was also just general this is me, and so I think that was an important thing for me, is just conveying myself to the reader.

Another student, David described the importance of an artifact that represented his values—

David: I think one of my first ones was the Eagle Scout project. That's just kind of a default, go to, throw it on any resume or talk about it in any situation, and so that was that was fairly much a no brainer, just *something that shows a certain amount of character* and something I definitely want to be able to showcase.

Interviewer: Because it's such a big project?

David: Uh, yeah, and just because not the project itself, but it represented a large amount of work and life commitments since the age of 12, so the more of a *character demonstrator* necessarily than the project itself, ideally. (Italics added for emphasis and to identify the dialogue between the student and interviewer.)

These students recognized the importance of representing themselves on multiple levels, not just as technical engineers. This perspective aligns with becoming a self-authoring individual and valuing self as a whole person. When describing the focus of his professional statement, Eric said, “but my thoughts during the production of the professional statement were I was trying to think about myself on a personal level.”

Summary of how students reported experiencing the pedagogy that aligns with the identity dimension. The findings suggest a connection between how students self-reported experiencing the portfolio and attributes of a self-authoring individual along the identity dimension. More specifically, the ways in which students characterized their experience constructing a preparedness portfolio in a portfolio studio align with students' engagement with two types of identity work: (1) representing a professional identity and (2) exploring the role of personal identity within the context of professional identity.

Relationships

As individuals move towards self-authorship they begin to interact with others differently; relationships become based on mutual respect. At the socialized mind individuals are easily influenced by others' perspective (i.e., take up others' beliefs and values without truly examining them in relationship to their own beliefs and values). As people move towards a self-authoring mind, they can understand others' perspective, while still holding firm to their values and beliefs. Therefore, self-authoring individuals can see where others are coming from, but still understand their own perspective within the context of relationships.

All students reported at least one thing about the relationship dimension. Primarily these comments dealt with their interactions in peer review—both the positive and negative aspects. While on the surface some of these comments may seem simply about peer review, there is evidence that the ways in which students described peer review represented an opportunity to think deeply about how to interact with others. These findings suggest that students engaged in two types of relationship development: (1) giving and receiving feedback within the context of peer review and (2) learning about interacting with others.

Students reported negative and positive aspects of peer review. Students generally characterized peer review as a positive opportunity to receive feedback from one another. Faith described the peer review as “helpful,” “so I mean it was helpful...to talk to everybody, because everyone had different opinions, so you got to see the different ways people see what you're writing.” Agreeing with Faith, Anna reported her experience receiving feedback as helpful, “It was very helpful hearing feedback on my work.” Some students described recognizing the positive nature of giving feedback. For example, David said, “Peer review was quite helpful...both giving and receiving feedback were helpful.” In describing her experiences with peer review, Faith said, “I gained a lot, *it helped me to practice giving good feedback* while gaining feedback that improves my work.” (Italics added for emphasis.) An open mind to the process of giving and receiving feedback begins to connect to self-authorship because self-authoring individuals can receive feedback from others, and process that feedback in light of their own beliefs and values. In peer review, self-authoring individuals can maintain their own position while still being able to learn from others feedback. A positive attitude towards such an activity represents openness to the possibilities of such an activity, which may catalyze the process of moving towards self-authorship. Without this openness, the positive impacts of these peer interactions are not even possible. There would be no opportunity to mutually construct meaning—a true marker of a self-authoring individual along the relationship dimension.

While students generally described peer review as a positive experience, students reported a desire for deeper feedback that was more informative about the content. For example, David described peer review as rarely beneficial because peers did not provide constructive criticism,

“people didn't edit my work as much as I would have liked.” Carl said “Most of the feedback was not good, because they simply pointed to parts that they liked. However, a few rare times I got very good feedback that sent my brain off on a train of new ideas.” A desire to actually be critiqued connects to markers of a self-authoring mind. This openness to critique demonstrates that the individual can see the benefits of receiving such feedback. While such feedback might challenge the ways in which the individual thinks about the writing, the individual knows that the constructive criticism will help strengthen the content. In his interview, Carl described facing this dilemma when he wanted deeper feedback, beyond “this looks good.” However, according to Carl, when another student finally provided him with such feedback, he struggled with how to actually use this feedback. At first he noted how personal the feedback felt, but once he was able to step outside his personal experiences—a marker of a self-authoring individual—he could see how the feedback could really help him strengthen the content,

Carl: But for it [peer review] to be more constructive, as far as like I like that you did this, that's actually meaningful versus it looks good.

Interviewer: Yeah.

Carl: It's just like, well, that doesn't help me on like what doesn't give me any improvements either. So that was typically what I got. But I'd say the one case that really stuck out was I think it was Ben, and so he was when he went through it, man, he tore my paper apart.

Interviewer: Really?

Carl: And at first I was like, oh, man, like *it almost felt like an affront to me at first, and then I was like, oh, this is actually really good stuff*, like, you know, he corrected some verb tenses that I was doing, 'cause I was trying to like talk about

concrete canoe like it was in the past, but it's happening now, and so that question kind of came up, and I was like, well, do I talk about it past tense or do I just be like this is what I'm doing right now. So I decided I'm just doing it now. But he was the one that originally brought up that concept to me. I was like, oh, yeah, I didn't even realize that I was fumbling with that quite a bit. You know, and he there were a number of other corrections that he made that was just like at first seemed a little bit harsh, but I was like this is really helping, and so I really appreciated that.

Interviewer: And so was it in the moment that you realized that it was really helping or after you kind of took a step back from it and took a breath?

Carl: Um, *I'd say it was just a fleeting moment where I was just almost like felt attacked a little bit, and then I was just like, oh, yeah, this is really good,* and I was like totally honed in on him, and was just trying to listen to what he was trying to say, so. . . (Italics added for emphasis and to identify the dialogue between the student and interviewer.)

Students described learning about interacting with others. How students characterized their interactions with others within the context of the pedagogy connect to an opportunity for students to learn how to engage in meaningful mutual relationships with others. While some students wanted more critical feedback, other students recognized the difficulties of providing such feedback. When describing the challenges associated with giving feedback, Eric said—

Um, it [peer review] was difficult for me in the sense that I tried to avoid being vindictive. I, you know, I had strong English abilities in elementary school,

middle school, high school, I was always identified as a gifted writer. And as a result, I kind of tend to always assume that I'm right. *So when you're peer editing someone's writing and they're commensurate in education level to you, it's very different in the sense that they're when you say this is wrong, it I don't know, it's harder to kind of say I'm right and you're wrong, because they might be right and I might be wrong.* I don't you know, there's no evidence to say, you know, I'm a Ph.D. so I'm right, you're wrong, period. It's there's no sort of pretentious attitude there. It's more like we're on equal terms, so I would more like be discussing an issue as opposed to just taking a red pen and saying, no, you know. So I feel like there was I didn't want to go mark people's stuff up, because it's always insulting when you get back something and it's just covered in red ink and you're like, oh, this sucks. Um, but at the same time, I wanted them to produce strong writing. So I tried to identify the major issues and focus on those, and then help them kind of you know, you might want to spell check in this area or you might want to restructure this paragraph or something like that. Um, so it was different in that way. I mean, I, um I used to be a tutor, so I read a lot of writing and edited it, and in that sense I was you know, I had an associate's degree already, and my word was more valued because I had credentials, whereas in this case, I mean the people in this studio were just as smart as I am, if not smarter. So it was really hard to say I'm right, you're wrong. And likewise the other way, you know, when people were insulting my writing saying this sucks, here, you need to change this, I was like, well, okay. And I thought about it and looked at it objectively, but at

the same time sometimes I was thinking, ah, I'm pretty sure that's right. (Italics added for emphasis.)

On the surface this quote simply represents how Eric reported experiencing peer review. However, this quote demonstrates Eric's deeper engagement with how to provide feedback based on his values and beliefs, while also considering others' values and beliefs, too. This quote represents how one student, Eric, described grappling with understanding others' perspective within the context of providing others feedback that will help them improve their writing, while also remaining true to his own viewpoint—a marker of a self-authoring individual along the relationship dimension.

While this behavior begins to exhibit markers of a self-authoring individual, Eric also described peer review in terms of the challenges associated with trying to step outside his own perspective and understand others' viewpoint. In struggling with similar challenges as Eric, Ben said

Giving feedback was hard for me because I don't like to tell people what they've done wrong, even though it's seen as positive criticism. And receiving feedback was sometimes a little hard because I had people tell me that what I did wasn't good enough. I know it wasn't meant that way but *I have a tenancy to take things personally.*

(Italics added for emphasis.)

While this quote demonstrates Ben's understanding of challenges associated with peer review, it is less evident how he is working through these challenges. Unlike when Eric described the importance of considering others' perspective as one strategy to overcome peer review challenges, Ben simply resonates to the challenges and does not offer ways

he is addressing these challenges. While it is promising that he can recognize these challenges (which begins to connect to self-authorship), his quote suggests an inability to step outside these challenges and think more broadly about them in respect to prospective solutions and thus suggests him as being subject to the challenges (which connects to socialization).

Furthermore, some students described the importance of their interactions with their peers, which provided the students with an opportunity to see how others' approached the activity. Anna described giving feedback as beneficial because

You can learn a lot about other people, just like about their experiences, which is cool, and also like *if you see how they structure or organize something in a certain way and you really like it, you can use it, too*. It can be helpful if you're like unsure about how to organize something. (Italics added for emphasis.)

How Anna described her experience with peer review aligns with how a self-authoring individual would approach such an activity. A self-authoring individual would be able to step outside the experience of peer review (not feeling judged by constructive criticism) and leverage the constructive criticism as an opportunity to improve the portfolio as a whole. Even in light of wanting deeper feedback, some students were able to step outside this mindset and value the opportunity to see how others' approached the activity, which is evident when Carl said

I guess it [peer review] was also helpful, even the people that maybe didn't respond so like give the best feedback to me, I was still able to read theirs and kinda get a feel for what they're doing, and occasionally be able to pick out like some cool ideas.

Agreeing with Carl, Anna went on to articulate the importance of giving feedback,

Um, well, I think gained, you can learn a lot about other people, just like about their experiences, which is cool, and also like if you see how they structure or organize something in a certain way and you really like it, you can use it, too. It can be helpful if you're like unsure about how to organize something. And then helpful for me was, uh, just, um let me think. Just hearing their feedback, and they notice different things than you do, so when I mean when you're close to something, you can think it says one thing, but to another person it doesn't say the same thing, so just having that pair of fresh eyes to look at it was extremely helpful, I think.

David also described how giving feedback provided him an opportunity to see how others' approached their portfolios. In addition, he recognized how this process contributed to his ability to edit others' work—

Oh, it's I learned I got some good ideas for what I wanted to show, not necessarily in specific but just how people threw things together, and it's always nice to have editing practice. It's a good skill to have.

Summary of how students reported experiencing the pedagogy that aligns with the relationship dimension. These findings suggest that students engaged in two types of relationship development: (1) giving and receiving feedback within the context of peer review and (2) learning from interacting with others. Students both positively and negatively described their experience giving and receiving feedback. These findings represent students' ability to leverage an activity even when parts of the activity produce less desirable outcomes. Through leveraging

peer review, students were able to see how others approached the portfolio, which provided further ideas about how to construct the portfolio. While on the surface some of these comments seem simply about peer review, there is evidence that the ways in which students described experiencing peer review represented an opportunity to think deeply about how to interact with others. The importance of these findings connect to how students began to engage with others in a way that connects to students understanding others' perspective, which is an important attribute of a self-authoring individual.

Socialization and self-authorship

The previous findings about how students' self-reports represent engagement with the developmental dimensions (i.e., knowledge, identity, and relationships) provide an opportunity to examine each students' talk in terms of socialization and self-authorship. The deconstruction of students' talk in relationship to the developmental dimensions begins the process of making the invisible aspects of development visible, thus providing an opportunity to connect to markers of socialization and self-authorship. Through this information, a more in-depth examination of each student's individual development is possible. The purpose of this deconstruction is to make students' progress and process towards self-authorship visible, rather than to judge students' individual movement toward self-authorship. Figure 4 represents how the ways these students described experiencing the pedagogy aligns with markers of socialization and/or self-authorship. The process of exploring students' individual development along this spectrum included (1) placing students at socialization, (2) exploring more explicitly indications of socialization, and (3) moving students towards self-authorship when markers indicated such movement (see Chapter 3 methods analysis for more details about the coding process of identifying markers of socialization and self-authorship).

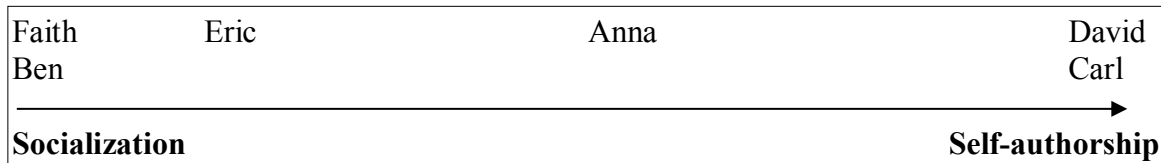


Figure 4. Representation of where students' individual development as drawn from the ways in which they described experiencing their participation in the pedagogy.

Exploring markers of socialization. The primary assumption that sets the stage for initial placement at socialization was grounded in literature that suggests college students are at the socialized mind (Baxter Magolda, 2001; Kegan, 1994). Scholars, such as Baxter Magolda (2001) and Kegan (1994), claim that life provides college students with formulas through which to make sense of the world. These formulas do not push college students to grapple with such things as their identity. Thus, unless individuals provided indication of markers of self-authorship in the ways in which they described experiencing the pedagogy, they were designated a socialized mind. While individuals may have been silent about their progression towards self-authorship, students' self-reports indicated markers of a socialized mind.

At the socialized mind along the knowledge dimension, students reported grappling with the dualistic nature of what counts as engineering experience and knowledge. In these instances, they described easily recognizing traditional and technical experiences as representing their engineering preparedness. Students described trying to understand the “right way” to construct the portfolio. This issue was quite salient for both Ben and Eric. As a returning student, Ben has many life experiences that could be connected to his engineering preparedness; however, throughout the course of developing his portfolio, he described struggling with how to connect these experiences to his engineering preparedness. On the other hand, Eric focused on communication experiences from technical communication coursework because he did not have

experiences that demonstrated his “technical aptitude.” Along the identity dimension, none of students talk aligns with a socialized mind. Within the relationship dimension, the ways in which students describe desiring more guidance from the facilitator indicates a more dependent type of relationship—a marker a socialized mind. Both Faith and Anna described leaning on the studio facilitator for guidance. Even after completing the portfolio, Faith described being unsure of the portfolio content; she still desired outside guidance.

Exploring markers of self-authorship. Self-authoring individuals hold a broader view of the world and an ability to step outside one’s current view of the world along the dimensions of knowledge, identity, and relationships. Movement toward self-authorship along the *knowledge* dimensions implies a fundamental shift in how one perceives knowledge. This evolution is marked by a movement from viewing knowledge as dualistic to viewing knowledge as dependent on context, and relying on authority figures as the disseminator of knowledge to viewing self as capable of constructing knowledge. A self-authoring mind has an ability to grapple with *identity* work by engaging with internal complexities through self-reflection, which can lead to an internal definition. This internal definition often results in improved confidence because the individual feels validated. Within *relationships*, a self-authoring mind can respect and understand others’ perspectives, engaging in mutually respectful relationships. Along these three dimensions—knowledge, identity, and relationships—Baxter Magolda characterizes one journey towards self-authorship as trusting the internal voice, building an internal foundation, and securing internal commitments.

Along the knowledge dimension, the ways in which students described broadening their conception of what counts as engineering knowledge aligns with markers of a self-authoring individual. The ways in which some students reported a change in their understanding of what counts as engineering knowledge from technical experiences to include non-technical experiences represents a shift from a socialized to a self-authoring understanding of what counts as engineering knowledge. For example, Carl emphasized the importance of representing a holistic background, which included a variety of personal experiences. All of the ways in which students described engaging with identity-related development align with markers of a self-authoring individual. For example, students described how the portfolio contributed to their sense of pride in past accomplishments, such as David describing connecting this growing pride to his feelings of validation as an emerging engineer. Furthermore, students' descriptions of wanting to represent themselves both personally and professionally demonstrate a securing of one's internal identity, which Baxter Magolda (2008) describes as the final element in one's process towards self-authorship.

Most of the ways in which students spoke about the relationship dimension align with characteristics of a self-authoring individual. For example, the ways in which students described peer review align with markers of self-authorship—optimistic about peer review; desiring deeper critique; understanding challenges associated with deeper critique; and seeing the benefits of giving feedback.

Summarizing unpacking self-authorship

All students reported at least one portfolio experience that connected to each of the developmental dimensions; many students had multiple comments for each of the dimensions.

Along the knowledge dimension students described grappling with what counts as engineering knowledge and desiring more structured guidance from the facilitator. Within the identity dimension, students self-reported a growing sense of pride of past accomplishments; assessing one's progress; valuing a holistic representation of self; and learning about self through constructing a portfolio. Along the relationship dimension, students commented about both the positive and negative aspects of peer review. For example, while students generally enjoyed the process of giving and receiving feedback, they desired more thoughtful comments about the overall content.

Summary of the empirical findings

This chapter focused on the empirical findings in order to explore and answer research question three—*If and in what ways did students report experiencing the construction of a preparedness portfolios in a portfolio studio as an opportunity to develop into self-authoring individuals?* In answering this question, the following sub-questions provided guidance for this chapter and provided structure for these findings:

- A. How did students generally characterize their experience of constructing a preparedness portfolio in a portfolio studio?
- B. How did students report experiencing the pedagogy along the three developmental dimensions—identity, knowledge, and relationships?

In linking to the developmental dimensions, many of the ways in which students characterized experiencing the pedagogy aligns with one or more of the developmental dimensions. The findings suggest that students talked about engaging in a variety of behaviors that indicate movement toward self-authorship. While the findings above do suggest movement towards self-

authorship, it is still quite challenging to make an assumption that these students changed, particularly because of their participation in the pedagogy.

Chapter 6: Discussion of the empirical findings

Students' descriptions of the pedagogy align with all three dimensions of self-authorship; the findings suggest that the pedagogy supports student development along all three dimensions. Along the *knowledge* dimension, students reported their experience in the pedagogy as an opportunity to (1) learn how to make a portfolio and (2) explore what counts as engineering knowledge. The ways in which students characterized their experience developing a preparedness portfolio in a portfolio studio align with students' engagement with two types of *identity* work: (1) representing a professional identity and (2) exploring the role of personal identity within the context of professional identity. These findings suggest that students reported engaging in two types of *relationship* development: (1) giving and receiving feedback within the context of peer review and (2) learning from interacting with others. When students' talk aligned with these dimensions, there is evidence of both socialization and self-authorship.

Do these findings really represent what happened? Given the empirical findings of the study, it is possible to revisit the potential limitations (discussed previously in Chapter 4) and highlight new relevant information. For example, one particularly interesting methods limitation to address is if and in what ways students responded in socially desirable ways. On the surface, students responding in socially desirable ways was plausible; however, the data suggests that students' self-reports were more authentic in nature. First, students' talk represented both positive and negative aspects of the pedagogy. Second, all student responses included a range of candid information, including triumphs and struggles. Furthermore, the range of positive and negative responses appeared throughout both data sets (i.e., survey and interview). While it is important to acknowledge the possibility that students may have responded in socially desirable ways, the

evidence suggests otherwise—students’ responses represent their authentic experiences in the pedagogy.

The purpose of the remainder of this chapter is to discuss the empirical findings of this research with an eye towards connecting it to prior and future research. The significance of the empirical findings is explored through summarizing each finding and acknowledging interesting aspects of the finding. In conclusion, future research questions are outlined as an opportunity to catalyze the next steps of this research.

Developmental dimensions

The findings of this research indicate that the way students described their experiences in constructing a preparedness portfolio aligned with the three dimensions of self-authorship (i.e., identity, knowledge, and relationships). While the nature of this research does not illuminate students’ development exactly (i.e., where they are and where they are going), it is promising to see the ways in which they characterized the experience along all three dimensions. This finding suggests that students’ characterizations of how they experienced the pedagogy relate to, and even in some cases catalyzed their engagement with aspects related to the crossroads of self-authorship. While each student’s developmental journey is marked by a different route based on their diverse experiences and backgrounds, these results are indicators that students’ talk about the pedagogy aligned with the developmental dimensions.

What is the significance of this finding concerning talk across all three dimensions of self-authorship? In connecting to engineering education, while endeavors in this community align with dimensions of self-authorship, and there is even a noteworthy amount of work in some

areas, none of this research represents work along the three dimensions of self-authorship. For example, there is evidence that the community addresses aspects of the relationship dimension through research related to teamwork (Ohland et al., 2005). The research presented in this dissertation lays the foundation for how the engineering community thinks about, addresses, and evaluates pedagogy along all three developmental dimensions. Once demonstrated, such a model may seem obvious; however, it is new to see this perspective alongside, and in parallel to current practice. This finding (i.e., students talk represented all three dimensions of self-authorship) captured a range of engagement with the developmental dimensions, which connects to higher education's dedication to recognizing and attending to students more as individuals. In particular these findings remind educators about the importance of recognizing and attending to students' current development. Furthermore, these findings connects to cognitive learning theory (Bransford, Brown, Cocking, Donovan, & Pellegrino, 2000), particularly what the community knows about *How People Learn* (Bransford et al., 2000), which draws attention to the importance of situating teaching and learning in students' experiences.

Knowledge

Along the knowledge dimension, students presented their experience in the pedagogy as an opportunity to (1) learn about how to make a portfolio and (2) explore what counts as engineering knowledge. Several students highlighted struggling with wanting to know the “right way” to construct their preparedness portfolio; these students initially provided details about looking to the studio facilitator for guidance. This initial mindset aligns with markers of a socialized mind (i.e., dependence on an authority figure for explicit instructions). While students reported initially desiring exact formulas for engaging with the activity, some students eventually moved past this mindset and were able to construct meaningful portfolios that represented their

preparedness as emerging engineering professionals. Additionally, students communicated grappling with what counts as engineering knowledge, often broadening their conception of what evidence supports their engineering preparedness claims. In arguing their engineering preparedness, students described first focusing on technical experiences, such as internships and co-ops. According to students, as they progressed through the process of constructing the preparedness portfolio, they began to understand how non-technical experiences, such as DIY projects, had prepared them for engineering. This growth in how one understands what counts as engineering knowledge demonstrates a fundamental shift from a more dualistic view of knowledge to a more contextual perspective, which is a marker of movement towards self-authorship along the knowledge dimension.

In considering the significance of this finding, it is (1) surprising that students did not connect some experiences (particularly non-technical) to their engineering preparedness and (2) interesting to think about supporting students' understanding of their engineering preparedness. Even though myriad experiences connect to attributes of a preparedness engineer, such as communication and leadership, students originally did not see these experiences as evidence of their engineering preparedness (i.e., unable to connect these experiences to claims of engineering preparedness). As a community, it is interesting to think about how we value other experiences. For example, does the community unintentionally devalue other experiences through verbal and non-verbal cues? In helping students think broadly about *all* of their life experiences, it is important to understand how action can have unintended consequences.

In both engineering education and higher education, knowledge development is highly studied because it is a main goal of teaching and learning (Felder & Brent, 2004a, 2004b; Miller et al., 1998; Pavelich, 1996; Pavelich & Moore, 1993, 1996). Fundamentally, this dissertation research connects to this discussion. This dissertation adds the perspective of positioning students at the center of grappling with different types of knowledge. In the research presented here, exploring opportunities to engage students in asking the question: what counts as engineering knowledge? This finding suggests the importance of connecting all types of knowledge to students' professional readiness.

Identity

The ways in which students characterized their experiences with constructing a preparedness portfolio in a portfolio studio suggest students' engagement with two types of identity work: (1) representing a professional identity and (2) exploring the role of personal identity within the context of professional identity. As students reflected on their past experiences in light of their future goals, they described experiencing the portfolio activity as an opportunity to engage in understanding their professional identity, asking challenging questions such as, who am I, what do I believe, and what (or who) are my beliefs based on? Through this process, students reported a growing sense of pride in their past accomplishments. According to students, the portfolio activity provided them with a designated time and space to assess their progress as emerging engineers. Throughout constructing their portfolio, some students described recognizing the value of representing themselves in a more holistic manner. This internal process, which was supported and challenged through activities like peer review, encouraged students to make values and beliefs that were once subject into object. Through making values and beliefs that

were once subject into object, students were able to make new meaning of these past experiences, which may have contributed to their development towards self-authorship.

It is interesting to explore the significance of the finding that suggests that students' grappled with how to represent their professional identities. First, it points to the importance of students' engagement with their professional identities, even as they are understanding how to be an engineering student. This finding reminds the community that even though students are learning the cultural norms of higher education, they are ultimately thinking about, and being prepared for professional practice. This finding connects to the importance of broadening the ways in which students are conceptualized (e.g., attending to students as more than just students). In thinking about this issue, the community should ask challenging questions, such as—how can educators help students think about their classroom learning in respect to their identity as an emerging engineering professional? One way to address this opportunity is to actually talk about topics such as identity. Through providing a safe environment to grapple with these issues, educators can help support students broaden their classroom learning to their outside lives, particularly along the lines of thinking about professional readiness.

Relationships

Along the relationship dimension, students primarily commented on their interactions in peer review. Most students reported both positive and negative aspects of peer review. Students reported enjoying receiving feedback from one another, but often wished the feedback was more informative about the content. Some students described struggling with giving feedback on such personal content. This research begins to explore what happens when students are asked to provide feedback on content that is quite personal in nature. This research suggests students can

grapple with how to give good feedback (i.e., what are their values and beliefs about the content and the process of giving feedback). This reflection was taking place alongside considering others' values and beliefs. At the surface, this result may simply appear as peer review; at a deeper level it represents students trying to grapple with mutually engaging in relationships—a marking of self-authoring individuals.

While self-authorship research acknowledges the importance of all three dimensions connected together, there is more of a focus on the identity and knowledge dimensions. For example, Baxter Magolda (2001) originally began her longitudinal study grounded in work on epistemology; therefore, her model is more detailed for the knowledge dimension. This research adds depth to the information about supporting individuals along the relationship dimension, while also acknowledging the role it plays within the larger context of the concept of self-authorship. This research suggests that one way to support students' development along the relationship dimension is to ask them to give and receive feedback about content that is quite personal in nature. As suggested in the findings, actively participating in this type of activity required students to think deeply about their own values and beliefs about how to conduct peer review as well as provide constructive criticism. These ideas were being thought about while also considering their peer's perspective. While on the surface these comments seem simply about peer review, it is evident that students began grappling with how to mutually engage in peer review in a fashion that was productive for all involved.

Summary of the discussion & future questions

This discussion highlighted the significance of the empirical findings. It is evident from students' self-reports that the pedagogy provided them with educational experiences that have the potential

to support their development towards self-authorship. This study contributes an optimistic perspective that college students have the potential to develop towards self-authorship. This perspective aligns with research that suggests that “educational experiences are most effective when they are tailored to students’ meaning making” (Baxter Magolda et al., 2007, p. 2). In understanding and evaluating this pedagogy, it is evident that other lenses could have been used (e.g., identity); however, self-authorship represents one way to broadly capture and appreciate the breadth and depth of students’ experiences constructing a preparedness portfolio in a portfolio studio.

Clearly, there are many more questions that could have asked and addressed in this study. Baxter Magolda (2008) draws attention to the importance of further researching self-authorship—

The potential of self-authorship to help adults meet the challenges of adult life effectively warrants a better understanding of the nature of self-authorship, how it evolves, and how it can be fostered among the diverse array of students who currently attend college.” (p. 270)

The research findings presented in this study provide a starting point for further research about student development towards self-authorship, especially in engineering education:

- *What would the results look like if a similar study was repeated with new data collection methods based on lessons learned from this study?* This question emphasizes lessons learned from this study as an opportunity to dig deeper into the phenomenon. For example, with the insights of this study, what different approaches could be used in the data collection and analysis?

- *What does engineering student development look like across the lifespan?* This question connects to Baxter Magolda's (2001) longitudinal study of college students through their lifespans and would provide comparison data points through a new context and participant demographics.
- *What would this study look like with different institutions and student demographics?* This question represents expanding the commitments of this study to include engineering students from other types of institutions (e.g., Olin College, small liberal arts, community college, and HBCUs), who have participated in other pedagogies (e.g., Purdue's EPICS), and a more diverse study population. Such an endeavor would add a larger sample, which may provide an opportunity to examine and compare/contrast students based on various characteristics (e.g., describe how URM students reported experiencing the pedagogy).
- *How does engineering students' development compare to what the community knows about student development about other student populations?* A research study addressing this question would further connect the findings of this research to the body of literature on student development. While this discussion begins this exploration, a more thorough study would add a level of depth.

Chapter 7: Implications for educational practice

The purpose of this chapter is to complete the research-to-practice loop by identifying educational practices that are motivated by the results of the research in this dissertation and have the potential to support student development towards self-authorship. This exploration answers research question four—*how does this work translate into implications for educational practice?* In other words, who should do what? While some scholars suggest that changes to educational practice should focus on the “whole undergraduate experience” (Hodge, Baxter Magolda, and Haynes, 2009, p. 18), this chapter focuses on more modest practices that could augment such larger efforts. This chapter first describes a systematic approach to crafting implications for educational practice. Then this method is used to articulate implications for two agents: educators and students.

Implications Analysis Method

Through empirical work, Turns, Paine, Sattler, and Muñoz (2012) attend to the importance of explicitly connecting research to practice. Turns et al. (2012) suggest purposefully constructing suggested actions based on empirical research. The research by Turns et al. (2012) guides the method used here:

1. Summarize findings
2. Select agents
3. Craft implications

Through this structure the study findings are linked to suggested implications for educational practice, which in turn answers research question four: *how does this work translate into implications for educational practice?*

Summarize findings

Turns et al. (2012) emphasize the importance of implications for educational practice being grounded in the findings; therefore, implications suggested here are provided in light of the research findings. Linking the implications to the findings explicitly connects the recommended action to empirical data (see Table 5 for a summary of the findings).

Select agents

Turns et al. (2012) demonstrate that research can offer implications for educational practice can implicate a variety of agents, such as “educators, faculty, instructors, we, practitioners, researchers and practitioners, students, engineering education, engineering programs, and institutions” (p. 4). While not all agents will be explicitly addressed, the implications presented here will provide a starting point for thinking broadly about how to connect this research to educational practice. In this chapter, two agents will be emphasized: educators and students. These agents represent different perspectives and roles in an educational setting.

Craft implications

In order to craft the implication, it is important to map findings to agents; present implications; and consider order of implications. To remain true to the data, implications are based on mapping findings to each agent. To systematically present implications, organization and sentence structure are important. A purposeful organization provides a prominent and consistent order (i.e., describe agent, present implications, provide application of the implication, and acknowledge challenges). In their work, Turns et al. (2012) draw attention to the importance of sentence structure and specific elements of the sentence—“*Because of **finding x**, **actor** with some degree of **certainty** should engage in **action***” (Turns et al., 2012, p. 2). In crafting implications it

is important to carefully consider the overall order because some implications may require sequencing.

Table 5. Suggested implications for each agent presented alongside the study research questions and findings.

Research Question	Finding	Educators could	Students could
In relation to educational activities, what <i>perspective</i> does the lens of self-authorship offer?	Self-authorship offers a perspective that is <ul style="list-style-type: none"> • Grounded substantially in theory • Explored and understood empirically • Presented holistic and multidimensional • Connected broadly to people’s lives • Linked to engineering and higher education 	<ul style="list-style-type: none"> • Use this pedagogy or pedagogy activities • Use this conceptual framework when planning and engaging in a pedagogy • Learn about development theories 	<ul style="list-style-type: none"> • Construct a portfolio • Connect experiences to future • Learn about developmental theories
In what ways could this pedagogy <i>connect</i> to supporting student development?	Pedagogy connects to surface and depth learning along all dimensions: <ul style="list-style-type: none"> • <i>Identity</i>: Presenting and internalizing self as an engineer • <i>Relationships</i>: Giving and receiving feedback on a portfolio and interacting with other engineers in terms of feedback • <i>Knowledge</i>: Making a portfolio and understanding what counts as engineering This pedagogy supports and challenges student development into trusting, building, and securing the internal voice through mechanisms such: <ul style="list-style-type: none"> • Scaffolding decisions about portfolio content • Providing a safe environment • Engaging students alongside one another and in self-evaluation 	<ul style="list-style-type: none"> • Learn about development theories 	
If and in what ways did students report <i>experiencing</i> the construction of a preparedness portfolios in a portfolio studio as an opportunity to develop into self-authoring individuals?	Students reported experiencing the pedagogy in: <ul style="list-style-type: none"> • Diversified ways • Aligned with three developmental dimensions: <ol style="list-style-type: none"> (1) <i>Knowledge</i>: learning to make a portfolio and exploring what counts as engineering knowledge (2) <i>Identity</i>: grappling with ways to represent professional identity and trying to represent themselves professionally and personally (3) <i>Relationships</i>: negative and positive aspects of peer review and learning to interact with others • Consistent with language about movement from socialization to self-authorship 		

Summary of implications analysis method

In summary, these methods are one mechanism for constructing implications for educational practice. In the following sections, implications are offered for two agents—educators and students—in a manner in which to provide clear suggested actions to specific agents, while also contextually why such action may be challenging:

1. Describe the agent
2. Overview all implications
3. Present explicit implication
 - a. Using the sentence structure suggested by Turns et al. (2012)—“*Because of finding x, actor with some degree of certainty should engage in action*” (p. 2)
 - b. Providing real-world examples of implications
 - c. Acknowledging reasons why the implications may be challenging

This structure is a tool for others as they draw implications from this research.

Implications for educational practice

The following discussion highlights implications for educational practice for both educators and students.

Educators

Educators are individuals directly and indirectly involved in teaching and learning; therefore, are an obvious group to be connected to implications for educational practice. Traditionally educators are those responsible for formal classroom engagement; however, more broadly the term includes individuals who support students throughout their academic journey. As universities have begun to recognize the importance of leveraging students’ non-academic

experiences, as well as supporting them in making meaning across experiences (Dewey, 1938), universities have initiated and implemented programs and positions to support these endeavors (e.g., Student Affairs). Student Affairs represent a range of people with a variety of responsibilities with a main mission of scaffolding student growth through co- and extra-curricular support systems. For example, academic advisors listen and offer advice to students in order to help them make sense of and navigate their experiences.

Based on this study, educators could use the preparedness portfolio and portfolio studio pedagogy or activities from this pedagogy; use this conceptual framework when evaluating, planning, and engaging in their own pedagogical activities; and learn about development theories. These implications were chosen because they are opportunities for educators to think critically about their practice in an effort to implement change.

Use this pedagogy or pedagogy activities. The study findings suggest that this pedagogy engages students in activities that have the potential to support and challenge students' development toward self-authorship; therefore, when working towards supporting self-authorship development in students, educators could use this pedagogy or activities from this pedagogy. The presentation of the components and elements of the pedagogy (see Chapter 3) makes it possible for educators to examine and evaluate if and in what ways this pedagogy or parts of this pedagogy translates to one's own practice.

Clearly the results of this study most directly point to the use of the pedagogy that was studied, and the results cannot be understood as generalizing to instances where only part of the

pedagogy is used. However, in cases where it is not possible for an educator to implement the entire pedagogy outlined here, activities from the pedagogy could still be tried. For example, if an educator is seeking the smallest activity from this research to implement into her classroom, she could invite students to complete a minute paper on how the activities in the class during a particular module have contributed to the students' preparedness for practice. Alternately, she could try checking-in with students using the feedback forms to understand how students are experiencing the class. In the context of the pedagogy, these forms ask the students to respond to a series of experience questions (i.e., surprises, frustrations, rewarding, and ah-ha) in relation to working on portfolio-related work outside of sessions, as well as participating in studio sessions. If the portfolio activity was not being used, then the educator could use this form and have students' respond to the questions in relation to their current class activities. Such modest exercises could encourage students to reflect on their experience participating in class related activities, while also providing the educator with valuable feedback regarding the students' experiences.

Use the self-authorship conceptual framework when evaluating, planning, and engaging in a pedagogy. Since self-authorship proved to be a promising conceptual framework for understanding the pedagogy presented in this study, educators could use it as a backdrop against which to evaluate, plan, and engage in their own pedagogical activities. The analysis presented in chapter three connects the pedagogy with suggestions for supporting and challenging student development towards self-authorship; educators could use this analysis method when thinking about their own pedagogy. While such an undertaking is associated with myriad challenges: (1)

personal, (2) support, and (3) “competing commitments” (Kegan, 1994), evaluating teaching practice can also provide opportunities for growth and improvement.

Learning about and applying developmental theories. Given the importance of attending to student development and how it connects to the main mission of higher education, educators could learn about development theories, such as self-authorship. The conceptual framework outlined in chapter two draws attention to the topic more generally, as well as how student development relates to engineering education. This framework is critical, especially when encouraging educators to add more complexity to an already full curriculum. To learn about developmental theories educators could read foundational texts, such as Kegan (1994) and Baxter Magolda (2001), attend student development focused conferences, or read this dissertation. An understanding of these theories could guide educators in contrasting these theories with the theories that underlie their practice. In principle, awareness about self-authorship may seem feasible; however, it may be challenging in practice. While in principle an educator’s role is to support and encourage student learning, in higher education, this responsibility is often muted in service of other responsibilities (e.g., research, service, and graduate mentoring).

In thinking more deeply about educating our future engineers, the community must reflect on the importance of supporting and challenging students’ development toward self-authorship. In exploring this topic the community could ask questions such as, what happens if students are not self-authoring when they face an ethical dilemma—how would they respond in such a situation? Without an internally defined value system, would the students be able to blow the whistle on injustice. These are serious issues that need consideration.

Summary and caveats. In summary, these implications for educators only begin the process of shedding light on the possible implications for educational practice. In order to align practice with supporting and challenging student development towards self-authorship, educators could learn about developmental theories, reflect on the goals of undergraduate education, and use this conceptual framework when evaluating, planning and engaging in a pedagogy. It is important for educators to reflect upon their current practices in order to understand better how to align it with supporting student development toward self-authorship. Furthermore, the implications offered here can be used by other agents, as well.

Students

In practice educators *should* support and challenge students' development toward self-authorship. But it is important to explore what students could do to help themselves take control of their education. These implications below involve challenging students to take a more active role in their development. Based on this study, students could construct a portfolio, connect experiences to their future, and learn about developmental theories. The opportunity exists for students to engage more actively in their learning; these implications provide one mechanism for students to take a more active role in owning their education.

Construct a portfolio. Students could make a portfolio throughout their academic career. As students progress through coursework and co-/extra-curricular activities, they could articulate how each experience prepares them for their future career. Constructing an entire portfolio requires personal dedication in the face of “competing commitments” (Kegan, 1994), such as required homework and exams.

Connect experiences to their future. While constructing and maintaining a complete portfolio may be particularly challenging, a more modest step is for students to make time for reflecting on their past experiences in light of future goals. To engage in this activity, students could maintain some documentation (in both picture and words) of all experiences. Recording such thoughts immediately after an experience will help the students have a more detailed account of the actual activity. While connecting experiences to future goals still requires dedication, time, and organization, this step might seem more manageable and thus worthwhile than creating an entire portfolio.

Learn about developmental theories in order to do a self-assessment. Given these findings, students could learn about development theories. For example, students could read foundational self-authorship texts, such as Kegan (1994) or Baxter Magolda (2001). Students could read this dissertation to learn about self-authorship and what it has to offer. In particular, the participant stories presented in Chapter 5 of this dissertation might be insightful for students. Knowing more about the concept can help students understand their daily lives and interactions with others. For example, through a self-assessment students can align their own development with the journey from socialization to self-authorship. While such an undertaking has many potential benefits, such a practice can be emotional.

Summary and caveats. In summary, these implications provide three action items for students on a personal journey toward self-authorship. While calling students to action based on research seems plausible, there are many challenges—social, academic, and personal. For example, for

traditional college students (i.e., those who enroll in college immediately from high school) college may be a time of social and personal change, it is also a time of continued socialization (e.g., socialization of what it means to be a “good” student). On the other hand, non-traditional students (i.e., returning students) often have a very specific academic agenda and time frame, which contributes to a focused mindset. Furthermore, maybe life has already challenged students to become a self-authoring individual, but they understand the importance of “playing the game,” so they revert to a socialized mind within the context of education. While these challenges are all legitimate, there is great risk in not moving towards self-authorship. As Kegan (1994) reminds us, when adults do not develop to engage in the world in new ways, we become “in over our heads.”

While such a practice seems reasonable, it may be challenging for socialized individuals to initiate these activities on their own, so perhaps tools could support these endeavors (i.e., how do students embark on engaging in self-authoring activities while still a socialized mind). Further, a deep rooted theoretical question exists—can a socialized mind even understand the concepts of self-authorship? Even if students are self-authoring, the norms of school do not encourage such behaviors, so students may use socialized behaviors in order to succeed in the classroom environment (i.e., classroom environments have specific norms to which students *must* conform in order to succeed). What is promising, however, is that the underlying task of the pedagogy being studied focused on something that students' wanted to understand—their preparedness for their future.

Summary of implications

While many suggestions could have been derived from this research, the implications for educational practice offered here are the result of a systematic process focused on the perspective of two agents—educators and students. Exploring each of these agents through the lens of the findings provided grounding for suggesting action with a strong connection to findings. While these suggested actions target specific agents, other agents could use these as an opportunity to connect the findings to other contexts. In conclusion, these implications challenge the community to think deeply about educational practice.

Chapter 8: Conclusion

This study was motivated by engineering education calls for change to a model of education in which educators attend to both students' professional and technical development (NAE, 2004; Sheppard et al., 2009). The engineering education community has responded to these calls through implementation of various pedagogies, such as problem-based learning. While the community has made progress, there exists an opportunity to better understand and evaluate the impact of such pedagogies. As discussed in chapter two, historically the community has assessed against the knowledge dimension of self-authorship, and more recently identity has been explored as a promising dimension. While it is evident that aspects of self-authorship are informing engineering education research and practice, there existed an opportunity to use a more holistic approach, such as the one offered by the multi-dimensional perspective of self-authorship.

The preparedness portfolio and portfolio studio pedagogy provided context to examine the use of self-authorship. In observations of students participating in the pedagogy (observations that preceded this study), it was noticed that the students were engaging with deep internal issues. But as these areas were explored, it became apparent that current theoretical perspectives, such as identity development, were not capturing students' whole experiences. In order to better understand students' experiences in the pedagogy, student development, specifically self-authorship, was explored in a pilot study that preceded this dissertation (Sattler, Turns, and Mobernd, 2011) and it seemed to be a quite promising way to situate how students were experiencing the pedagogy because it captured *all* of the students' experience, rather than just a

part. The emergence of self-authorship as a promising theoretical perspective through which to understand this pedagogy guided the study research questions:

1. In relation to educational activities, what perspective does the lens of self-authorship offer? (Chapter 2)
2. In what ways could the preparedness portfolio and portfolio studio pedagogy connect to supporting student development? (Chapter 3)
3. If and in what ways did students report experiencing the construction of a preparedness portfolio in a portfolio studio as an opportunity to develop into self-authoring individuals? (Chapters 4, 5, & 6)
4. How does this work translate into implications for educational practice? (Chapter 7)

In connecting to each of these research questions at a high-level, the contributions of this study are (1) introducing the perspective of self-authorship to a new discipline (i.e., engineering education) and exploring what perspective it offers; (2) connecting a pedagogy to suggestions for supporting and challenging student development; (3) demonstrating through empirical evidence the usefulness of self-authorship in evaluating pedagogies; and (4) applying the findings to implications for educational practice. To further explore these high-level contributions, the study findings and contributions are explored and presented against the backdrop of each research question.

In relation to educational activities, what perspective does the lens of self-authorship offer?

The findings presented in chapter two suggest that self-authorship offers a perspective that is grounded substantially theoretically; explored and understood empirically; presented as holistic

and multidimensional; connected broadly to people's lives; and linked to engineering and higher education. The conceptual framework presented in chapter two outlines self-authorship with a particular focus on exploring how this conceptual framework links to engineering education. This chapter details the underpinnings of the concept, as well as associated challenges. This approach recognizes why such change may be difficult (i.e., asking questions such as what is the community up against) and honors current practices. In connecting to engineering education, the chapter explores current research in engineering education that relates to self-authorship in order to demonstrate how parts of self-authorship are being addressed by the community. This foundational information coupled with the empirical findings of this study demonstrate one avenue through which educators and researchers can explore and assess educational programs and activities—using self-authorship as a lens.

In what ways could the preparedness portfolio and portfolio studio pedagogy connect to supporting student development? As the findings in chapter three demonstrate, the preparedness portfolio and portfolio studio pedagogy has the potential to connect to surface and depth learning along all three developmental dimensions: (1) knowledge: making a portfolio and being an engineer; (2) identity: presenting and internalizing self as an engineer; and (3) relationships: giving and receiving feedback on a portfolio and interacting with other engineers in terms of feedback. This pedagogy also has the potential to support and challenge student development through the processes of trusting, building, and securing the internal voice (Baxter Magolda, 2008) and through mechanisms such as scaffolding decisions about portfolio content; providing a safe environment; and engaging students alongside one another and in self-evaluation. This study extends the research (e.g., Baxter Magolda, 2004b; Meszaros, 2007; Pizzolato, 2003, 2004,

2005) about how to construct educational practice to support student development—the extension is to a new pedagogy (i.e., preparedness portfolios and portfolio studios) and a new discipline (i.e., engineering education). The purpose of chapter three was to present connections between the pedagogy—preparedness portfolio in a portfolio studio—and the potential to support and challenge student development toward self-authorship. In linking the pedagogy to suggestions for supporting and challenging self-authorship development, it was demonstrated why students may move toward self-authorship within the pedagogy. These connections laid the groundwork for the empirical portion of this dissertation (i.e., without these connections, why would we expect students to become self-authors within the context of this pedagogy). The first contribution of this chapter relates to demonstrating the components and elements of the pedagogy; if educators are interested in the pedagogy, this chapter presents detailed information about how to implement the pedagogy. Second, the chapter's systematic connection between the pedagogy and self-authorship demonstrates one way of understanding if a pedagogy has the potential to support student development.

If and in what ways did students report experiencing the construction of a preparedness portfolio in a portfolio studio as an opportunity to develop into self-authoring individuals? The empirical findings presented in chapter five demonstrate that students reported experiencing the pedagogy as: personal, aligned with the three developmental dimensions, and consistent with language about movement from socialization to self-authorship. Along the knowledge dimension, students reported learning how to make a portfolio and exploring what counts as engineering knowledge. Along the identity dimension, students described grappling with ways to represent their professional identity and trying to represent themselves professionally and personally. In the

relationship dimension, students reported experiencing both negative and positive aspects of peer review and learning to interact with others.

The empirical findings of this study suggest that these students experienced the construction of a preparedness portfolio in a portfolio studio as supporting and challenging their development toward self-authorship. A contribution of these findings is that pedagogies with similar elements and components as this one may support and challenge students' development towards self-authorship. Furthermore, the ways in which students' descriptions aligned with socialized and self-authoring talk reminds the community of the importance of attending to individually to students' development. As research suggests (Baxter Magolda et al., 2007), educational activities have the potential to contribute to and detract from students' development depending students' current development.

How does this work translate into implications for educational practice? As described in chapter seven, the findings of this research translate to a variety of implications for educational practice. For example, educators could use this pedagogy or pedagogy activities; use this conceptual framework when evaluating, planning, and engaging in a pedagogy; and learn about development theories, including the concept of self-authorship. Students could construct a portfolio; connect experiences to their future; and learn about developmental theories, including the concept of self-authorship.

The implications for educational practice presented in chapter seven provide a small sample of suggested actions that can be drawn from this research. The systematic methods for connecting

research to practice provides a way for readers in roles other than student or educator to draw implications from this research to their context. Furthermore, this method can be used in future research as a mechanisms to help close the research to practice gap, which is a currently a significant issue in engineering education.

Concluding study contributions. While these contributions are all generally applicable to the research community, they can be particularly significant to the two disciplines directly addressed in this study—engineering education and higher education. In relationship to this research study, these disciplines are important because higher education ascribes to the overall mission of supporting student development and as a component of higher education, engineering education should also attend to this mission.

Four main study contributions connect to engineering education: this study (1) introduced the concept of student development toward self-authorship to engineering education; (2) explored what it has to offer the community; (3) explored students' reports of the pedagogy through the lens of self-authorship; and (4) demonstrated to the community the importance of attending to student development. Furthermore, it is important to explore what this study has to offer higher education, specifically student development, because the higher education community is where self-authorship is most widely studied and applied. The work of this dissertation offers higher education a new discipline (i.e., engineering education) and context (i.e., preparedness portfolio and portfolio studios) in which the perspective of self-authorship is shown to be of relevance. This study demonstrates the broad applicability and usefulness of self-authorship as a perspective

to guide educational practice. In addition, this study contributes an optimistic perspective that college students have the potential to develop towards self-authorship during the college years.

This research draws attention to the fact that the community *must* recognize the potential impacts on the world when citizens are unprepared for the modern demands of life. For example, when unprepared for the modern demands of life, citizens will depend on others for direction, unable to deal with new situations, and unable to deal with ambiguity. If it is less clear why self-authorship is a critical characteristic, maybe we should imagine a world of only socialization. In such a world everyone would depend on one another for answers. Who would rise as leaders? Who would innovate? To move past a future defined only by socialization, education is one area of life in which we can support and challenge individuals' development towards self-authorship. The community *must* rise up to this challenge by asking difficult questions: how do we collectively and individually prepare students in such a way that they have the ability to engage with the world in more complex ways? This transformation would align with preparing students for the mental demands of life, so they are not “in over their heads” (Kegan, 1994). In higher education and engineering education, we have a commitment to attend to such issues.

References

- Abes, E. S., & Jones, S. R. (2004). Meaning-Making Capacity and the Dynamics of Lesbian College Students' Multiple Dimensions of Identity. *Journal of College Student Development, 45*(6), 612-632.
- Adams, R. S., Turns, J., & Atman, C. J. (2003). Educating Effective Engineering Designers: the Role of Reflective Practice. *Design Studies, 24*(3), 275-294.
- Atkins, S., & Murphy, K. (1993). Reflection: a review of the literature. *Journal of Advanced Nursing, 18*(8), 1188-1192.
- Atman, C. J., Sheppard, S. D., Turns, J., Adams, R. S., Fleming, L. N., Stevens, R., et al. (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. (2000). Teaching to Promote Holistic Learning and Development. *New Directions for Teaching and Learning, 82*, 88-98.
- Baxter Magolda, M. B. (2001). *Making Their Own Way Narratives for Transforming Higher Education to Promote Self-Development*. Sterling, VA: Stylus Publishing, LLC.
- Baxter Magolda, M. B. (2003). Identity and Learning: Student Affairs' Role in Transforming Higher Education. *Journal of College Student Development, 44*(2), 231-247.
- Baxter Magolda, M. B. (2004a). Evolution of a Constructivist Conceptualization of Epistemological Reflection. *Educational Psychologist, 39*(1), 31-42.
- Baxter Magolda, M. B. (2004b). Self-authorship as the common goal of 21st century education. In M. B. Baxter Magolda & P. M. King (Eds.), *Learning Partnerships: Theory and*

- models of practice to educate for self-authorship* (pp. 1-35). Sterling, VA: Stylus Publishing, LLC.
- Baxter Magolda, M. B. (2008). Three Elements of Self-Authorship. *Journal of College Student Development, 49*(4), 269-284.
- Baxter Magolda, M. B., & King, P. M. (Eds.). (2004). *Learning Partnerships: Theory and models of practice to educate for self-authorship*. Sterling, VA: Stylus Publishing, LLC.
- Baxter Magolda, M. B., King, P. M., Stephenson, E., Brown, M. K., Lindsay, N., Barber, J., & Barnhardt, C. (2007). Developmentally Effective Experiences for Promoting Self-Authorship. Presented at *American Educational Research Association National Meeting*. Chicago, IL: AERA.
- Baxter Magolda, M. B., & King, P. M. (2007). Interview Strategies for Assessing Self-Authorship: Constructing Conversations to Assess Meaning Making. *Journal of College Student Development, 48*(5), 491-508.
- Baxter Magolda, M. B., Creamer, E. G., & Meszaros, P. S. (Eds.). (2010). *Development and Assessment of Self-Authorship Exploring the Concept Across Cultures*. Sterling, VA: Stylus Publishing, LLC.
- Belenky, M. F., Clinchy, B. M., Goldberger, N. R., & Tarule, J. M. (1986). *Women's Ways of Knowing: The Development of Self, Voice, and Mind*. New York: BasicBooks, Inc.
- Bonis, S. A. (2009). Knowing in nursing: a concept analysis. *Journal of Advanced Nursing, 65*(6), 1328-1341.
- Boud, D., Keogh, R., & Walker, D. (Eds.). (1985). *Reflection: Turning Experience in Learning*. London: Kogan Page.

- Bransford, J. D., Brown, A. L., Cocking, R. R., Donovan, M. S., & Pellegrino, J. W. (Eds.). (2000). *How People Learn: Brain, Mind, Experience, and School: Expanded Edition*. Washington, D.C.: The National Academies Press.
- Case, J. M., & Light, G. (2011). Emerging Methodologies in Engineering Education Research. *Journal of Engineering Education*, 100(1), 186-210.
- Charmaz, K. (2000). Grounded Theory: Objectivist and Constructivist Methods. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of Qualitative Research* (2nd ed., pp. 509-536). London: Sage Publications, Inc.
- Creswell, J. (2008). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research* (3rd ed.). Upper Saddle River, NJ: Pearson Education, Inc.
- Denzin, N. K., & Lincoln, Y. S. (2005). Introduction: The Discipline and Practice of Qualitative Research. In N. K. Denzin & Y. S. Lincoln (Eds.), *The Sage Handbook of Qualitative Research* (3rd ed., pp. 1-43). Thousand Oaks, CA: Sage Publications, Inc.
- Du, X. (2006). Gendered practices of constructing an engineering identity in a problem-based learning environment. *European Journal of Engineering Education*, 31(1), 35-42.
- Dukhan, N., Schumack, M. R., & Daniels, J. J. (2008). Implementation of service-learning in engineering and its impact on students' attitudes and identity. *European Journal of Engineering Education*, 33(1), 21-31.
- Dym, C. L., Agogino, A. M., Eris, O., Frey, D. D., Leifer, L. J. (2005). Engineering Design Thinking, Teaching, and Learning. *Journal of Engineering Education*, 94(1), 103-120.
- Eliot, M., & Turns, J. (2011). Constructing Professional Portfolios: Sense-Making and Professional Identity Development for Engineering Undergraduates. *Journal of Engineering Education*, 100(4), 630-654.

- The Engineering Education Research Colloquies. (2006). *Journal of Engineering Education*, 95(4), 257-258.
- Felder, R. M., & Brent, R. (2004a). The Intellectual Development of Science and Engineering Students. Part 1: Models and Challenges. *Journal of Engineering Education*, 93(4), 269-277.
- Felder, R. M., & Brent, R. (2004b). The Intellectual Development of Science and Engineering Students. Part 2: Teaching to Promote Growth. *Journal of Engineering Education*, 93(4), 279-291.
- Fenwick, T. J. (2001). *Experiential learning: A theoretical critique from five perspectives*. Columbus: ERIC Clearinghouse on Adult, Career and Vocational Education.
- Fouger, X. (2008). The Twenty-First Century Grand Engineering Education Challenge. *Journal of Engineering Education*, 97(3), 241.
- Gabriele, G. A. (2005). Advancing Engineering Education in a Flattened World. *Journal of Engineering Education*, 94(3), 285-286.
- Geisler, C. (2004). *Analyzing Streams of Language: Twelve Steps to the Systematic Coding of Text, Talk, and Other Verbal Data*. New York: Pearson Education, Inc.
- Guba, E. G., & Lincoln, Y. S. (2005). Paradigmatic controversies, contradictions, and emerging influences. In N. K. Denzin & Y. S. Lincoln (Eds.), *The Sage Handbook of Qualitative Research* (3rd ed., pp. 191-215). Thousand Oaks, CA: Sage Publications, Inc.
- Harvey Mudd College. (2012). *Mudd Design Workshops*. Retrieved December 10, 2012, from <http://www.hmc.edu/academicclinicresearch/interdisciplinarycenters/cde1/workshops.html>

- Haynes, C. A. (2006). The Integrated Student Fostering Holistic Development to Advance Learning. *About Campus*, 10(6), 17-23.
- Hirt, J. B. (2009). Self-Authorship: Advancing Students' Intellectual Growth [Review of the book]. *The Review of Higher Education*, 32(2), 278-280.
- Hofer, B. K., & Pintrich, P. R. (Eds.). (2002). *Personal epistemology: The psychology of beliefs about knowledge and knowing*. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
- Jarvis, P. (2007). *Globalisation, Lifelong Learning and the Learning Society Sociological perspectives*. New York: Routledge.
- Johnson, D. W., Johnson, R. T., & Smith, K. A. (1991). *Cooperative Learning: Increasing College Faculty Instructional Productivity*. ASHE-ERIC Higher Education Report No. 4. Washington, D.C.: The George Washington University, Graduate School of Education and Human Development.
- Johnson, D. W., Johnson, R. T., & Smith, K. A. (2006). *Active learning: Cooperation in the College Classroom* (8th ed.). Edina, MN: Interaction Book Co.
- Jonassen, D., Strobel, J., & Lee, C. B. (2006). Everyday Problem Solving in Engineering: Lessons for Engineering Educators. *Journal of Engineering Education*, 95(2), 139-151.
- Keenan, T., & Evans, S. (2009). *An Introduction to Child Development* (2nd ed.). London: Sage Publications Ltd.
- Kegan, R. (1982). *The Evolving Self: Problem and Process in Human Development*. Cambridge: Harvard University Press.
- Kegan, R. (1994). *In Over Our Heads The Mental Demands of Modern Life*. Cambridge: Harvard University Press.

- Kegan, R. (2000). What "Form" Transform? A Constructive-Developmental Approach to Transformative Learning. In J. Mezirow (Ed.), *Learning as Transformation* (pp. 35-69). San Francisco: Jossey-Bass.
- Kilgore, D., Sattler, B., & Turns, J. (2011). Shaping the past, shaping the future, and shaping oneself in portfolio studios. Paper presented at *Research in Engineering Education Symposium*. Madrid, Spain: REES.
- Kilgore, D., Sattler, B., & Turns, J. (2012). From Fragmentation to Continuity: Engineering Students Making Sense of Experience Through Development of a Professional Portfolio. *Studies in Higher Education*. Retrived from <http://www.tandfonline.com/toc/cshe20/current>
- King, M. F., & Bruner, G. C. (2000). Social desirability bias: A neglected aspect of validity testing. *Psychology and Marketing*, 17(2), 79-103.
- King, P. M., & Baxter Magolda, M. B. (2005). A Development Model of Intercultural Maturity. *Journal of College Student Development*, 46(6), 571-592.
- King, P. M., & Kitchener, K. S. (2002). The reflective judgment model: Twenty years of research on epistemic cognition. In B. K. Hofer & P. R. Pintrich (Eds.), *Personal epistemology: The psychology of beliefs about knowledge and knowing* (pp. 37-61). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
- Knowles, M. S., Holton, E. F., & Swanson, R. A. (2011). *The Adult Learner: The Definitive Classic in Adult Education and Human Resource Development* (7th ed.). Burlington, MA: Elsevier Inc.

- Lohmann, J. R. (2005). Building a Community of Scholars: The Role of the *Journal of Engineering Education* as a Research Journal. *Journal of Engineering Education*, 94(1), 1-4.
- Lohmann, J. R. (2008). A Rising Global Discipline. *Journal of Engineering Education*, 97(3), 227-228.
- Lohmann, J. R. (2011). JEE and its Second Century. *Journal of Engineering Education*, 100(1), 1-5.
- MacGregor, J., Cooper, J. L., Smith, K. A., & Robinson, P. (Eds.). (2000). *Strategies for energizing large classes: From small groups to learning communities*. San Francisco: Jossey-Bass Inc.
- Mailhot, P. (2008). Rethinking Engineering Education. *Journal of Engineering Education*, 97(3), 243-244.
- Marra, R. M., Palmer, B., & Litzinger, T. A. (2000). The Effects of a First-Year Engineering Design Course on Student Intellectual Development as Measured by the Perry Scheme. *Journal of Engineering Education*, 89(1), 39-45.
- Matusovich, H. M., Streveler, R. A., & Miller, R. L. (2010). Why do students choose engineering: A qualitative, longitudinal investigation of students' motivational values. *Journal of Engineering Education*, 99(4), 289-303.
- McNair, L. D., Paretto, M. C., & Kakar, A. (2008). Case Study of Prior Knowledge: Expectations and Identity Constructions in Interdisciplinary, Cross-cultural Virtual Collaboration. *International Journal of Engineering Education*, 24(2), 386-399.
- Merriam, S. B., Caffarella, R. S., & Baumgartner, L. M. (2007). *Learning in adulthood: A comprehensive guide* (3rd ed.). Hoboken, NJ: John Wiley & Sons, Inc.

- Meszaros, P. (Ed.). (2007). *Self-Authorship: Advancing Students' Intellectual Growth*. San Francisco: Jossey-Bass.
- Meyers, K. L., Ohland, M. W., Pawley, A. L., & Christopherson, C. D. (2010). The Importance of Formative Experiences for Engineering Student Identity. *International Journal of Engineering Education*, 26(6), 1550-1560.
- Mezirow, J. (2000). *Learning as Transformational Critical Perspectives on a Theory in Progress*. San Francisco: Jossey-Bass.
- Miller, R. L., Olds, B. M., & Pavelich, M. J. (1998). Measuring Engineering Students' Intellectual Development Using Neural Network And Expert System Technology. In *Proceedings of the American Society for Engineering Education Conference*. Seattle, WA: ASEE.
- Moore, W. S. (2002). Understanding Learning in a Postmodern World: Reconsidering the Perry Scheme of Ethical and Intellectual Development. In B. K. Hofer & P. R. Pintrich (Eds.), *Personal epistemology: The psychology of beliefs about knowledge and knowing* (pp. 17-36). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
- National Academy of Engineering. (2004). *The Engineer of 2020: Visions of Engineering in the New Century*. Washington, D.C.: The National Academies Press.
- National Academy of Engineering. (2012). *NAE Grand Challenges for Engineering*. Retrieved December 10, 2012, from <http://www.engineeringchallenges.org/>
- National Research Council. (2009). *Rising Above the Gathering Storm Two Years Later: Accelerating Progress Toward a Brighter Economic Future*. Washington, D.C.: The National Academies Press.
- Non-Tenure-Track Faculty Report*. (2001). New York: Association of American Universities.

- Ohland, M. W., Layton, R. A., Loughry, M. L., & Yuhasz, A. G. (2005). Effects of Behavioral Anchors on Peer Evaluation Reliability. *Journal of Engineering Education*, 94(3), 319-326.
- Pavelich, M. J. (1996). Helping Students Develop Higher-Level Thinking: Use of the Perry Model. In *Proceedings of the Frontiers in Education Conference*. Salt Lake City, UT: IEEE.
- Pavelich, M. J., & Moore, W. S. (1993). Measuring Maturing Rates of Engineering Students Using the Perry Model. In *Proceedings of the Frontiers in Education Conference*. Washington, D.C.: IEEE.
- Pavelich, M. J., & Moore, W. S. (1996). Measuring the Effect of Experiential Education Using the Perry Model. *Journal of Engineering Education*, 85(4), 287-292.
- Perry, W. G., Jr. (1970). *Forms of Intellectual and Ethical Development in the College Years: A Scheme*. New York: Holt, Rinehart, and Winston, Inc.
- Pizzolato, J. E. (2003). Developing Self-Authorship: Exploring the Experiences of High-Risk College Students. *Journal of College Student Development*, 44(6), 797-812.
- Pizzolato, J. E. (2004). Coping With Conflict: Self-Authorship, Coping, and Adaptation to College in First-Year, High-Risk Students. *Journal of College Student Development*, 45(4), 425-442.
- Pizzolato, J. E. (2005). Creating Crossroads for Self-Authorship: Investigating the Provocative Moment. *Journal of College Student Development*, 46(6), 624-641.
- Pizzolato, J. E. (2007). Assessing Self-Authorship. In P. S. Meszaros (Ed.), *Self-Authorship: Advancing Students' Intellectual Growth* (Vol. 109, pp. 13). San Francisco: Wiley Periodicals, Inc.

- Prince, M. (2004). Does Active Learning Work? A Review of the Research. *Journal of Engineering Education*, 93(3), 223-231.
- Prince, M. J. & Felder, R. M. (2006). Inductive Teaching and Learning Methods: Definitions, Comparisons, and Research Bases. *Journal of Engineering Education*, 95(2), 123-138.
- The Research Agenda for the New Discipline of Engineering Education. (2006). *Journal of Engineering Education*, 95(4), 259-261.
- Sattler, B., Thompson, A. A., Turns, J. A., & Kilgore, D. (2011). The Dialectics of Goal Setting and Monitoring: Two Students' Experiences with Portfolio Construction. In *Proceedings of the American Society for Engineering Education Conference*. Vancouver, B.C.: ASEE.
- Sattler, B., Turns, J., & Kilgore, D. (2010). "I Have Never Spent Time to Think About What I Have Gained From My Projects": Linking Portfolio Development and Life-Long Learning. In *Proceedings of the Frontiers in Education Conference* (pp. 1-6). Washington, D.C.: IEEE.
- Sattler, B., Turns, J., & Mobrand, K. (2012). Supporting Self-Authorship Development: The Contribution of Preparedness Portfolios. In *Proceedings of the American Society for Engineering Education Conference*. San Antonio, TX: ASEE.
- Schommer-Aikins, M. (2002). An Evolving Theoretical Framework for an Epistemological Belief System. In B. K. Hofer & P. R. Pintrich (Eds.), *Personal epistemology: The psychology of beliefs about knowledge and knowing* (pp. 103-118). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
- Sheppard, S. D., Macatangay, K., Colby, A., & Sullivan, W. S. (2009). *Educating Engineers: Designing for the Future of the Field*. San Francisco: Jossey-Bass.

- Sheppard, S. D., Pellegrino, J. W., & Olds, B. W. (2008). On Becoming a 21st Century Engineer. *Journal of Engineering Education*, 97(3), 231-234.
- Smith, K. A., & Imbrie, P. K. (2005). *Teamwork and project management*. Boston: McGraw-Hill BEST-Basic Engineering Series and Tools.
- Smith, K. A., Sheppard, S. D., Johnson, D. W., & Johnson, R. T. (2005). Pedagogies of Engagement: Classroom-Based Practices. *Journal of Engineering Education*, 94(1), 87-101.
- Stein, D. S., Wanstreet, C., & Trinko, L. A. (2011). From Consideration to Commitment: Factors in Adults' Decisions to Enroll in a Higher Education Degree Program. *Journal of Continuing Higher Education*, 59(5), 68-76.
- Stevens, R., O'Connor, K., Garrison, L., Jocuns, A., & Amos, D. M. (2008). Becoming an Engineer: Toward a Three Dimensional View of Engineering Learning. *Journal of Engineering Education*, 97(3), 355-368.
- The Royal Academy of Engineering. (2006). *Educating Engineers for the 21st Century*. London: The Royal Academy of Engineering.
- Thompson, A., Sattler, B., & Turns, J. (2011). Understanding a Studio Environment: A Complex System Approach to a Community of Practice. In *Proceedings of the Frontiers in Education Conference* (pp. 1-6). Rapid City, SD: IEEE.
- Tinberg, H., & Weisberger, R. (1998). In over Our Heads: Applying Kegan's Theory of Development to Community College Students. *Community College Review*, 26(2), 43-56.
- Tonso, K. L. (2006a). Student Engineers and Engineering Identity: Campus Engineer Identities as Figured World. *Cultural Studies in Science Education*, 1(2), 273-307.

- Tonso, K. L. (2006b). Teams that Work: Campus Culture, Engineer Identity, and Social Interactions. *Journal of Engineering Education*, 95(1), 25-37.
- Torres, V. (2003). Influences on Ethnic Identity Development of Latino College Students in the First Two Years of College. *Journal of College Student Development*, 44(4), 532-547.
- Torres, V., & Baxter Magolda, M. B. (2004). Reconstructing Latino Identity: The Influence of Cognitive Development on the Ethnic Identity Process of Latino Students. *Journal of College Student Development*, 45(3), 333-347.
- Turns, J., Sattler, B., & Kilgore, D. (2010). Disciplinary Knowledge, Identity, and Navigation: The Contributions of Portfolio Construction. In Gomez, K., Lyons, L., & Radinsky, J. (Eds.) *Learning in the Disciplines: Proceedings of the 9th International Conference of the Learning Sciences* (pp. 818-825). Chicago, IL: International Society of the Learning Sciences.
- Turns, J., Paine, D., Sattler, B., & Muñoz, D. (2012). What are the Implications for Teaching? An Analysis of How Educational Implications are Represented in Engineering Education. In *Proceedings of the Frontiers in Education Conference* (pp. 1-6). Seattle, WA: IEEE.
- Turns, J., & Sattler, B. (2012). When Students Choose Competencies: Insights from the Competency-specific Engineering Portfolio Studio. In *Proceedings of the Frontiers in Education Conference* (pp. 1-6). Seattle, WA: IEEE.
- Turns, J., Sattler, B., Eliot, M., Kilgore, D., & Mobernd, K. (2012). Preparedness Portfolios and Portfolio Studios. *International Journal of ePortfolio*, 2(1), 1-13.
- van Woerkom, M. (2010). Critical reflection as a rationalistic ideal. *Adult Education Quarterly*, 60(4), 339-356.

Vest, C. (2008). Context and Challenge for Twenty-First Century Engineering Education.

Journal of Engineering Education, 97(3), 235-236.

Wilson, D. M., Bell, P., Jones, D., & Hansen, L. (2010). A Cross-Sectional Study of Belonging

in Engineering Communities. *International Journal of Engineering Education*, 26(3),

687-698.

Appendix A: Facilitator Guide

Portfolio Studio Facilitator Guide

Authors:

Jennifer Turns, Brook Sattler, Matt Eliot, Deborah Kilgore, Ken Yasahura,
Kathleen Gygi, Kate Mobernd, and Cindy Atman

©Center for Engineering Learning and Teaching, University of Washington

To cite this report use:

Title

Names, *Title*, Center for Engineering Learning and Teaching, University of Washington, Seattle,
2001.

Keywords: Preparedness portfolio, portfolio studio, facilitator guide

Overview of the Studio

The portfolio studio has two main goals:

- (1) help participants develop a professional portfolio, and
- (2) help participants leverage the portfolio development effort as an opportunity to substantially engage in learning.

While the second goal may be of greater interest to educators and educational researchers, the first goal is the initial attraction for the students. As a result, it is important to recognize their mutually constituting, dialectic relationship.

Portfolio as Boundary Negotiating Artifact / Boundary Object: The studio and the advice associated with the studio are oriented toward a specific type of portfolio defined by the following key features:

- A portfolio that contains a professional statement and multiple annotated artifacts
- A portfolio in which the content is controlled extensively by the student

The “studio” is essentially the set of activities that are used to scaffold students through the development of their portfolio. Moreover, the activities involve making the thinking associated with the construction of the portfolio visible, so that other significant educational activities can result (e.g., identity construction, knowledge integration, development of meta-cognitive awareness of one’s own knowledge at a very strategic level). The work of the studio includes individual “assignments” as well as various events during group sessions.

In the studio represented in these materials, the activities are distributed across five sessions. Each session involves the following types of activity:

- Feedback: Time for participants to reflect on surprises, challenges, frustrations and aha moments associated with their preparation for the current session.
- Looking back: A recap of what has been done so far; Highlights of their feedback from the previous session.
- Leveraging their work: One to three activities building on the assignment they completed before attending the current session
- Looking ahead: A reminder of what they have to do for the upcoming session and then a warm-up activity to get them prepared for the assignment
- Feedback: Time for participants to reflect on surprises, challenges, frustrations and aha moments associated with their preparation for the current session.

The activities and their sequencing take into account educational principles such as:

- Address cognitive issues – what are we supposed to do, how do I do it, addressing their misconceptions, giving them ideas
- Address motivational issues – help them get excited, help them see themselves as someone who can do this (self-efficacy)
- Promote the group as a self-organizing system and support emergent knowledge

Introduction to this guide

In developing the guide, the emphasis has been on (a) providing enough information to empower but not overwhelm a facilitator and (b) clearly delineating where the facilitator needs to and also has the opportunity to customize the activities.

In service of the first goal, the sessions are described in 2 pages or less. The following structure is used to describe the activities:

- Objectives: “By the end of the activity, participants should be able to…” Each activity is associated with a statement concerning the direction for the activity.
- Suggested Procedure: A suggested procedure is offered and is described at a high level.
- Rationale: Rationale for the activity is included in order to help the facilitator make sense of the suggestion.
- Adaptations: Possible adaptations are mentioned.

Also, this document is organized chronologically – providing information about the sessions and assignments as they are experienced over time. In the case of repeated activities (i.e., activities that take place weekly), the description appears in the session associated with the first instance of the activity.

Session 1

In this session, participants learn about the type of portfolio they will be making, issues associated with making this type of portfolio and the first step in making the portfolio. In the session, participants learn from the facilitator but also through conversations with each other.

Getting situated—Portfolio overview

- Objective: By the end of the activity, participants will have an initial sense of what type of portfolio they will be asked to create and how they will go about creating this portfolio over time.
- Suggested procedure: Walk through the slides.
- Rationale: The overview provides some basic ideas—ideas that set the stage for the initial conversation that follows.
- Adaptation: During the presentation of the slides, the facilitator could interact with students such as by asking students whether they have created portfolios in the past.

Getting situated—Initial conversation

- Objective: In this activity, students are invited to talk about the usefulness of having a portfolio, the usefulness of creating a portfolio, their concerns about creating a portfolio, and their thoughts on why educators do not typically ask students to create portfolios. By the end of the activity, participants will have a stronger sense of what the portfolio workshops will be about.
- Suggested procedure: Introduce the four topics for the conversation. Using a think-pair-share structure, provide students with some individual time to record thoughts for each topic, then time to discuss with one to two other students, and then finally elicit responses from students. Record the responses directly onto the slides that can be provided—this permits students to see the ideas that are offered. Also, the revised slides can subsequently be shared with the students so that students can revisit the ideas generated during this first session.
- Rationale: Addressing these issues up front can increase student motivation—by helping them see the ways that having *and* creating the portfolio will be useful, because their concerns are already out in the open being addressed, and because they are invited to recognize that their activity is not a traditional activity. Also, by having the ideas come from the students themselves, this can also contribute to their motivation. Finally, the activity is intended to help students create a productive mindset toward the activity.
- Adaptation: The students could write their ideas for each question on post-it notes, which could subsequently be aggregated and organized by either the facilitator or groups of students themselves.

Portfolio work—Portfolio orientation

- Objective: By the end of the activity, participants will be able to identify the elements of the portfolios that they will make, identify possible content for each element, and recognize work on the portfolio will involve the dual challenges of imagination and selection.
- Suggested procedure: Review the slides introducing the key issues. Then, using the think-pair-share technique, work with the students to generate potential claims for the professional statement and experiences/artifacts for the rest of the portfolio. Record the

students ideas directly onto the slide in order to help students track what is going on and also to provide documentation for later.

- Rationale: Because the key ideas of making claims and finding evidence/artifacts are assumed to be new and possibly challenging to the students, this activity helps students get a running start.
- Adaptation: The brainstorming could be done using post-it notes.

Looking ahead—Professional statements

- Objective: By the end of the activity, participants will know what they need to do in order to prepare for the next session.
- Suggested procedure: Review the slide “Preparing for session 2.” Discuss the technology options available to students for creating their portfolio (e.g., Google sites). Distribute the handout “Preparing a professional statement.” Ensure that students understand that the next session will involve peer review of their draft statements.
- Rationale: Students should be challenged with the activities themselves, not with figuring out what activities they are supposed to do.
- Adaptation: If needed, the facilitator can include a tutorial on tools that students can use to create their e-Portfolio.

Session 2

In this session, participants engage in peer review of the draft professional statements and then start thinking about artifacts and annotations.

Getting situated—Revisiting prior activity

- Objective: By the end of the activity, participants will remember what happened in previous sections, and be better prepared to contribute effectively in the current session.
- Suggested procedure: Show 5-7 slides from previous slide decks to highlight prior activities, prior ideas generated by students, etc.
- Rationale: Since the sessions are two weeks apart, it is quite likely that participants will not be able to exactly remember what happened during prior sessions. Presenting actual slides from previous presentations provides students with the opportunity to not only be refreshed mentally on what transpired, but to also possibly use “visual” memory to reactivate memories of the prior session.
- Adaptation: Participants could be asked what they remember.

Getting situated—Their feedback

- Objective: By the end of the activity, participants will be able to describe how their experiences of the program fit with others experiences of the program and also how the students’ ongoing experiences are influencing the direction of the program activities.
- Suggested procedure: Present one or more slides capturing the feedback that participants provided during the previous session. Indicate how this feedback is influencing the current activities.
- Rationale: Letting participants see how their experiences align with other participant’s experiences can serve to calibrate them. Being heard/included can contribute to activation of intrinsic motivation.
- Adaptation: The facilitator could include slides that address particular aspects of the feedback. For example, if students comment about the vague quality of the guidance involved in the program, the facilitator could share comments about why the level of guidance is the way it is (e.g., liberating constraints).

Portfolio Work—Taking stock of the writing experience

- Objective: In this activity, students are invited to share thoughts concerning the experience of writing the professional statement, the state of their professional statement, a strength of their professional statement, and where they would like help. By the end of the activity, participants will have a sense of how their experiences/ideas fit with those of the group.
- Suggested procedure: Invite participants to record, on separate post-it notes, a word/phrase for each of the 4 prompts. Then, create four groups of students and have each group organize/find themes within a collection of the notes. Finally, each group has a chance to share what they have found and the facilitator provides additional observations concerning the results. Of particular significance, the facilitator should strive to validate the results shared by all students. “Taking stock and additional information” provides additional ideas concerning this exercise.

- Rationale: The exercise is intended to diffuse issues that could, if unchecked, create challenges during the peer of the professional statements. For example, the exercise helps students to realize that most participants consider their statements to be “rough,” “unfinished,” and/or “drafts.” Thus, participants can go into the peer review with a constructive attitude.
- Adaptation: This exercise could be done without the post-it notes.

Portfolio Work—Peer review of professional statements

- Objective: By the end of the activity, participants will have ideas about the strengths of their current professional statement drafts, and ideas for improving their professional statements
- Suggested procedure: Review the ground rules for peer reviewing. Then have students work in pairs where they exchange, read, and then discuss their statements. Upon completion of the peer review, the group then engaged in a report-out period in which participants are asked to identify what they found to be features of strong statements (ideas that are recorded directly onto the slides so that they can be tracked in the moment and documented for the future).
- Rationale: Peer review, in this context, is not just a means to help students generate better statements. It is also a means for students to gain insight into how others understand engineering and talk about themselves as engineers.
- Adaptation: If there is an odd number in the group, it can be helpful to find out which students consider themselves “fast readers,” and then suggest that the group of three students be formed from among those students who consider themselves fast readers.

Looking ahead—Artifacts and Annotations

- *Assignment for next session: Develop an annotation for one artifact, upload it to the portfolio, and bring three copies to the next session; Develop a list of potential artifacts to add to the portfolio (the artifact scavenger hunt)*
- Objective: By the end of the activity, participants will know what they need to do in order to prepare for the next session.
- Suggested procedure: Review the slide “Preparing for session 3.” Distribute the handout “Preparing artifacts and annotations.” Using the slides, discuss with students the challenges associated with writing annotations.
- Rationale: Students should be challenged with the activities themselves, not with figuring out what activities they are supposed to do.
- Adaptation: If needed, the facilitator can include a tutorial on tools that students can use to create their e-Portfolio.

Session 3

In this session, participants engage in peer review of their draft annotations and then start thinking about how to more fully populate their portfolio.

Getting situated—Revisiting prior activity

- See above

Getting situated—Their feedback

- See above

Portfolio Work: Portfolio check-in

- **Objective:** By the end of the activity, participants will have a general sense of how the portfolios across the group are shaping up. In addition, the review of the portfolio can help participants start to think about their portfolio holistically (i.e., in terms of navigation, overall flow, etc.).
- **Suggested Procedure:** Collect any portfolio URLs that have not been collected up to this point. Then, for each participant, display their portfolio to the group, invite the participant to comment on the state of their own portfolio, and invite the other participants to comment on what they like about the portfolio.
- **Rationale:** This procedure honors the students' progress, gets the group excited about their collective progress, draws student attention to the portfolios as a holistic composition, and provides an informal opportunity for students to work out various issues that may be arising.
- **Adaption:** The facilitator can take the opportunity to draw participants' attention to issues such as navigation, naming, etc.

Portfolio Work: Peer Review of Annotation

- **Objective:** By the end of the activity, participants will have ideas about the strengths of their current annotations, and ideas for improving their annotations.
- **Suggested procedure:** Review the ground rules for peer reviewing. Then have students work in pairs where they exchange, read, and then discuss their annotations. Upon completion of the peer review, the group then engaged in a report-out period in which participants are asked to identify what they found to be features of strong annotations) (ideas that are recorded directly onto the slides so that they can be tracked in the moment and documented for the future).
- **Rationale:** Peer review, in this context, is not just a means to help students generate better annotations. It is also a means for students to understand what it is like to read about an artifact/prior experience that they themselves were not a part of. This is important because writing annotations requires one to anticipate what a reader will not know about an artifact or experience, and this can be hard for participants. In addition, the peer review provides an opportunity to grapple with the "it should be short" ideal while also realizing how much they might want to say about their artifact.
- **Adaptation:** If there is an odd number in the group, it can be helpful to find out which students consider themselves "fast readers," and then suggest that the group of three students be formed from among those students who consider themselves fast readers.

Looking ahead: Populating your portfolio

- *Assignment for next session: Add three or more additional annotated artifacts to the portfolio and update existing portfolio components as they see fit.*
- **Objective:** By the end of the activity, participants will know what they need to do in order to prepare for the next session. In particular, participants will be prepared to choices about what content to include next in their portfolio.
- **Rationale:** Students should be challenged with the activities themselves, not with figuring out what activities they are supposed to do. The challenges that participants may encounter during the upcoming step include: a) not being able to imagine what else to include at all, b) not being able to imagine how to translate their general idea into a specific artifact, and c) not being able to confidently choose among options.
- **Suggested Procedure:** Review the slide “Preparing for session 3.” Using the slides, discuss with students the challenges associated with populating the portfolio. Invite students to discuss their respective “artifact scavenger hunt” lists with each other and talk about what they plan to add to their portfolios.
- **Adaptation:** If there is available time, participants could be invited to think more formally about their next choices or to more formally guide their peers. For example, each participant could be asked to identify something they are committed to adding next or they could be asked to identify something they think that a peer should add to his/her portfolio.

Session 4

In this session, participants have the opportunity to get feedback on their overall portfolio as well as specific elements, and then start thinking about how to finish and present their portfolios.

Getting situated—Revisiting prior activity

- See above

Getting situated—Their feedback

- See above

Portfolio work—How do readers experience your portfolio?

- Objective: By the end of the activity, participants should understand how others might interact with and interpret their portfolio and also have an idea about how to use information from such understanding to guide the final decisions in putting together their portfolio.
- Suggested Procedure: The facilitator first demonstrates how to provide a think-aloud protocol, and then helps the participants organize into pairs. For a designated period of time, one participant conducts provides a concurrent think-aloud while interacting with the other participants' portfolio, while the author of the portfolio listens and takes notes. Then, participants change roles. At the end of the think-aloud period, participants discuss what they learned from the exercise.
- Rationale: Up to this point, participants have been focused on figuring out what to say in their portfolio and populating their portfolio. With a sufficient amount of content under their belt but yet still time to revise the portfolio, now is a good time for them to see how others interact with their choices.
- Adaption areas: While think-aloud seems particular promising for this goal, other activities may be equally appropriate or fit better within the constraints of a particular group dynamic, facilitator comfort zone, etc. Also, there are clearly multiple ways to have students share their observations/feedback with each other and with the group.

Portfolio work—Getting feedback on one selected element

- Objective: By the end of the activity, participants should have gotten feedback/advice on the elements of their portfolio that they are most concerned about so that they can confidently revise said elements.
- Suggested Procedure: Provide students with an opportunity to decide what they would like to get feedback on. Then have students form pairs/small groups in order to get feedback from others. Wrap up the activity with time for students to share what they gained from the activity.
- Rationale: At this point in the process, different students are likely to be concerned about different aspects of the portfolio so giving them the responsibility to figure what type of feedback they need and the opportunity to get such feedback makes sense.
- Adaption areas: It might makes sense to poll the group about the types of feedback that they want prior to having students form groups, since the information about who wants what feedback might support group formation. It may or may not be particularly valuable to have students report out on what they learned from this exercise.

Looking ahead—Portfolio presentations

- Objective: By the end of the activity, participants should be able to describe the goal of the portfolio presentation activity, identify potential characteristics of a good presentation, and have an idea of how they should go about preparing for the presentation.
- Suggested Procedure: Introduce the portfolio presentation activity. Work with the group to brainstorm elements/features of an effective presentation. Work with the group to brainstorm what needs to be done to the portfolio in order to be prepared for the presentation.
- Rationale: Presenting the portfolio provides a means for not only encouraging the portfolio to be completed but also an opportunity to practice how to use the portfolio. The brainstorming activities are intended to give the students a head start on the activity.
- Adaption areas: It could be interesting to invite students to imagine other contexts in which they would be asked to talk about their portfolio. It could be interesting to have a student volunteer to give a demonstration presentation, or for the facilitator to demonstrate such a presentation.

Session 5

In this session, participants present their completed portfolio, discuss what they learned from the presentations, and then reflect on the portfolio studio overall.

Getting situated—Revisiting prior activity

- See above

Getting situated—Their feedback

- See above

Portfolio work—Presentations and Reflections

- Objective: By the end of the activity, students should have a sense of the successfulness of their portfolio and their presentation and be able to describe the portfolio elements and presentation elements that they might leverage in the future.
- Suggested Procedure: Revisit the presentation scenario highlighting the context and the 2 minute constraint. Provide a bit of context for why this is a valuable activity. Revisit some of the ideas they already created concerning a good presentation. Indicate to students that they should frame their listening in terms of what are promising strategies (what they liked) and what questions were raised. Students draw numbers to determine the order of presentations, Students give them 2-minute presentations in clusters. Students write down ideas after each cluster, Open discussion at the end concerning their reactions to the portfolios and presentations in general and relative to the framing ideas.
- Rationale: Honor their work; Help them get feedback from each other; Have them use each other's work to get new ideas;
- Adaption areas: : The *frame* mentioned above could be revised. The number of students could affect the number of clusters.
- Data from earlier offerings:
 - What we liked in presentations: Variety of artifacts, ties to prof. statements, Highlighting parts of portfolio, Flow of presentation coordinated w/ artifacts, Volume of content, Getting to know everyone
 - Questions it raised: Timing, Finding strongest points to cover in 3 min, Could gather feedback via portfolio tool

Wrapping Up—Finishing the requirements

- Objective: By the end of the activity, students should have either fulfilled or have clear instructions for how to fulfill any remaining requirements.
- Suggested Procedure: Revisit the studio requirements and help students figure out what else remains.
- Rationale: Students should be challenged with the activities themselves, not with figuring out what activities they are supposed to do.
- Adaption areas: The specific wrap-up activities stem from the specific way in which the portfolio studio is being implemented.

Taking stock, Additional information

Points to go with Experiences:

- Overarching comment: Writing a professional statement with limited prior discussion can be a strange, unusual activity for students – eliciting feelings such as the inappropriateness of bragging and/or discomfort at not knowing where one’s career is headed. We invited you to share a bit of your experience in order to let you see that it is likely that others are experiencing it in the same way you are experiencing it.
- What we expected – A lot of discomfort, concerns that it is like bragging...
- Did they notice a trend? Did anything in particular stand out to them?”
- Moving ahead: Exercises to help overcome the discomfort, differentiate the activity from bragging (as claims that are not completely supported)...

Points to go with State

- Overarching comment: While some of you may be quite happy with your current professional statement draft, others may be struggling to figure out exact what you want to say resulting in unfinished and incomplete drafts. We invited you to share your assessment of the state of your draft with others so that you can know about this range. In addition, self-assessing the state of your professional statement is a valuable way to prepare for a productive peer review.
- What we expected: Unfinished but also people having trouble getting a solid start
- Did they notice a trend? Did anything in particular stand out to them?”
- Moving ahead: Peer review to help it get better...

Points to go with Like:

- Overarching comment: Regardless of the extent to which you feel you need to improve your statement, it is likely that there is something that you like about your current statement—the introduction, a particular sentence, a metaphor, etc. Thinking about this helps you by figuring out what to leave unchanged as you try to improve. In addition, sharing these good parts can help other students get ideas.
- What we expected: Quotes at the beginning, particular pieces of content
- Did they notice a trend? Did anything in particular stand out to them?”
- Moving ahead: Peer review as opportunity to see some of these elements

Points to go with Help

- Overarching comment: Figuring out where you need help is also a valuable way to prepare for a productive peer review. You can work to ensure your own needs are addressed, you can help other with their needs, and the facilitator can help the whole group.
- What we expected: Who is the audience?
- Did they notice a trend? Did anything in particular stand out to them?”
- Moving ahead: Peer review as a time to talk through these issues, perhaps discussion at the end of peer review, perhaps follow-up in next session...

Appendix B: Session Materials

Portfolio studio session materials

Authors:

Jennifer Turns, Brook Sattler, Matt Eliot, Deborah Kilgore, Ken Yasahura,
Kathleen Gygi, Kate Mobernd, and Cindy Atman

©Center for Engineering Learning and Teaching, University of Washington

To cite this report use:

Title

Names, *Title*, Center for Engineering Learning and Teaching, University of Washington, Seattle, 2001.

Keywords: Preparedness portfolio, portfolio studio, session materials

Portfolio Description Handout

Life-wide Engineering Preparedness Portfolio Assignment

Overview: We want you to create a life-wide engineering preparedness portfolio consisting of a statement, several artifacts, and annotations for each artifact. Creating this portfolio should strengthen your understanding of your prior experiences, your understanding of your engineering discipline in general, and your sense of how your experiences have helped you become better prepared to practice as an engineer.

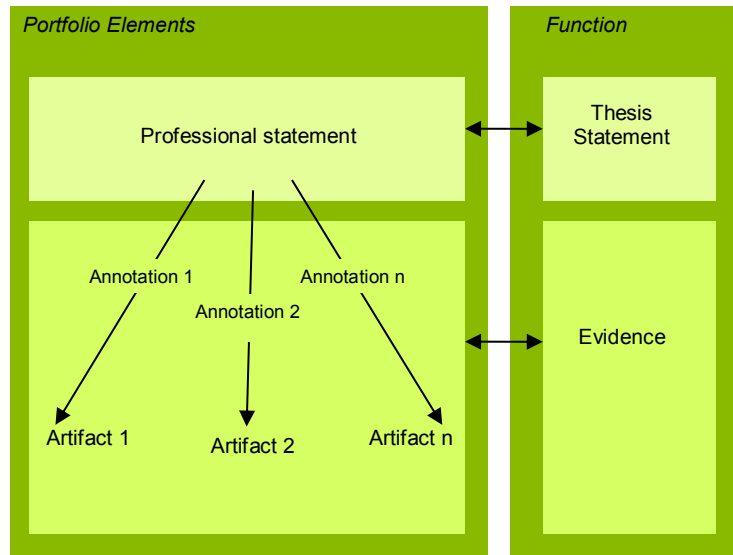
Assignment: Your portfolio will consist of the following components. Figure 1 is a schematic diagram of the function and structure of your portfolio and its components.

I. STATEMENT: In what ways are you prepared to function as an engineer? Prepare a 400-500 word statement describing your understanding of your engineering discipline, your experiences, and the connection between the two. This statement is the backbone of your portfolio and is your opportunity to showcase and sell your knowledge and skills – you will link everything else in your portfolio to this statement. You might think of this statement as the cover letter to your portfolio.

II. ARTIFACTS: What examples of work have you produced? Review your experiences. Identify three or more pieces of work (knowledge/concept/topic) that you think are important to you, your engineering discipline, and the points you made in the statement.

III. ANNOTATIONS to above artifacts: Explain the significance of the artifacts (knowledge) in light of the statement you prepared. For each artifact, write 100-250 words that explain its value and connections to the ideas in the statement.

Figure 1 (to right): Schematic diagram of the function and structure of your portfolio.



Professional Statement Handout

Writing the Professional Statement

The professional statement is where you describe the skills, experience and knowledge that make you fit in AND stand out

The

purpose of this task is to help you take the first step in creating your professional portfolio. In your professional statement, you should share your understanding of what it takes to be a professional engineer and how you fit into that overall vision. Your statement should include all of the following:

- Your understanding of the professional activity – What is it and how does it work?
- Your encounters with key elements of the professional activity through your skills and knowledge
- Concrete examples citing these key elements (which will be illustrated and discussed in more depth in your artifacts and annotations)

In terms of length, 500 words is good starting benchmark—enough to provide some detail but not so much as to get excessively long-winded. Ultimately, the length of your professional statement will be up to you and your goals for your portfolio.

Brainstorming: These activities will help to get you started with your professional statement. Make sure you write down key insights!

- **Activity 1 – “Who will be reading this?”** Common questions about professional statements and professional portfolios include the following:
 - “Who will be reading this?”
 - “What will they do with it?”
 - “What will they expect to see?”

Use a context that is relevant to you, such as a job search or applying for grad school.

- **Activity 2 – Professional activity as decision-making.** Identify a project, experience, or even a course assignment that was particularly impactful in relation to the professional activity you are writing about. Brainstorm the decisions you made about that assignment or experience. Arrange the decisions into a pattern that makes sense to you. You may gain insight from both the decision topics you find and the pattern in which you arrange those decisions.

Another way to discern what your professional statement should contain is to see how others have articulated their professional visions. Whether you know it or not, you do have a vision of the professional activity even if you have never had a reason to articulate it. A good place to

begin refining your articulation (if you have not already) is in examining the professional portfolios of others (try a search online).

Artifacts and Annotations Handout

Introducing Artifacts and Annotations

An artifact is a demonstration of your skills and your knowledge. Many people use assignments and other deliverables from their selected course as artifacts.

The next phase of creating professional portfolios is to select and annotate artifacts. Dictionaries often define “artifact” in terms of something created by people for a singular purpose. Many people associate “artifacts” with archaeology. This isn’t too far off for you, since you may need to do some digging to find artifacts that you remember or that represent your engineering expertise the way you would like. You may even find something you didn’t expect that points you in a new and creative direction. Try to have fun digging around in your engineering past.

Gathering and selecting artifacts: First, gather as many *potential* artifacts as you can find from previous courses, internships, etc. You can include assignments, e-mails, lab notes, etc. Try to jot down a few notes about why you would include each potential artifact. Your notes should not take you more than a couple of minutes to write for each artifact.

Remember, portfolios are not supposed to just chronicle your academic and professional career, but also demonstrate your excellence. You want to include materials that make you proud (and employable). The process that you use to build your resume provides a good analogy. In your resume, you include jobs you’ve held, not jobs you didn’t get. You list successful projects or skills you’ve mastered, not times you fell short of the mark. Artifacts extend that purpose, literally showing someone an example of when you have done your best. Consider that you may want to include artifacts that do double duty, that are evidence of multiple skills or knowledge in more than one area.

Before the end of the quarter you will review all of your artifact ideas and select 5-7 artifacts that most clearly illustrate the important points in your professional statement. Some people say that the process of selecting and annotating artifacts actually inspired them to make improvements to their professional statement.

Artifact activities: The following activities can help you gather and select artifacts:

- *Activity 1:* Identify potential artifacts
 - Initial lists... Individually, take some time to write a list of specific artifacts from your own experience. Identify which ones you currently can locate and others that will take some effort to obtain. List artifacts you aren’t sure you can find. Even if you can’t find them they may lead you to artifacts you can use, or have forgotten.
 - Working from specific experiences... Brainstorm some of the non-academic experiences you have had. For each experience, brainstorm how the experience might illustrate some important idea about engineering and what artifacts might come from the experience.

- *Activity 2:* Take a look at the portfolios provided on the studio web site. Identify the artifacts those people chose and think about how well those artifacts represent their skills and knowledge. What about those artifacts works and what doesn't? Why?

An annotation explains key points about the artifact and helps the reader understand what the artifact demonstrates.

A picture may be worth a thousand words, but if these words don't mean anything to your audience then the picture is worthless. To help people understand your artifacts (pictures) you need to translate your knowledge. Annotations perform this work. Annotations exist to bridge knowledge structures. They are both the glue binding your artifacts to the main theme of your portfolio and the context needed for the uninitiated to understand the value and importance of your work.

Annotating artifacts: For each artifact you have, write an explanation which connects it to your professional statement. Write an annotation for all of your artifacts, not just the ones you suspect you will include in your portfolio. Ideally, the artifacts will demonstrate both excellence in practice and support your statement. Each explanation should be less than 1 page, double spaced.

The purpose of writing these annotations is twofold. First, it provides a way to talk about the analysis you've done of the pieces you intuitively sense are your best work. Second, you will begin to flesh out an intelligible annotation that can be used in your professional portfolio.

Session Slides

Portfolio Development Studio
Session 1




Today's Agenda

- Overview
- Your thoughts on portfolio construction
- Portfolio orientation
- Looking ahead to session 2
- Final thoughts

What is a Professional Portfolio?

- Portfolio = An argument about your readiness to be a professional x
- Portfolio = A professional statement, several artifacts, and explanations (annotations) about the artifacts



Portfolios on the web



Your Task: Creating Professional Portfolios

Portfolio Overview



Five session experience

Overall Goal: Develop a 5-page portfolio that, at minimum, contains a statement and five annotated artifacts and is published online.



Example Portfolio

1. Professional Statement:
Discussion of being prepared

Annotation:
Explanation of the artifact, how it represents evidence of preparedness

Artifact:
Evidence of preparedness, drawn from experience

And others...

Across the sessions

- Overall Description:
 - Structured yet flexible work environment in which to develop and evaluate professional portfolios
- Outcomes:
 - High quality portfolio
 - Increased identification with x
 - Increased capacity to engage in lifelong learning
 - Improved ability to reflect on experience
- Responsibilities:
 - Attend sessions
 - Complete deliverables
 - Engage in peer review and discussion

On session structure...

[Creating successful learning experiences involves] the imposition of constraints—or more precisely, the imposition of *liberating constraints*.

These are guidelines and limitations for activity that are intended to provide enough organization to orient students' actions while allowing sufficient openness for expression of the varieties of experience, ability, and interest represented in any social group.

Liberating constraints must not be overly prescriptive. By the same token, the notion of liberating constraints is not an embrace of an anything goes attitude.

Working together

My role

- Project Manager
- Leading group through tasks
- Fostering discussion

Your role

- Attend each workshop
- Create *your* portfolio
- Raise key questions

Next: An initial conversation

Initial Conversation

- Usefulness of having a portfolio?
 - To you
 - To others (which others, what use)
- Usefulness of creating a portfolio?
- Concerns about creating your portfolio?
- Why do you think educators do not ask students to construct portfolios at some point in the curriculum?

Usefulness of having portfolios

Usefulness of creating portfolios?

Concerns?

Why educators don't ask...

Next: Portfolio Orientation

Your task: Convincing others that you are prepared for professional life



Example Portfolio

1. Professional Statement: Discussion of being prepared



Annotation: Explanation of the artifact, how it represents evidence of preparedness

Artifact: Evidence of preparation, drawn from experience

The Components

- **Professional Statement**
 - Backbone of portfolios, Part of an ecology of documents about you, Solid claims but also readable...
- **Artifacts**
 - Evidence but also enticement...
- **Annotations**
 - The glue, the context, the backstory

Task: Convincing others that you are prepared

"Think Fast" Analysis of people (based on knowledge, skills, attitudes, personal perspective, etc.) that you could draw about yourself relative to the goal of your portfolio (e.g., demonstrating you as a teacher, as a researcher, as a professional).



"Experience/Fact Fast" Evaluation of your potentially developed (or experienced) and the history of that trait (e.g., could help to suggest from those experiences).

The Challenge of Imagination...

"Think Fast" Analysis of people (based on knowledge, skills, attitudes, personal perspective, etc.) that you could draw about yourself relative to the goal of your portfolio (e.g., demonstrating you as a teacher, as a researcher, as a professional).

WHAT???

WHAT???



WHAT???

WHAT???

WHAT???

WHAT???

WHAT???

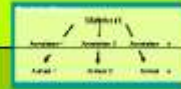
"Experience/Fact Fast" Evaluation of your potentially developed (or experienced) and the history of that trait (e.g., could help to suggest from those experiences).

The Challenge of Selection...

"Think Fast" Analysis of people (based on knowledge, skills, attitudes, personal perspective, etc.) that you could draw about yourself relative to the goal of your portfolio (e.g., demonstrating you as a teacher, as a researcher, as a professional).

Which???

Which???



Which???

Which???

Which???

Which???

Which???

"Experience/Fact Fast" Evaluation of your potentially developed (or experienced) and the history of that trait (e.g., could help to suggest from those experiences).

Exercise: Let's imagine (and then discuss)...

"Classroom Portfolio" A collection of portfolio items about knowledge, skills, attitudes, personal experiences, etc. that you could make about yourself relative to the goal of your portfolio (i.e., items about you as a teacher, as a researcher, as a professional)

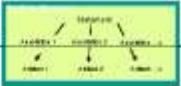
Transferable Student Portfolio: A collection of your portfolio relevant prior experiences and the various artifacts that you could bring forward from those experiences.

For next week: Select for professional statement

"Classroom Portfolio" A collection of portfolio items about knowledge, skills, attitudes, personal experiences, etc. that you could make about yourself relative to the goal of your portfolio (i.e., items about you as a teacher, as a researcher, as a professional)

Criterion: Fit to and stand out **Criterion: Escape reader**

Criterion: Focus on what you are passionate about **Criterion: Consider breadth vs. depth**



Transferable Student Portfolio: A collection of your portfolio relevant prior experiences and the various artifacts that you could bring forward from those experiences.

Next: Looking ahead to Session 2

Preparing for Session 2




- Write your portfolio statement (~500 words)
- Bring 3 copies for peer review
- Create portfolio and upload statement

Writing the Statement

Hints:

- What makes you prepared? What makes you stand out?
- Like a cover letter for a resume
- See handout...

Using the Catalyst CommonView Tool



Final Thoughts



Session 2

Agenda, Session 2

Warm up – feedback form (5)

- Part 1: Getting situated (10)
- Part 2: Professional statements
 - Taking stock (15)
 - Getting feedback via peer review (30)
- Part 3: Artifacts and annotations –
 - Next tasks
 - Example portfolios (15)

Wrap up – feedback form (5)

Getting situated

- Insert slides from previous session



Your feedback

Rewarding

- Insert comments from feedback sheets

Frustration

- Insert comments from feedback sheets

Surprised

- Insert comments from feedback sheets

Aha

- Insert comments from feedback sheets

Next: On Writing the Professional statement

Taking the pulse

- **Four post-it notes – A word or short phrase on each.**
 - Note 1: The **experience** of writing
 - Note 2: The **state** of your professional statement
 - Note 3: Something you **like** about your prof statement
 - Note 4: Where you need **help**
- Aggregate...
- **Discussion suggestions**
 - Experiences: Are there trends in the experiences?
 - State: Are there trends in the current state?
 - Like: What are elements that can be shared?
 - Help: What do we need to address?

42

The Experience
of Writing

The State of
your Statement

Like about your
Statement

Would like help
on...

Next: Peer Review of
Professional statement



Peer Review of Professional Statements

- Goal
 - Help each of you improve your professional statements
- Structure
 - Work in groups of 2 or 3
 - About 20 minutes
 - I'll let you know when we are halfway through
- Hints
 - Be respectful
 - Authors - Say what you would like help with
 - Reviewers - comment on strengths as well as areas of improvement, ask questions

CCP Session 2

Peer Review of Professional Statements

What **strengths** did you notice in your peers' statements? What makes a statement strong?

What **questions** did the reviewers ask?

Next: Looking ahead to Artifacts and Annotations

Your task: Convincing others that you are prepared



Example Portfolio

1. Professional Statement: Discussion of being prepared



Annotation: Explanation of the artifact, how it represents evidence of preparedness



Artifact: Evidence of preparation, drawn from experience

Preparing for Session 3

- Artifact scavenger hunt
 - Please bring a list of potential artifacts...
- Portfolio development
 - Write an annotation for *at least* one artifact
 - Load artifact and annotation into your Portfolio
 - Please bring one copy of artifact, three copies of annotation

On the difficulty of finding artifacts

- Yes, finding artifacts and mapping them to your claims can be difficult
- From interviews with students in the past
 - "I did think about theory, but that was beyond... how am I going to show that I know?"
 - "a lot of stuff in the class was like learning teamwork and stuff and there wasn't really the best way to put that in like an artifact and talk about it"
 - "like teamwork, okay, well, what can I say? How do you represent that, you know?"

Next: Looking back

• Insert slides from previous session



Next: Your feedback at end of Session 2

Rewarding

Over last week	In session
----------------	------------

Frustration

Over last week	In session
----------------	------------

Surprised

Over last week	In session
----------------	------------

Aha

Over last week

In session

Next: Checking in on portfolios...

Portfolio Check-in

- What is status of each portfolio?
- What software tools have people chosen?
- Does facilitator have the URLs for sharing with the group?
- Any concerns? Comments?



Portfolio Check-in..

We reviewed four portfolios: One in common view, two in google sites, and one hand coded.

What issues did this raise?

Next: Peer Review of Artifacts and Annotations

Artifacts and Annotations

- Discussion in 2-3 people
- Authors: Key decisions, what you left out
- Reviewers:
 - Feedback
 - Suggestions
 - Ask questions



Artifacts and Annotations

What roles do they play in your portfolio?

Next: Looking ahead to
Populating the portfolio

Looking to Session 4

- Before session:
 - Add 3 or more additional annotated artifacts to e-portfolio.
 - Consider revising professional statement based on feedback, actual artifacts.
- During session:
 - Overall review of portfolio, Peer review of annotations, Open discussion of challenges, Discuss next steps

Your task: Convincing others that you are prepared for professional life



Task

- Share your artifact scavenger hunt lists with a peer and discuss which artifacts are most promising for including in the portfolio...
 - When sharing your list, point out what you are most excited about.
 - When looking at a list that is not yours, point out what artifacts most interest you, generate the most curiosity, etc.

Artifact selection - Discussion

- What are you going to add next?
- What ideas did you get from others?



Session 4

Five session experience

Overall Goal: Develop a five-session portfolio that, at minimum, contains a statement and five annotated artifacts and is **publishable online**.



Agenda

Warm up (5)

- Getting situated—Looking back/feedback (10)
- Portfolio Work
 - How do readers experience your portfolio? (30)
 - Getting feedback on one selected element (30)
- Looking ahead—Portfolio presentations (15)

Wrap up (5)

11

Next: Looking back

- Insert slides from previous session



Next: Your feedback at end of Session 3

Rewarding

Over last week In session

Frustration

Over last week In session

Surprised

Over last week In session

Aha

Over last week In session

Next: How might readers
experience your portfolio?

"Think-aloud"

- What: A technique often used in usability testing to understand what is going through someone's mind when interacting with a product
- How: The reader/user is invited to interact with a product and voice out loud what is going through their mind during their interaction with the product
- Benefit?: You can see a) order of activities, b) problems, c) unexpected interpretations, d) opportunities,...
- Illustration...

Portfolio "Think-aloud"



- **Purpose:** To you the opportunity to see how a reader interacts with your portfolio
- **Procedure: Working in pairs**
 - Authors provide any background information necessary
 - Readers then interact with the portfolio while providing a "think-aloud" for specified period of time (5 min.)
 - At end, author can ask reader for clarification, more information, etc.
 - Discussion
 - Switch roles...

"Think-aloud" Takeaways?

Next: Getting feedback on one selected element

Feedback on one selected element

- **Framing:** Given your portfolios now have many elements, we will focus *peer review* on an element that you select in order to enable detailed feedback
- **Your decision:** Which element (e.g., professional statement, a specific annotation) would you most like to have feedback on?

Peer Review

- **Setting up**
 - Exchange the elements you want to be peer reviewed
 - Authors provide context for peer review (i.e., concerns, specific questions)
- **Reviewing**
 - Read through the element you have been given
 - Identify strengths, suggestions, areas for improvement
 - Think about concerns/questions raised by author
 - When reviewing, think not only about the element in isolation but also the element in the context of the whole portfolio
- **Giving feedback**
 - Start with strengths
 - When giving suggestions also indicate when problem the suggestion would solve
 -

Feedback – Takeaways?

Feedback – Takeaways?

Next: Looking ahead

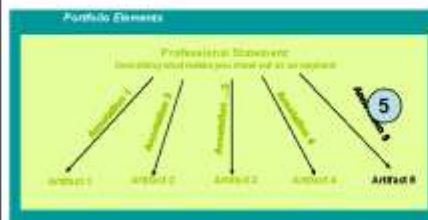
Session 5 – Portfolio Presentations

- Scenario: Imagine you have brought your portfolio to a job interview, and the interviewer asks you to walk him/her through the portfolio
- Time: 2 minutes
- Let's brainstorm
 - Features of a good presentation
 - What is needed to complete your portfolio

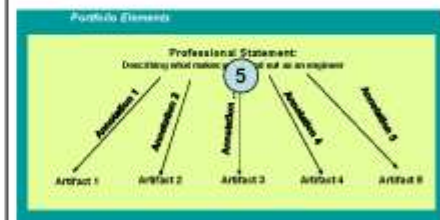
Preparing for Session 5

- Before session:
 - Finish populating portfolio with 5 annotated artifacts to e-portfolio.
 - Revise all elements of portfolio to create the strongest product
 - Prepare presentation
- During session:
 - Portfolio presentations
 - Open discussion of first 5 sessions

Your task: Convincing others that you are prepared for professional life



Your task: Convincing others that you are prepared for professional life



Think-Pair-Share

- What would make a good presentation?
- What do you need to do in order to "finish"?

Final thoughts



Session 5

Agenda

Warm up (5)

- Getting situated—Looking back/feedback (10)
- Portfolio Work
 - Portfolio Presentations (20)
 - Portfolio Discussion (30)
- Looking ahead (15)

Wrap up (5)

138

Next: Looking back

- Insert slides from previous session



Next: Your feedback at end of
Session 4

Rewarding
Over last week In session

Frustration
Over last week In session

Surprised
Over last week In session

Aha
Over last week In session

Next: Portfolio Presentations

Portfolio Presentations

- Scenario: Imagine you have brought your portfolio to a job interview, and the interviewer asks you to walk him/her through the portfolio.
 - Note: In keeping with our conversation last week, let us know if you decided to go after a different scenario by sharing audience and scenario
- Timing
 - 2 minutes to address highlights, invite interest

Framing the listening...

- What do you like? What is good?
 - About presentation
 - About portfolio
 - Note that it may be the first time you've seen some of the portfolios
- What questions do you have? did it raise?
- Looking ahead
 - Beyond common view, next steps,

Portfolio Presentations

- Order assignment
 - Volunteers, random, self-organize
- Three minutes as desired time
 - 1 minute warning at 1 minutes
 - 0 minute warning at 2 minutes
 - Asked to finish at 2.5 minutes

What we liked...

Questions raised...

Next: Final feedback

(Thank you!)

Appendix C: Survey & Interview Questions

Interview	Developmental Dimension Targeted*
01. What are your chief take-aways from this experience?	All
02. Thinking back on your experience with portfolio development this quarter, what was the most surprising thing about it?	All
03. What was the most rewarding thing about it?	All
04. What was easy or enjoyable about creating your portfolio?	All
05. What was the most challenging or unpleasant thing creating your portfolio?	All
06. Please describe the aspects of your portfolio you like the most.	All
07. Please describe the aspects of your portfolio that you like the least, besides the Catalyst or Google formatting limitations.	All
08. How would you change your portfolio if you worked on it more in the future?	All
Learning Environments	
09. What expectations did you have when joining the portfolio studio? Did you experience align with these expectations? Please explain.	All
10. In what ways was the portfolio experience different from the rest of your undergraduate coursework?	Knowledge
11. In what ways was the portfolio experience similar from the rest of your undergraduate coursework?	Knowledge
12. What is your view of an ideal classroom environment that is conducive to your needs? In this environment, what is the role of the educator? What is the role of the student? How do you feel when the educator evaluates you or your work?	Knowledge, Relationships
13. Did the portfolio studio align with this view? If yes, please explain how? If no, how could it better align?	Knowledge
14. People have said that working on the portfolio influences how they view the courses they have taken or plan to take. Is this true for you?	Knowledge
15. How useful was working on portfolio in regard to current coursework, future plans?	Identity, Knowledge
16. How does creating a portfolio compare to other things you have done?	Knowledge
Interactions with others	
17. Describe your interactions with peers in the portfolio studio.	Relationships
18. Describe your experiences with peer review - both receiving and giving feedback. What did you gain from these activities?	Relationships
19. How do you deal with encounters with people who hold different views from yourself?	Relationships

20. During the portfolio studio, did you encounter people who held views different from yourself? If yes, how did you handle the situation? If no, how would you hypothetically handle the situation?	Relationships
21. Do you think you handle these types of situations (encountering people with different views) differently since participating in the portfolio studio?	Relationships
22. Generally, do you think the portfolio activity has better prepared you to work in teams?	Relationships
23. Do you think the portfolio has made you more open to others' ideas?	Relationships
24. Often working in groups people offer up ideas that the group does not take up, has this happened to you? Please explain the situation, your attitude and feelings. Do you think this portfolio experience has influenced how you would respond to such situations in the future?	Relationships
25. Describe a time you were advised to take a certain course of action, but didn't agree with this path and want to take another path. Do you think this portfolio experience has influenced how you would respond to such situations in the future?	Relationships
26. Describe a situation when you felt like you were being pulled in different directions. Do you think this portfolio experience has influenced how you would respond to such situations in the future?	Relationships
Decision-making	
27. Think about the various experiences that you revisited or reflected on during this term. Select one that stands out to you and tell me about it. What was the experience and what types of thoughts did you have while you were revisiting or reflecting on it?	Identity, Knowledge
28. Describe the decision-making process of choosing a specific artifact? How did you decide on the artifact? Why this artifact over other artifacts?	All
29. In retrospect, are you surprised by any of the artifacts you included in the portfolio? Tell me a little more about that.	Knowledge, Identity
30. In a situation where information is not clear cut, how do you go about making a decision? OR How do you make decisions in the face of conflicting information?	All
31. What was the most important decision you made while developing your portfolio? What was the decision? What were your options? Are you pleased with the decision?	Knowledge, Identity
Dilemma	
32. Please describe a dilemma you have faced in life. Describe how you experienced the dilemma, who was involved, how you handle it. If you were to face the same dilemma now (after the portfolio experience) that you would respond different?	Identity, Relationships
Thinking Process	
33. Did this professional portfolio activity get you to think? If yes, please explain in what ways. If no, explain why not.	Knowledge

34. Has this experience led you to think differently about or approach other learning experiences at the university in new ways? Explain.	Knowledge
35. People have said that working on the portfolio makes them think differently. Is this true for you?	Knowledge
36. Do you believe that your experience creating a portfolio has resulted in a change in your values, beliefs, opinions, or expectations? Please explain.	Knowledge
37. Tell me a story about one of the most significant learning experiences you had while here at the UW. What was it about this experience that made you identify it as one of your most significant learning experiences? What did you learn? Why do you think you learned so much? How do you think you will use what you learned in the future? Who was involved in the experience, and what were their roles?	All
38. What do you see as the relationship between knowledge and truth?	Knowledge
Future & Preparedness	
39. Do you intend to complete a major in engineering?	Knowledge
40. If someone were to read your portfolio, would they think you were ready to work in industry or to attend graduate school?	Knowledge, Relationships
41. In your opinion, would the artifacts and annotations in your portfolio convince others of your readiness for industry or graduate school?	Knowledge, Relationships
42. In your opinion, would your professional statement convince others of your readiness for industry or graduate school?	All
43. Some students report learning about themselves and even being impressed by their accomplishments (gaining confidence), did this happen to you? Please explain.	All
44. Sometimes we've heard that creating the portfolio creates tensions between what one wants to do and what one should do. While creating the portfolio did you experience any tensions like this one? Please explain.	Relationships
Comfort level	
45. Students have described having different comfort levels with the portfolio process and studio, could you talk about your comfort level? What made you comfortable? What made you uncomfortable? How did you get over the discomfort?	All
46. Have you experienced other situations where the comfort level was similar to the portfolio? If yes, could you explain the situation, what you did, what was different, the same?	All
Closing	
47. Did the portfolio contribute to your sense of empowerment? Please explain.	Identity
48. Is there anything else that you think is important for me to know to understand how you experienced the portfolio studio?	All

* In addition to the developmental dimensions targeted, the question may illicit answers from other dimensions.

(Table borrowed and modified from (Sattler et al., 2012) with permission.)

Appendix D: Codebook for identifying meaningful units of data

To identify meaning units of data, I looked for places that would trigger students' journey through the crossroads, demonstrate the process of self-authorship, and illuminate skill sets and/or in which self-authorship can be seen (e.g., exhibiting markers of self-authorship).

1. **Triggers** – Crossroads (Baxter Magolda, 2001) provide a place in which students may be encountering disruption in their meaning making. Crossroads is an important aspect of one's journey toward self-authorship because either one significant life event or several smaller life events do not fit into one's structure of how they make sense of life. The crossroads described by Baxter Magolda (2001) (crossroads have also been described by other scholars as “disjunctures” (Jarvis, 2007), “disorientating dilemmas” (Mezirow, 2000), and “provocative moments” (Pizzolato, 2005)) and used to analyze this data are:
 - a. Emotion – Dissatisfaction with following formulas or not fitting into current patterns of meaning making disrupts the current ways in which they made meaning about the work, which caused various emotions (e.g., anger, frustration, fear, disappointment, etc.).
 - b. Dilemmas – In a specific incident, which may be complicated, life changing, etc., may cause the person to engage in evaluating his or her internal system.
 - c. Change, growth, development – Explicit use of such language could indicate students' recognition of some type of internal change.
2. **Process elements** – Baxter Magolda (2008) demonstrates “one possible portrait of the evolution of self-authorship” (p. 273) through narratives that describe trusting the internal voice, building an internal foundation, and securing internal commitments. The process of trusting the internal voice, building an internal foundation, and securing internal commitments is not simply linear; there exists the opportunity to people to cycle through process throughout their lifetime. The process toward self-authorship described by Baxter Magolda (2008) and used to analyze this data are:
 - a. Trusting the internal voice – An awareness of confidence in self, and one's ability to have an internal voice.
 - b. Building an internal foundation – Once an internal voice is determined, one moves towards creating a life philosophy/foundation/commitments.
 - c. Securing internal commitments – Once an internal foundation was developed, one moves toward living by this foundation “living their convictions” (Baxter Magolda, 2008, p. 281).
3. **Skill Sets** - Skills sets are specific areas for which self-authorship takes place within each of the developmental dimensions (i.e., cognitive, intrapersonal, and interpersonal). Therefore, at each dimension, scholars have or are trying to understand what individuals are capable of doing at each of these dimensions for specific developmental levels. Scholars often “dig deeply” into one specific development dimension, or explore each of these dimensions (i.e., cognitive, interpersonal, and intrapersonal) separately and then try to weave together a story of development. While this approach is a start, it does not truly capture the nature of student development toward self-authorship. In describing her exploration of characterizing student development, Pizzolato (2007) emphasizes the importance of connection to practice—“To be a truly helpful too, an instrument should assess the degree of development in a way that informs practice” (p. 34). With an eye

towards connecting to practice, Pizzolato (2007) developed the Self-Authorship Survey (SAS) and the Experience Survey (ES) by “deconstructing the dimensions [cognitive, intrapersonal, and interpersonal] into skill sets” (p. 34) She used these skills sets— problem-solving skills, relationships with authorities, volitional competence, and autonomy—to organize these surveys; I see the opportunity to couple these skills sets with other developmental factors (e.g., cross-roads and behaviors). The skills sets described by Pizzolato (2007) and used to analyze this data are:

- a. Problem-solving skills – approaches to figuring out a solution to a dilemma
- b. Relationships with authorities – interactions with others, particularly related to dependence/independence in relationship to interdependence (e.g., mutual engagement in relationships)
- c. Volitional (competence) efficacy – “belief in one’s ability to persist in goal-directed behavior in the face of challenge (e.g., Corno, 1989, 1993; Gollwitzer, 1999; Kul, 1987)” (Pizzolato, 2005, p. 630).
- d. Self-regulation in challenging situations – regulating of one’s actions in the face of a dilemma

Appendix E: Students' Portfolio Artifacts

Participant	Description	Artifact type	Individual or group	Claim(s)
Carl	Concrete canoe	Co-curricular	Group	Management/leadership, communication
Carl	Metals report	Class	Individual	Technical communication, data analysis, technical skills
Carl	University Christian Union	Co-curricular	Individual and group	Leadership/management, planning
Carl	Kenya internship	Internship	Individual	Developing business proposals, teaching children
Carl	Marriage	Personal	Individual	Responsibility, communication, planning
David	Super conductors research paper	Class	Group	Technical abilities, technical communication
David	Research lab	Academic	Individual	Patience, problem solving, technical abilities
David	Eagle scout project	Co-curricular*	Individual	Leadership, individual dedication, community involvement
David	Robotics club	Co-curricular*	Group	Problem solving, design
David	Chemistry lab	Class	Individual	Technical knowledge, technical communication, adaptability, self-direction, independent research
Anna	DIY t-shirt design project	Personal	Individual	Project management, problem solving, creativity
Anna	Seattle Latino Film Festival Program	Internship	Individual	Communication
Anna	Research lab	Academic	Group	Teamwork, budget management
Anna	Presentation	class	Group	Presentation skills
Eric	Memo	Class	Individual	Communication
Eric	Technical instructions	Class	Individual	Communication

Eric	Research essay	Class	Group	Communication
Eric	Research poster	Class	Group	Communication
Eric	MATLAB script	Class	Individual	Technical abilities
Ben	Family pictures	Personal	Individual	Dedication, time management, multitasking
Ben	Skagit Valley College AA & transcript	Academic	Individual	Academic success
Ben	UW transcript	Academic	Individual	Academic success
Ben	Solid modeling project	Class	Individual	Technical ability, academic success
Ben	House re-model project	Personal	Pair	Time management, problem solving, team work, communication
Faith	Restoration project	Personal	Apprenticeship	Problem solving, mechanical inclination, persistence
Faith	Solarworld Industries America Internship	Internship	Individual	Diverse experiences, teamwork, work ethic
Faith	Dean's letter	Academic	Individual	Academic success, persistence
Faith	Robot project	Class	Group	Teamwork, adaptability problem solving
Faith	Student government handbook	Co-curricular*	Individual	Research, communication, planning, decision-making

* High school experience.