

Knowing Our Story: Framing a Cooperative Inquiry Project to Explore the Personal Growth of Graduate Students in Engineering Education

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Abstract

Doctoral education is often described by faculty and graduate students as “a journey”, “a learning process”, and “a transformative experience”. These descriptions speak to the experiential nature of doctoral education which aims at bringing about some change in students to prepare them for their future career. In the research literature, the path and process of becoming an engineering education researcher is an emerging field. In this paper, we present the framing of a co-operative inquiry project to explore our personal growth as graduate students.

Co-operative inquiry is a research method in which multiple people share and explore a topic from their own perspectives through collective dialogue, reflection, interrogation, and transformation. Our co-operative inquiry group consisted of the authors of this paper as co-researchers and co-subjects and is situated in our shared interest in graduate education and learning. While we are at different stages of the doctoral program, we have the mutual experience of completing the first year of the program at the same institution. We engaged in co-operative inquiry sessions, focused on learning *within* ourselves and *with* others, to make new meaning from our experiences. Reflections during the formative first year of doctoral training were explored as well as reflections and memos generated as part of the inquiry process. Through the co-operative inquiry process, this study offers insight into opportunities for peer-to-peer mentorship and learning enrichment in graduate studies. Our insight may support graduate students in discovering and charting their own personal journeys of learning and development in engineering education research. Our future work will be guided by our co-operative inquiry process and structure, with a focus on delving deeper into the aspects that make up our personal and collective story.

Introduction

As doctoral students, we are inspired to envision how we may position ourselves for future careers as teachers, researchers, and educational leaders: How will we inspire others? How will we formulate and communicate our vision for teaching and research? How will we affect change and innovation in education? To respond to these types of questions, we see a need to reflect on and share our personal “story”, as a launching point for our personal inspiration, vision, and actions. We frame the concept of “story” as a way of capturing what it means to become aware of who we are, to understand our process of growth, and to envision our future pathway moving forward (see also Adams et. al., 2007).

We believe that an examination of our story can reveal compelling insight into (1) our personal motivations for pursuing graduate school and (2) the challenges and opportunities for growth we have experienced during the program. With this insight, we will be able to better articulate and apply our learning to new experiences in the future.

To explore our personal and collective stories as graduate students, we formed a co-operative inquiry group with each of us acting as co-researcher and co-participant. Through our co-operative inquiry group, we were also interested in the ways that mentorship and peer support could enrich our Ph.D. experience. This paper is the beginning of an exploration into our stories and how those stories intertwine with aspects of our doctoral career path. We describe the emergent process of our group's formation and framing of our inquiry project. We will draw on evidence from our early inquiry sessions to show how we have chartered an approach for examining our personal story of development and the aspects of graduate school that we collectively share.

Background - Exploring the personal Ph.D. journey with others

As emerging educators and scholars, we believe the path of pursuing a Ph.D. is as much a personal journey of growth as it is an academic pursuit. Therefore, we approach the process of our graduate education as operating in two interrelated ways of personal development and professional training. Dall'Alba (2009) emphasized how the personal development of one's being is equally important to one's professional learning of knowing and acting (Dall'Alba, 2009). We describe the personal development space as "discovery of oneself" leading to the discovery of personal meaning and purpose in one's career. Our professional training is focused on developing the career-related knowledge, skills, and attitudes to be an educational scholar and consists of coursework, research projects, and other experiences in which we learn theories and methods to conduct research. In this professional context, the scholarship of *becoming an engineering education researcher* and *professional formation of engineers* is a growing field (National Science Foundation, 2017). For example, researchers have considered the conceptual difficulties of engineering educators learning educational research methods (Borrego, 2007; Streveler, Pitterson, Hira, Rodriguez-Simmonds, & Ortega-Alvarez, 2015).

With this research project, we aim to integrate the two spaces of the personal and professional by adopting an inquiry approach to learn about both personal and professional issues related to *being* a Ph.D. student and *becoming* an engineering education researcher (Dall'Alba, 2009). Prior research on experiences with becoming an engineering education researcher (Adams et. al, 2006; Gardner & Willey, 2016; Siddiqui, Allendoerfer, Adams, & Williams, 2016) have suggested: (1) a shared domain such as engineering education be supported through sharing personal experiences by those in the field, (2) community building is supported through collaboration with others with similar and different background and experiences, and (3) sharing stories reveals the true nature of professional work. An important distinction is that these studies focus on

researchers and educators while our study focuses on doctoral students. Moreover, traditional studies take a researcher/participant approach that distinguishes between researchers and participants. Our positionality is of researcher *as* participant which affords us the opportunity to learn about ourselves, about others, and about phenomenon that may emerge through the relationships between researcher and participant. Additionally, because of our place within our “becoming” pathway as doctoral students (Alias & Williams, 2011), we are engaged in reflection on our past experiences and reflection in our current program. Therefore, we have the unique opportunity to conduct research and take action towards impacting our experiences as doctoral students.

We believe it is important for researchers to be able to articulate their pathway in the research enterprise so that they may be able to inspire future students and can continue to grow their respective field. In support of this endeavor, our engineering education Ph.D. program has a fundamental course in the first year that are designed to introduce new engineering education students into the research community. In this course, faculty are invited to share their research area and pathway into engineering education research. Another example of sharing “pathway stories” is the Engineering Education Pioneers project (Atman, Turns, & Yasuhara, 2017) that offers a contemporary collection of rich stories and profiles of researchers and educators identified as “pioneers” in the field of engineering education. The project is an example of storytelling to “shed light on past change efforts in engineering education in order to facilitate continuing transformation in the field” (Atman, Turns, & Yasuhara, 2017). As individuals who live in relationship with others, we find ourselves to be natural storytellers. As Cron (2012) described, “story evolved as a way to explore our own minds and the minds of others, as a sort of dress rehearsal for the future” (p. 9). With this growing community practice of storytelling (Adams et. al, 2007), we seek to articulate our own pathway story into the engineering education research enterprise, so we may engage others in our work, inspire future doctoral students, and prepare ourselves for future research and teaching practice.

We adopted a theoretical and action-oriented approach to build our understanding of “our story” and to use inquiry sessions as an outlet for managing and overcoming our personal challenges in our Ph.D. program. In this way, this project is aimed at the dual purpose of fostering personal development and intellectual growth around our professional issues in graduate education.

Methodology and Methods

Based on our shared interests in using reflection to make meaning from our experiences, we formed a co-operative inquiry group to explore our individual and shared stories *into* and *through* engineering education research. We are four graduate students each pursuing the Ph.D. degree in engineering education at Purdue University. One author is a Ph.D. Candidate, two authors have passed their qualifying examinations and preparing to defend their research proposal, and one author is preparing for the qualifying examination. While we are at different

stages in our Ph.D. program we all hold the shared experience of completing the first year of the program at Purdue University.

For our project, we were inspired by methodologies and paradigms of autoethnography and co-operative inquiry, while being open to a fluid and emergent process that would fit our needs and accommodate our research styles. We introduce these methodologies as a way to frame our research orientations that guided our approach during the project.

Autoethnography. Autoethnography is a method that focuses on the researcher as the subject of inquiry. Some autoethnography is designed to be cathartic or self-therapeutic in intention, where the life of the researcher becomes a conscious part of what is studied in a way that reveals a deeper understanding of oneself and one's cultural environment. As Patton (2005) described, autoethnography works in an iterative manner where individual researchers move between analysis of their social environment and their personal experiences, while revealing different ways of knowing:

...autoethnography displays multiple layers of consciousness. Autoethnographers gaze back and forth. First, they look through an ethnographic wide-angle lens, focusing outward on social and cultural aspects of their personal experience. Next, they look inward, exposing a vulnerable self that is moved by and may move through, refract, and resist cultural interpretations. As they zoom backward and forward, inward and outward, distinctions between the personal and the cultural become blurred, sometimes beyond distinct recognition. (p. 48)

In our project, we use autoethnography to emphasize the narrative nature and personal sense-making of oneself and one's environment that we strive to achieve in this project. While the methods of autoethnography focus on a single subject's experience, we are also interested in the ways our individual experiences may be similar to others' experiences and how to make new meaning through dialogue with others. We turn to co-operative inquiry to address these research needs.

Co-operative inquiry. We utilize co-operative inquiry as a method because we are conducting research *with* other people who hold positions as co-researchers and co-subjects (Heron, 1996):

Co-operative inquiry involves two or more people researching a topic through their own experiences of it, using a series of cycles in which they move between this experience and reflecting together on it. Each person is co-subject in the experience phases and co-researcher in the reflection phases. (p. 1)

Decisions about the research project are made collectively and the process of research is grounded in a dialogical and cyclical process. As Collinson and Cook (2007) stated, "the act of working through an inquiry cycle—whether formally or informally—creates and uncovers new

knowledge that allows organizational members to propose more informed potential solutions and to make more knowledgeable decisions” (p. 96). In this way, the cyclical process helps move researchers to a new understanding and new positions for future action.

Our co-operative inquiry took the form of bi-weekly inquiry sessions in which we met in-person for one to two hours. In between the sessions, we were each tasked with writing reflections about the data from our pre-project artifacts and reflections based on the discussion from the inquiry session. The format of our inquiry sessions followed open sharing, discussion, interrogation and exploration, identification of inquiry questions, and generation of new artifacts and reflections.

Our goal with this project was to learn about ourselves and explore the characteristics of the internal and external elements that have contributed to our development. As our project developed, two spaces of inquiry emerged: 1) coming to know our story and 2) examining our story. For this paper, we will focus on the process of coming to know our story to share our inquiry approach, initial framings, questions, and insight. We will draw on elements of our story (inquiry space 2) to demonstrate how our inquiry process has developed. A deeper exploration and analysis of the elements of our story is currently in progress.

Our initial source of data was through personal artifacts generated prior to the initiation of the inquiry project. Subsequent sources of data consisted of our ongoing individual reflections during the inquiry process and the collective notes and ideas generated from discussion during the inquiry sessions. In this way, our reflections served as the medium through which new ideas and perspectives were brought to the inquiry sessions for discussion and exploration. The collectively shared notes generated during the inquiry sessions were recorded in an online collaborative project journal. While we present a condensed description of our process in sequential order of development, each of these developments occurred over multiple inquiry sessions.

Initial framing of inquiry group

Our “launching statement” (Heron, 1996) used to drive our initial framing was written as follows: *In what ways are you growing in your Ph.D. studies?* This broad question allowed us to be open to our individual topics of interests while honoring the perspectives and experiences each of us brought to the inquiry sessions. We aimed to explore our individual experiences and challenges around our personal pathway of being a doctoral student in engineering education.

The data collection of our pre-project artifacts was bounded by previous reflections and writings leading up to our entry in the Ph.D. program, during our first year of the program, and throughout the program. When applicable individual researchers chose to supplement their personal data with relevant reflection entries made during formal milestones of the Ph.D. program, for example, written reflections made during performance reviews, dissertation

proposals, and grant application essays. A list of documents collected are listed in Table 1 below. These documents were selected for their significance in our development, the formal nature of the writing task through which the reflections were situated (for example, the reflections were required for our coursework), and for offering a view into our thoughts and feelings at different time points.

Table 1

Pre-project data used for launching the co-operative inquiry.

Data Type	Description	Time of reflection
Admission Essays	Four essays written as part of the application to the Ph.D. program (statement of purpose, statement of research, statement of teaching, statement of diversity)	Written prior to starting the Ph.D. program
Coursework papers	Research and reflective papers on philosophy of engineering, education, and engineering education.	Written as part of the foundations course in the Ph.D. program
Coursework reflections	Reflections focused around becoming an engineering education researcher, becoming socialized into the community, navigating graduate study	Written as part of the foundations course in the first year of the Ph.D. program
Travel Grant and Fellowship application materials	Documents showing interest in and yearning for professional development and growth opportunities.	Written throughout the Ph.D. program.
Performance Review, Preliminary/Qualifying Exam Reflections	Collection of writings that target research interests and career planning.	Written at different formal milestones in the Ph.D. program (if applicable)
Ph.D. graduate portfolio	The portfolio targets the development of our graduate program's specified competencies.	Work-in-progress throughout the program

Our inquiry project began by first collecting the personal reflection documents identified in Table 1 and performing an initial review of the documents to become familiar with our personal data. From this initial “tour” of our artifacts, we individually generated a brief “primer

reflection” that was based on the pre-project reflections. This “primer reflection” served as the initial entry point for our first inquiry session.

As part of our initial framing, we sought questions that would explore the experience of engaging in the formulation of the “primer reflection” and becoming familiar with our personal data. For example, our initial questions for discussion targeted aspects of the reflective process (What was it like writing the “primer reflection?”), individual approaches to writing and thinking (How did you start looking at your reflections?), and preliminary identification of elements of interest (What are the features that are so special? Is there anything that stuck out to you? Is there anything that we all have in common?). In the inquiry session, we shared our “primer reflections” and generated individual notes on what resonated across the documents.

This initial framing helped each of us situate ourselves within the project and learn more about our shared intentions and interest. At this point, it was decided that we would not try to utilize any theoretical framework or lens to view the data, but instead to “let the data live for a while” (Project Journal Entry, Oct. 24, 2016), and to “let the data speak”. These qualities and decisions illustrate the emergent nature of our inquiry in the search for shared understanding as well as collective decision making on the inquiry process.

An emergent and generative process of inquiry

Our action-reflection cycle (Heron, 1996) involved each of us generating reflections and questions during the action phase (occurring individually between inquiry sessions) and then bringing those reflections and questions to the sessions for discussion and interrogation. We found ourselves using divergent and convergent thinking to come to inquiry questions, as well as moving between personal and collective topics of interest in the form of abstractions from personal meanings to potential meanings for the overall phenomenon of graduate studies. For example, a collective topic of interest considered that while our paths may be different, we are very interested in the ways that our experiences are similar (Project Journal, Jan. 20, 2017). This realization of similarity brought new feelings of meaningfulness, in the form of connection with others, and support in recognizing that “we are not alone” as we go through the Ph.D. program (Project Journal Entry, Jan. 27, 2017).

Based on the inquiry session around our primer reflections and pre-project data, we identified four questions (Table 2) to be addressed during the next reflection-action cycle of inquiry.

Table 2

Reflection prompts for exploring “primer reflection”.

Reflection Prompts	Description
What changed?	This question aimed to explore aspects of change and transformation. Additionally, change does not necessarily mean positive change or negative change.
What stayed the same?	This question aimed to identify our current position and elements that have not changed.
Do you notice any enhanced understanding or growth?	This question explored areas where elements may have been identified in the pre-project reflection and have become more salient and noteworthy today. For example, what did you say previously that you still agree with but now understand more deeply or differently?
Are there any tensions in your experiences?	This question aimed to explore tensions and challenges of graduate study experiences.

The generative process is also evident as we generated new data through our discussion and preliminary analysis. This data was captured through individual written reflections, a shared project journal, and visual artifacts. Additionally, our inquiry process was emergent in that we did not establish specific frameworks for inquiry or analysis, or for specific topics of inquiry. Our inquiry topics were driven by our personal needs and interests, and as we collectively learned more about each other’s experiences.

Going deeper with our inquiry questions

We have noticed how our inquiry process has gone deeper as we encouraged and challenged each other to explore and explain our thoughts and feelings. This process has also helped us converge on targeted areas of interest for further exploration. Building from the inquiry questions generated after the first pass of the data (Table 2), we identified a temporal structure to organize inquiry questions that considered experiences in the past, present, and future (Table 3). These questions are situated in the context of our goals of the inquiry project and represented the next iteration of our inquiry development.

Table 3

Inquiry questions with temporal and emotional focus.

	Inquiry Question	Description
Past	What past dreams of the future did you experience?	This question aimed to elicit motivations and aspirations about what we hoped to achieve in pursuit of graduate studies.
Present	What are you surprised about that has or has not changed?	This question aimed to elicit perspectives on growth, transformation, and progression in the context of graduate school, our learning experiences, and personal development.
Future	What scares you about the future?	This question aimed at targeting a future-oriented perspective and to reveal challenges, barriers, tensions, and fears.

We observed that the nature of these questions targeted a deeper layer of feelings and invoked a different sense of exploration. We found that these questions inspired visceral feelings of our thinking and being, and helped take our inquiry “to a deeper level more connected with emotions” (Project Journal, Jan. 20, 2017). In the first set of questions (Table 2) the focus of inquiry was on the phenomenon of graduate study. In the second iteration of questions (Table 3), the use of the words “dreams”, “surprises”, and “scares” were intentionally chosen after discussion on what it is we *really* wanted to uncover. The questions are framed in a way that places the focus and emphasis on our personal feelings in relation to the aspects of our story. We used this language and this iteration of questions as devices to help “bring our thoughts to life” and to explore the richness and depth of meaning in our stories.

Discussion

In this paper, we have demonstrated how our process of inquiry was initially framed and structured to follow multiple reflection-action cycles. We have presented the emergent nature of generating inquiry questions to show how our questions initially started at a highly conceptual and abstract level and have moved to a deeper, visceral space that targets feelings of the graduate experience in the form of dreams, surprises, and fears. Figure 1 below illustrates a process map that summarizes the development of our co-operative inquiry project.

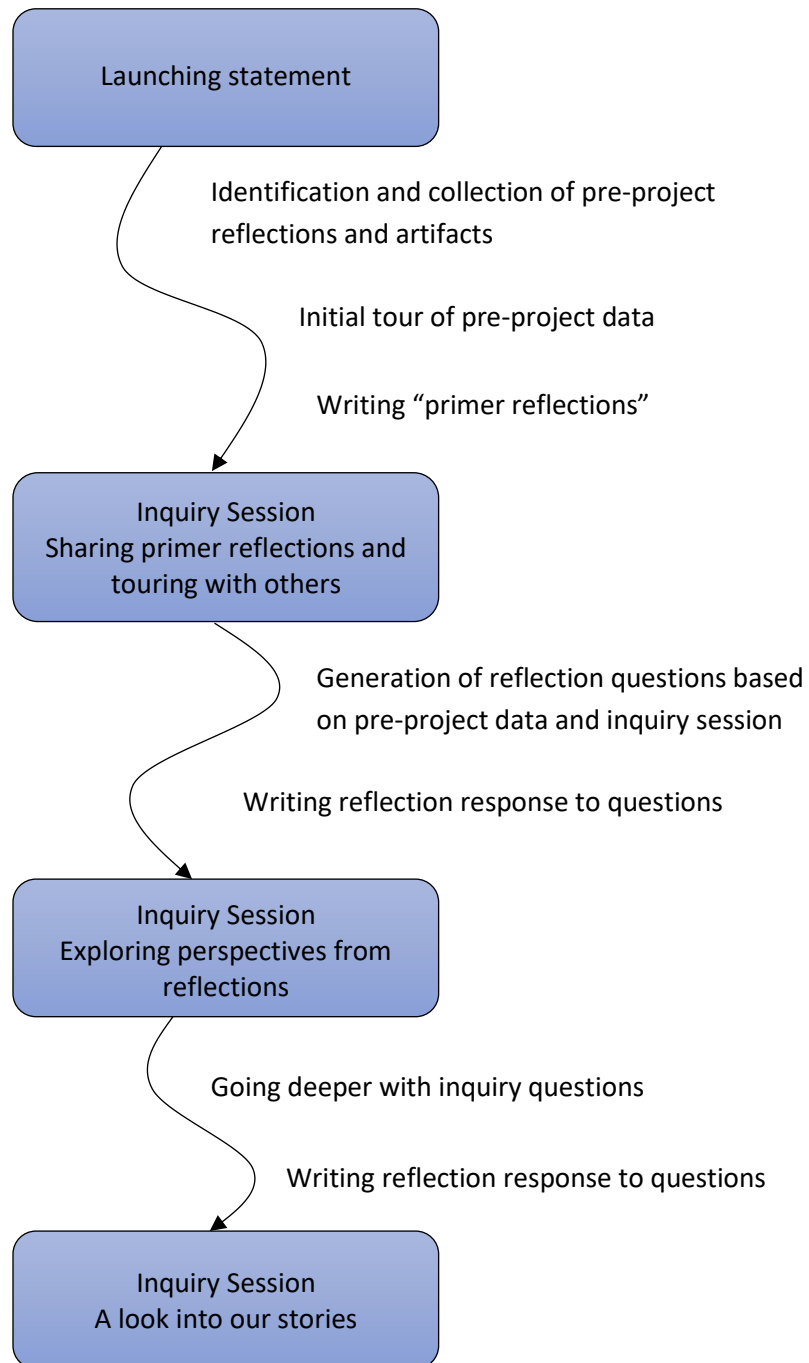


Figure 1. Process map of our co-operative inquiry development.

Although this process map ends with the block labeled “Inquiry session: A look into our stories”, this block marks the beginning of the next phase of our inquiry project. As we continue to hold inquiry sessions that explore and examine “our story”, the nature of our inquiry project will move towards a deeper reflection and articulation of story elements so that we may implement action-oriented practices to solidify our learning and growth.

We hope that the story of our pathway in the engineering education community will be beneficial for newcomers and current members alike. We see the potential for fellow graduate students to initiate their own co-operative inquiry group and relate to our stories and process, or pieces of it, in their own personal and professional development. Sharing our story may help readers articulate their own stories, appreciate their path, and increase their sense of belonging in the engineering education community. We believe that the major elements of our stories transcend the borders of engineering education and connect to the broader graduate student experience. For example, finding and rekindling the deep personal connection to our research work became a topic of interest. In addition, the ability to affect change while being authentic and true to our values was another topic of interest that arose throughout the discussions of the future and fear.

Qualities of our co-operative inquiry group. For researchers and students seeking to embark on a co-operative inquiry, the generative and emergent nature of the work can be a challenge and enriching aspect of the process. We have identified elements of our inquiry group that contributed to the effectiveness, enjoyment, and uniqueness of our inquiry project as a tool for personal development. Our co-operative inquiry was formed on the basis of mutual experiences in the foundational first year Ph.D. program. This shared experience offered a common ground from which to launch our project and facilitated the start-up of the project since we each had prior experience with reflection and the scholarship of becoming an engineering education researcher. Our inquiry group also benefited from a level of trust and external forces that contributed to bringing us together. Our research lab groups share an open and intimate, collaborative work space. Also, we have mutual graduate advisors who supported engagement among our research lab groups prior to the formation of our formal inquiry group.

The kinds of questions and nature of our inquiry required a high degree of commitment and willingness to engage in the project, given the vulnerable nature of the inquiry and potential for discomfort. Inherent in our inquiry group was the confidence that our inquiry sessions would be held in private. We could share openly without fear of negative repercussions or power dynamics. This environment of safety and collegiality allowed us to fully engage in peer-to-peer sharing, learning, and mentorship. We each sought to develop meaningful relationships with each other as our group shared a commitment to the project and a commitment to learn about each other. This quality of peer mentorship was an element of the inquiry process that was identified at the start of the project, but did not become a focus of the co-operative inquiry. Nonetheless, sharing and openly discussing our individual stories and motivations in the program, and across cohort years, allowed us to learn from one another and take advantage of our diverse perspectives.

Conclusion and Future Work

This paper has explored elements of what it means to “know your story” and has demonstrated one way through which we have come to know our story as four Ph.D. students in engineering

education. Our future work will continue to explore, discuss, and interrogate the content of our collective stories. We have offered insight into our process of co-operative inquiry formation and structuring as a way for other graduate students, researchers, and educators to engage in co-operative inquiry.

As the Ph.D. process challenges us personally and intellectually, we see the greatest benefit of our inquiry group as the opportunity to learn about ourselves in community with others in a supportive environment specially fitted for our needs. We believe that learning our personal stories offers a way to formulate meaningful connections with others and engage in personal reflection. At the same time, our stories and action-oriented approach through inquiry sessions may illuminate challenging aspects of change along the Ph.D. journey and offer a supportive mechanism for learning and navigating through these changes.

We believe that co-operative inquiry in doctoral education offers many unique opportunities for learning. We hope that this project can inspire others to learn and share their story in such a way that new connections and meaning can be made. The practice of co-operative inquiry can be applied to other learning experiences such as communities of practice, peer coaching, reading circles, doctoral seminars, and leadership and professional development initiatives. Our project was inspired by these different types of formats while enabling us to meet our individual goals and collective aspirations. We will continue our inquiry sessions into the nature and qualities of our personal stories, with the aim of abstracting overall themes that honor our unique perspectives while capturing broader areas of focus for enriching graduate education.

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