



Developing Leadership in Civil Engineering: Turning Students' Hindsight into Others' Foresight

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Dr. Simmons has extensive experience leading and conducting multi-institutional, workforce-related research and outreach. She is a leader in research investigating the competencies professionals need to compete in and sustain the construction workforce. Dr. Simmons oversees the Simmons Research Lab (www.denisersimmons.com), which is home to a dynamic, interdisciplinary mix of graduate researchers and postdoctoral researchers who work together to explore human, technology and society interactions to transform civil engineering education and practice with an emphasis on understanding hazard recognition, competencies, satisfaction, personal resilience, organizational culture, training, informal learning and social considerations. The broader impact of this work lies in achieving and sustaining safe, productive, and inclusive project organizations composed of engaged, competent and diverse people. The SRL is supported by multiple research grants, including a CAREER award, funded by the National Science Foundation (NSF).

Dr. Simmons is a former project director of the Summer Transportation Institute (STI) at South Carolina State University and Savannah River Environmental Sciences Field Station (SRESFS). Both programs were aimed at recruiting, retaining and training women and minorities in transportation, environmental science and engineering and natural resources-related fields of study. As SRESFS director, she led a board composed of 29 colleges and universities.

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Abstract

This paper introduces one component of a multi-phase, multi-institution, mixed methods National Science Foundation-funded study. The overall project is exploring how leadership is defined in civil engineering and construction from the student, faculty, and industry perspectives. The research began by ascertaining how leadership is understood from professionals' points of view and which competencies they consider important for engineering graduates entering practice. These competencies were presented in an online survey to faculty and students to examine similarities and differences between the stakeholders. A sub-set of students and faculty were interviewed to gain deeper insight into their conceptualizations of leadership and influences on their leadership development. The student interviews informed the development of a grounded theory of leadership development in the undergraduate civil engineering and construction experience. This paper focuses on the preliminary development of the grounded theory model.

Introduction

There are limitations in the current understanding of leadership that necessitate further study of how the concept is defined and developed in civil engineering and construction (CEC). In the CEC literature, leadership focuses on who a leader is and their skills or actions, which maps to the trait and behavior periods, respectively, in leadership studies [1]. These periods were dominant in the first half of the 20th century in leadership studies but still dictate the conversation in CEC education and practice. These leader-centric paradigms focus on leader development, training charismatic technical experts for supervisor roles, instead of leadership development, a culture that shares the leadership and followership processes. Contemporary understandings of leadership (e.g., [2]) underscore this holistic context in which leadership and followership transpire. This framework is pertinent for CEC because it accounts for the broader ecosystem and the societal context in which engineering is embedded and plays a significant role in underscoring the skills that engineers need to address societal challenges. As a result, the traditional way of conceiving leadership in CEC education and practice is at odds with contemporary conceptions while those contemporary conceptions have not been applied specifically to the CEC context. This research aims to bridge that gap.

Project Summary

Motivation

This National Science Foundation-funded project addresses the overarching research question: How is leadership competence defined, developed, and measured to enable undergraduate engineering students to tackle the challenges of today and tomorrow? Through multiple phases, the research is investigating the conceptualization of leadership from industry, undergraduate student, and faculty perspectives. Building on these findings, the project aims to develop a model of undergraduate student leadership development and create an instrument to measure leadership self-efficacy and its relationship to power.

Study Design

This multi-phase and multi-institution study employed quantitative and qualitative approaches to explore engineering leadership. The study design is displayed in Figure 1.

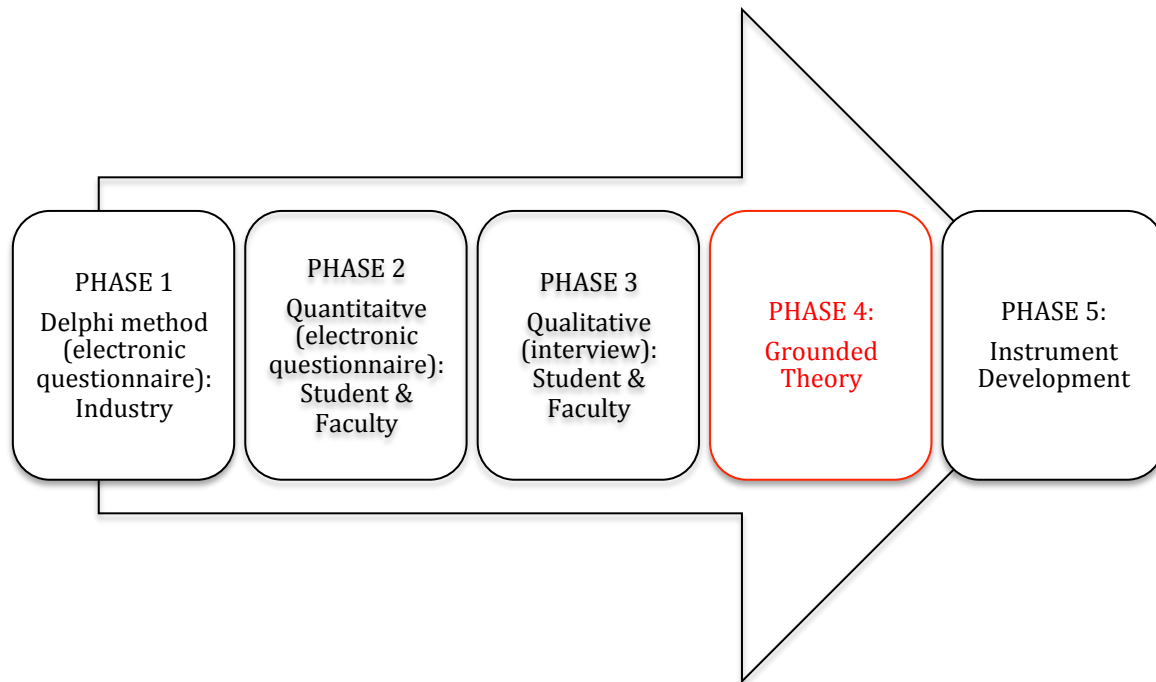


Figure 1: Study design

Data collection for Phases 1-3 is complete. Phase 4, the focus of this paper, is ongoing at the time of writing. The preliminary grounded theory model has been developed and will be described. Phase 5 is ongoing during spring 2020.

Phase 1 Summary

The first phase was designed to understand which competencies industry professionals view as most important for graduates entering the CEC workforce. A Delphi method was employed to achieve this end. The Delphi method uses surveys distributed to a panel of experts to elicit anonymous feedback and eventually converge on consensus around a topic. For this study, panelists were invited to participate based on four criteria: they (1) were employed in CEC, (2) had at least 10 years of industry experience, (3) held a management position, and (4) served on a college advisory board. The 26 panelists participated in three rounds of the Delphi until they reached consensus on the most important competencies for graduates entering the CEC workplace. This process resulted in a framework of 19 professional competencies, as detailed in [3]. The competencies that were identified as most important for new professionals in CEC were communication skills, ethics/responsibility, professionalism, critical thinking/problem solving, and “big picture” thinking.

Phase 2 Summary

The next phase explored whether the competencies identified as important by the industry experts were considered important by undergraduate students and faculty members. This phase also sought to explore the leadership experiences and perspectives of students and faculty. An online survey was completed by 74 faculty members and 2209 undergraduate students (87% of which were engineering majors). The students were asked about their involvement in leadership clubs/programs, opinion on the importance of leadership in their future career, and knowledge of the industry in which they prefer to become employed after graduation. They were also asked to consider the industry in which they want to be employed and rate on a scale from 0 to 100 (highest) the importance of each of the competencies from the Delphi process. Analysis of the results is ongoing.

Phase 3 Summary

Following the survey, a sub-set of student and faculty respondents were invited to participate in an interview. The interviews were designed to explore leadership involvement, professional preparation, and workforce entry in greater detail. In 2019, interviews were completed with 14 undergraduates in CEC and 13 faculty members. Faculty interviewees were asked about their professional experience, leadership perspectives, and personal instruction. The semi-structured student interviews covered a range of topics including participants' pathways to their engineering major, the skills they expect to need for future success, their interactions with faculty, their out-of-class activities, and their perspectives on leadership. Most of the interview participants were nearing the end of their undergraduate education so they could reflect on their experience and impending transition to industry. As a result, they had the benefit of hindsight, which offered important implications for understanding the development of leadership self-efficacy throughout the college experience. Analysis of the findings is ongoing.

Phase 4: Focus of the Present Paper

The student interviews were designed to inform the development of a theory and model of leadership self-efficacy and understanding. Constructivist grounded theory [4] was used as the methodological framework for this part of the study. According to Charmaz [4], constructivist grounded theory is built on the assumption that there are multiple realities, not a single objective truth. It also recognizes that data is mutually constructed in research through interaction with the participants. This assumption recognizes that the researcher builds theoretical concepts instead of them emerging from the data, and as a result, there is an understanding that the researcher has values that affect their views. The constructivist approach was used since the researchers sought to understand how and why CEC students construct meaning in the development of their leadership self-efficacy. It also acknowledges that leadership development and attribution are situated in the lived experience of each individual student so there is no single truth for how those processes are facilitated and manifested.

Constructivist grounded theory is employed when there is no existing theory to explain a phenomenon or when an existing theory needs to be further developed for a sample population. Existing theories that relate to the phenomenon and sample can serve as sensitizing concepts that enable the understanding of the phenomenon in a particular context. This research drew sensitizing concepts from Leadership Identity Development [5]-[7], Full Range Leadership model [8], and Theory of Involvement in college [9]. While these extant theories and models

provide ways to understand different facets of leadership development, identity, and involvement, no single framework captures students' process of internalizing leadership self-efficacy in the context of undergraduate CEC.

Model

The grounded theory was centered around the core phenomenon of undergraduate CEC students' perceptions of their self-efficacy and understanding of leadership, both in how they currently engage with it and how they anticipate engaging with it during their future careers. A preliminary grounded theory model was developed based on iterative coding, memo writing, and discussion between the three authors. The detailed analytical process is not presented because this phase is ongoing. Analysis of the interview transcripts indicated that before understanding this phenomenon, it was instructive to identify each participant's ontological underpinning. Whether a student perceived leadership as something that could be learned or not was a driver in how they constructed meaning of leadership and articulated it in the interview. For example, when asked about where and when CEC students should learn about leadership, Phil responded,

So, this is going to be a very unpopular opinion, but I personally don't think that leadership can be taught. I think that people are just born with it. It's like are you born to be a basketball player? I think it's the same thing. Yes, this guy is just naturally more charismatic, he's better at leading people in general. I feel like there's nothing that can teach a person.

This stance informed his perception that leadership self-efficacy was innate and therefore relatively stagnant and that leadership could not be developed in the classroom. Students' ontological perspective thus shaped the experiences they described as developing their leadership, the roles of others (e.g., mentors, professors, self) in supporting their leadership development, and their awareness of the pathways through which they and their peers can grow in their leadership self-efficacy.

The model is shown in Figure 2 as an early anchor point in our data analysis and synthesis process and to solicit input from the engineering education community on the initial conceptualization.

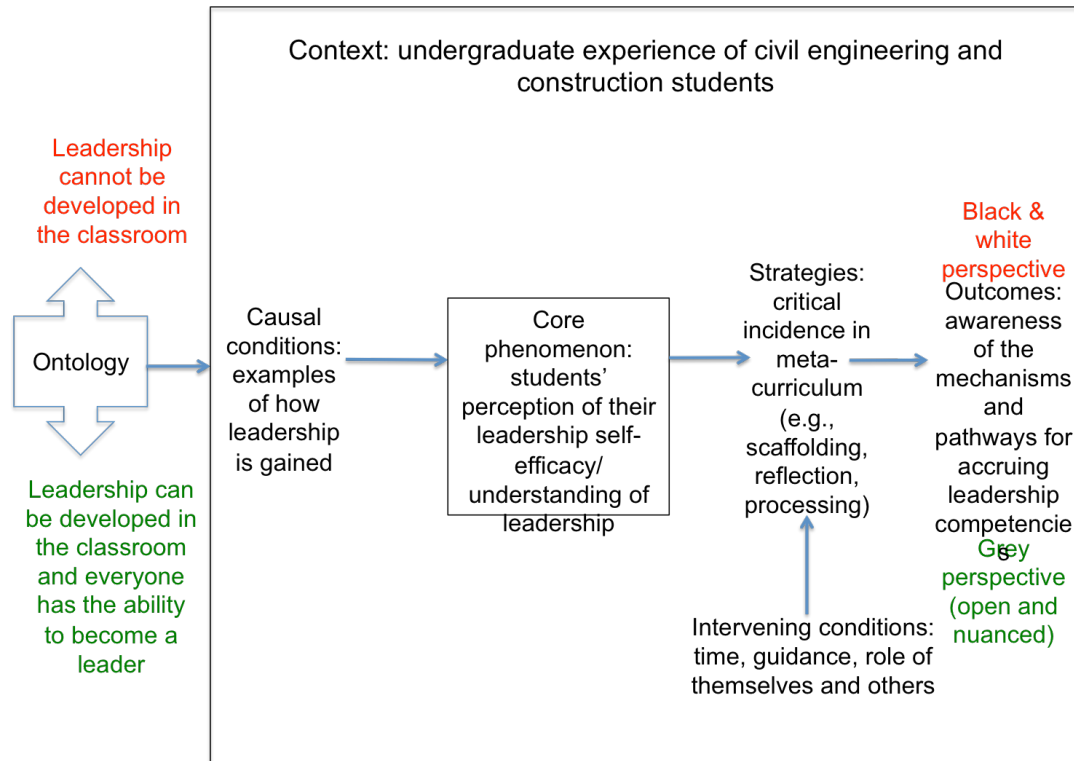


Figure 2: Preliminary grounded theory model

Next Steps and Future Directions

The findings from the student interviews and preliminary model are being used to inform the development of an instrument. The instrument will include measures related to power, shared process of leadership, transformational leadership skills, self-efficacy, and motivation to expand our understanding of how undergraduate engineering students perceive and engage in leadership based on constructs that were salient in the qualitative phase.

Acknowledgments

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