

# Uncovering the Hidden Curriculum of Leadership Education in Civil Engineering\*

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The undergraduate experience is crucial for developing competencies and socializing future engineers into the profession. Leadership is a key outcome of engineering education that individuals are expected to develop for employment and advancement and that the profession is expected to demonstrate to address complex and interdependent societal challenges. Despite the growing inclusion of leadership in the formal curriculum in part due to accreditation criteria and industry pressure, there are persistent concerns over engineering students' workforce-ready leadership competence. This research examined how 13 civil engineering undergraduate students at four institutions in the United States define leadership and understand its development through the lens of the hidden curriculum. This framework was selected to conceptualize values and beliefs that are unintentionally transmitted to explore the potential misalignment between how leadership is formally taught and inadvertently learned. Thematic analysis of the semi-structured interviews indicated the varying ways in which students understand whether leadership can be learned, how leadership is defined, and who can lead. The findings are viewed through hidden curriculum to uncover their taken-for-granted beliefs and situated in the literature to show the tension between students' perspectives and contemporary leadership theory. Since students learn about leadership throughout their lives, inside and outside the classroom, this research does not attempt to trace the roots of these leadership beliefs. Instead, this paper uncovers students' tacit understandings of leadership to offer implications for educators and programs to recognize students' understandings and support their leadership development.

**Keywords:** leadership; hidden curriculum; civil engineering

## 1. Introduction

The undergraduate curriculum is a key component in the professional formation and workforce development of future engineers. Educators have long focused on engineering science and problem solving as the bedrock of an engineering degree. However, working in an increasingly interconnected and technology-dependent global workforce requires engineers to have a broad set of skills that reach beyond the historically narrow technical focus of engineering [1]. The development of interpersonal, intrapersonal, and professional competencies is important for engineering graduates to be successful in industry [2]. The National Academy of Engineering [1], ABET [3], and industry [4, 5] acknowledge the importance of leadership as one of these professional competencies. In the engineering profession, leadership is essential for organizational competitiveness and individual advancement [6]. On a broader scale, leadership enables the engineering profession to address complex challenges and drive forward innovation.

Although many engineering programs have goals

and vision statements related to training future leaders, the majority lack a formal mechanism and systematic approach for developing students' leadership [7]. Students, however, learn far more in the classroom than what is explicitly contained in course lessons and objectives. Given the traditionally narrow focus of the curriculum and thus the privileging of technical skills, some of what students learn about leadership and leadership development might be unconscious and unintentional. The hidden curriculum describes the transmission of implicit attitudes and behaviors [8]. Turning an eye to the tacit values and messages of engineering education might make visible what is otherwise a blind spot in the curriculum. To better understand students' perceptions of leadership, this study explores what engineering undergraduates learn about leadership through the lens of the hidden curriculum.

## 2. Background

Leadership is included in accreditation criteria, as programs must demonstrate their students' "ability

to function effectively on a team whose members together provide leadership” [3]. Instruction related to leadership is left to the discretion of each engineering program, and unlike math, science, and engineering topics that have specified curriculum requirements within ABET, leadership is part of the “broader education component” and often embedded within the culminating design experience [3]. However, engineering is not monolithic and each discipline has unique challenges and opportunities to which the curriculum has to respond, as indicated by disciplinary program-specific criteria for accreditation [3].

### *2.1 Importance of Leadership Development in Civil Engineering*

Civil engineers have a unique responsibility because their work is situated at the nexus of the natural and built environment. As a result, they have been historically credited as the architects of civilization, acknowledging their role in creating the vital infrastructure that underlies modern society. In more recent times, this view has shifted as some claim civil engineers have lost their eminence and respected role in the community and world at large. Arciszewski [9] argued civil engineering is currently undergoing an identity crisis and needs to take steps to regain its leadership role in society. This crisis is partially due to new challenges confronting civil engineers. The profession must respond to populations shifting to urban centers, growing emphasis on sustainability, increasing risk of natural hazards, and failing infrastructure. As civil engineering is “entrusted by society to create a sustainable world and enhance the global quality of life,” both the profession and individuals within it are expected to act as leaders [10] (p. 9).

### *2.2 Leadership Development in Civil Engineering Education*

The importance of leadership in practice necessitates leadership development in civil engineering education. Undergraduate education provides an optimal time for formal leadership development of engineers. Given the variable level of on-the-job training for leadership [6], the civil engineering education curriculum provides an institutionalized opportunity for all future engineers to develop leadership. Additionally, leadership education at the undergraduate level can facilitate engineers’ ability to move from entry-level to management once in the workforce [11, 12].

The college experience of civil engineering undergraduates provides a range of curricular contexts in which leadership can be taught and developed [13]. Curricular activities can provide opportunities to put leadership knowledge and skills into practice.

The classroom fosters technical knowledge, which then contributes to social power and opportunity to exercise leadership. For example, group projects in courses can facilitate the development of leadership skills by allowing individual students to act as group leaders [13]. Engineering programs at James Madison University and University of Texas at El Paso have an explicit focus on leadership development through project-based learning and learner-centered approaches that foster the holistic training of versatile engineers [14]. Although the number of initiatives focused on leadership development in engineering is growing, most programs are relatively new, their sustainability is tied to the champion faculty member who established them, and they are situated outside the technical core of the curriculum (e.g., based in business or management) [7].

Out-of-class activities, such as design competition teams and student chapters of professional societies, have also been cited as opportunities to develop leadership [15]. One caveat in this consideration is engineering students tend to participate in fewer co-curricular and extra-curricular activities and to a smaller extent than their peers in other majors given their heavy course load [16]. Even within engineering, there are differential opportunities and barriers for students seeking out-of-class activities based on demographics such as parent income and education level [17]. For example, students participating in undergraduate research tend to have parents with higher income and education, are high achieving, and interact with faculty to a greater extent [18]. As a result, relying on out-of-class activities to develop leadership as a work-around for not making space in the formal curriculum for leadership development may fail to provide sufficient exposure for all engineering students. In-classroom instruction addressing leadership therefore becomes critical for civil engineering undergraduate leadership development.

### *2.3 Challenges to Teaching Leadership*

The complexity of leadership makes it challenging for engineering educators to teach [13, 19]. Despite its recognized importance, some faculty members “simply do not know how to cultivate leadership attributes within the constraints of academics” [6] (p. 6). Simmons and colleagues [15] argued embedding leadership development into an already-full civil engineering curricula is not a matter of adding courses or programs but integrating into existing courses with a clear and contextualized emphasis on values-based leadership competencies and processes.

Another challenge in leadership development is technical and social competencies are often

decoupled in engineering education despite being inseparable in practice [20]. The technical and social dualism pervasive in engineering, which privileges technical skills over social skills, is one of the pillars of the culture of disengagement [21]. By teaching technical and non-technical skills separately, engineering faculty may be transmitting the false notion of their separation via the hidden curriculum. Since leadership in engineering can be defined as the convergence of technical, interpersonal, and managerial skills [19], this dichotomy can have important implications for how students understand and practice leadership.

To ensure a smooth integration of leadership development into existing curriculum, educators need to be aware of existing messages being transmitted through the hidden curriculum. These messages include the visible, explicitly stated learning outcomes associated with technical content and the implicit, hidden ideas that might include technical and social dualism and as-of-yet unidentified perceptions of leadership.

### 3. Theoretical Framework

This study is underpinned by the theory of the hidden curriculum, a framework for exploring what is learned instead of focusing on what is taught in education [22]. Three types of curricula – formal, null, and hidden – define the learning environment [23]. The formal curriculum is the official guidelines, lessons, and rules that determine what schools and educators teach. The null curriculum is what is not taught, whether due to explicit mandates against certain material or an educator's lack of knowledge. The hidden curriculum is the tacit and unintended lessons and values students learn. Hafferty [22] also adds that learning can take place through the unscripted interactions between instructors and students (the informal curriculum).

The hidden curriculum framework has been applied to medical education [8, 22, 24], law school [25], and dental education [26] to understand the lessons students acquire outside of what is formally stated and intended and to uncover ways to reform the educational experience. There is limited application of this framework in the engineering context. Villanueva and colleagues undertook the first exploration in engineering education to understand the hidden curriculum and its effects on students with a particular focus on broadening participation and increasing persistence of underrepresented students. This work has identified mechanisms behind hidden curriculum in engineering including the role of emotions, self-efficacy, and self-advocacy [23]. Mechanism is conceptualized as

the construct through which students process hidden messages and thus how the hidden curriculum operates and transmits lessons. As part of their broader project, the framework has also been used to compare student and faculty perspectives on expectations in engineering and sources of those expectations [27] and faculty socialization [23].

The hidden curriculum has been conceived as unintended learning with implications for how students are conformed to societal expectations, which shapes their professional formation [28]. Consequently, the framework is an important part of socialization [29]. Through the formal curriculum, students acquire the skills and knowledge needed for their future work and through the hidden curriculum, they acquire the values and attitudes that characterize their occupation. Socialization marks the progression from neophyte to professional that begins during academic training [30]. The university is “a major point of origin and transmission of engineering culture, as exhibited in the behavior and attitudes of both engineering students and faculty, and in classroom procedures and general atmosphere” [31] (p. 343). This process of socialization plays a significant role in engineering since the profession is defined by a unique culture and responsibility in society. Engineering culture is marked by prioritization of technical skills [32], masculinity [30], and disengagement with public welfare [21]. These attributes are not formally taught in the curriculum but are enculturated in the educational process. Students' understanding of what it means to be an engineer has important implications for their professional development and prioritization of skills they deem important for their future career.

The majority of research on engineering leadership education has focused on the formal curriculum to document leadership programs, courses, and pedagogies [7, 33]. However, the importance of leadership in the formal curriculum may be undermined if it is not valued in the hidden curriculum. The attitudes and messages salient in the learning environment transmit to students' values as they implicitly learn what it means to be an engineer. Although the hidden curriculum is usually used in the context of negative implications, there are also opportunities to leverage the hidden curriculum for positive shifts in the culture of engineering education. The contribution of this study is to examine leadership through the lens of the hidden curriculum given its limited application in engineering education broadly and engineering leadership specifically. The aim is to make visible what may otherwise be hidden since awareness and acknowledgment of the hidden curriculum can enable educators to address it in their classrooms.

## 4. Research Question

This study explored the following research question through the lens of the hidden curriculum by exploring tacit values and normative assumptions related to leadership:

*How do civil engineering students define leadership and understand its development?*

## 5. Methods

### 5.1 Study Context

This study is embedded in a larger project exploring leadership from the student, faculty, and practitioner perspectives. The broader research aims to synthesize a definition of leadership in civil engineering and examine the competencies needed to successfully practice leadership in industry while understanding alignment, or lack thereof, between perceptions of key stakeholders. The present study focuses on student perspectives through a qualitative approach to understand what they learned about leadership through the hidden curriculum.

### 5.2 Participants

Thirteen civil engineering undergraduate students

participated in the study. Interviewees were recruited based on their participation in the preceding quantitative phases of the larger project, which included responses from 1888 undergraduate engineering students across the eight institutions included in the project. Respondents completed an online survey related to leadership and could indicate their willingness to participate in a follow-up interview. A total of 71 civil engineering undergraduate students provided their contact information for a follow-up interview. Only students who indicated on the survey they were knowledgeable about the importance of leadership in the industry in which they want to be employed ( $n = 28$ ) were considered. The other selection criterion was being in at least their third year of study to be able to reflect on their college experience. The participant selection process, generated from the survey in the larger project, and the criteria at each step are summarized in Fig. 1.

Participant information is shown in Table 1. Participants were asked to select a pseudonym at the beginning of the interview. Although eight institutions were included in the larger study, the final sample of 13 interview participants represented four institutions.

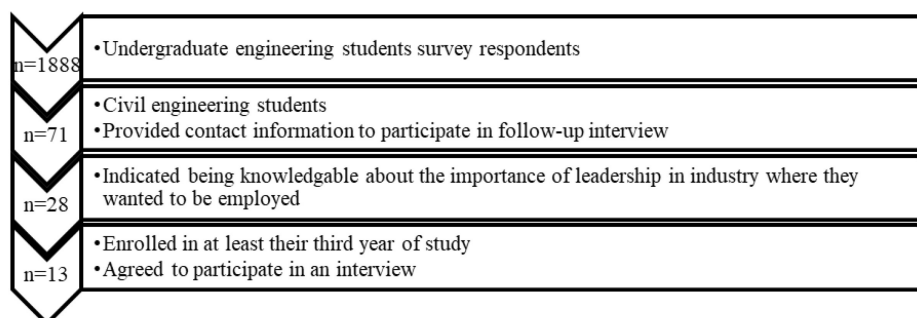


Fig. 1. Participant selection.

Table 1. Participant Information

Pseudonym	Gender	Race	Year	Institution Pseudonym
Albert	Male	Hispanic or Latinx	4th	Southeast University
Beca	Female	White	5th	Southeast University
Lily	Female	Information not provided	5th	Southeast University
Tobias	Male	East Asian or Asian American	5th	Southeast University
Alex	Female	Hispanic or Latinx	3rd	Southeast University
Mike	Male	Information not provided	6th	Southeast University
Max	Male	Hispanic or Latinx	2nd (after transferring)	Smaller Southeast University
Kim	Female	White	4th	Mid-Atlantic University
Shelby	Female	White	4th	Mid-Atlantic University
Kaitlyn	Female	Information not provided	3rd	Mid-Atlantic University
Phil	Male	East Asian or Asian American	5th	Midwest University
Charles	Male	South Asian or Indian American	4th	Midwest University
John	Male	White	4th	Midwest University

### 5.3 Data Collection

Interviews with the students were conducted in 2019. The interviews were designed to explore students' understanding of skills necessary to be successful in their future field, their experiences inside and outside the classroom that developed these skills, their perception of leadership in civil engineering, and the role of engineering faculty and coursework in teaching leadership. The interviews were semi-structured and included questions such as:

- What do you see yourself doing after you graduate from your program?
- Keeping this future goal in mind, what do you need to be successful in your career?
- Where did you learn what you need to be successful in your career?
- What do you know about leadership?
- How do you define leadership in your field?
- When do students in your field learn leadership skills?
- What are your instructors' roles in developing you as a leader?
- Do you feel students should learn about leadership inside or outside the classroom?

An undergraduate civil engineering student conducted the interviews in-person or via video. This approach was taken so the interviewees would feel more comfortable discussing their experiences related to their courses and instructors with someone similar to them in age since they might not have been as candid if speaking with a faculty member. The student interviewer completed the institutionally mandated training for conducting research with human subjects and received training on interviewing from mentors: a postdoctoral researcher and faculty member with extensive qualitative experience. The training included use of reference material, pilot interviews with the faculty mentor, and debriefing with the postdoctoral mentor after interviews. The interviews lasted approximately an hour, were audio recorded, and transcribed verbatim.

### 5.4 Data Analysis

Thematic analysis [34] was conducted and employed multiple cycles of coding to capture the complexity of the phenomena, as recommended by Gelles and colleagues [35] in their exploration of hidden curriculum in engineering. The first cycle involved in-vivo coding to capture, in the direct words of the participants, the normative values and internalized assumptions students expressed related to leadership. This process led to 189 transcript excerpts as in-vivo codes. For the second cycle, the

in-vivo codes were revisited and grouped into summary codes that represented similar ideas, leading to 46 codes. For the third cycle, the summary codes were organized and condensed into thematic categories. The thematic categories captured patterns in the data related to similarities and differences in how students define and understand leadership.

The first author developed the initial codebook through the first two cycles of coding, which the second author reviewed. The first author, an engineering education researcher, and the second author, an education and leadership researcher, iteratively discussed the codes to develop the thematic categories in the third cycle. The analytical process followed the criteria for trustworthiness in qualitative research [36]. Credibility was established through the peer review and inter-rater reliability process to refine the codebook and develop the thematic categories. Transferability was situated in the thick description of the study context and confirmability was established through the analytical audit trail of the codebook.

### 5.5 Limitations

The findings are limited to the perspectives of the students who chose to participate in the interviews. As such, the qualitative work is not intended to be generalized across all undergraduate civil engineering students in the United States or globally. The interview was also limited to a single point in time. As a result, it is difficult to untangle the temporal influences of the hidden curriculum, which are pervasive at all levels of education. The findings are thus interpreted with the understanding that students' ideas related to leadership and informed by the hidden curriculum are not localized in the college classroom but draw from a wide range of sources.

## 6. Findings

Three thematic categories emerged that represented students' views of leadership beyond what was taught and practiced in the engineering curriculum. Students expressed varied understandings of whether leadership can be learned, how leadership is defined, and who can lead. Within each of the three themes, there was a dichotomy in student perspectives detailed in the following sections.

### 6.1 Can Leadership be Learned? Innate Versus Developed

Students' views on whether or not leadership can be learned emerged in response to various interview prompts related to general understandings of leadership, faculty members' roles in developing lea-

dership, and the timing and setting for learning leadership skills in undergraduate education. Within this theme, student perspectives emerged in two ways: leadership cannot be learned because it is innate, and leadership can be developed through experience. Phil typified the former in stating:

“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, saying, like . . . I don’t know. If you take a shy person, you can’t teach them to not be shy. You can teach them how to talk to people but they’ll still be shy in the end, I want to say. That’s how I view it. Some people don’t see it that way. I know they have leadership classes but I’ve never been a part of one, and I don’t plan to, just because I don’t really think that’s necessary.”

Phil expressed that leadership ability is an immutable character trait. His gendered language and distinction between charisma and shyness also sketch an image of who he thinks a leader is. Across the summary codes (second cycle) based on the in-vivo codes (first cycle), the group of students who believed leadership cannot be taught expressed that teaching leadership is a waste of time since it cannot be developed by people who are not born with that capacity and student personalities are formed by the time they reach college. As an example, John commented:

“I think it’d be a waste of our time and money to try and provide that [leadership] in a classroom. You’re paying a lot of money for technical skills and knowledge and I think a lot of leadership can become a waste of time because you’re going to have people that aren’t committed to learning that. . . Not everybody is a good leader and you can’t teach everybody how to be a good leader, it’s who is willing to become that.”

John represented the perspective that leadership should not be taught because it cannot be learned. He made the distinction between those who have a natural leadership ability and willingness to develop it further and those without such an ability and willingness. John and Phil were the only two students who firmly claimed this perspective on leadership.

In contrast, the other students expressed that leadership can be developed. Within this perspective, a subset of students expressed that although possible, it is difficult to learn leadership without a predisposition for leadership competence. Similar to John and Phil, Albert, Max, and Charles shared a belief that leadership is innate, but they diverged in that they did not believe it is immutable. For example, Albert stated:

“For those people that don’t naturally have it [leadership], I also feel like it’s very difficult to have it just sprout, I mean it’s possible, it definitely is but it’ll take a lot especially in your later part of life.”

Albert conceded leadership can be learned, but growth is more challenging if the seed is not planted at a young age. He went on to say he never had to attend “a leadership conference or go to a development program” because his leadership preparation occurred throughout his life, starting with traits he inherited from his parents.

The other subset of students within this perspective expressed that leadership can be learned and did not describe it as an inherent ability. Alex, Beca, Kim, Shelby, Mike, Tobias, and Lily expressed that leadership is learned through experience. For example, when asked when leadership can be learned, Kaitlyn responded:

“I think that it [leadership learning] can happen inside of class with group projects, you know just like anytime you’re dealing with somebody else I think that can come into play, I think if, my other classmates are involved in clubs. That kind of interaction where you’re trying to accomplish those goals and then through any sort of, not even field specific work, but just any kind of job. Just dealing with other people.”

Kaitlyn’s comment indicated her belief that leadership can be learned inside and outside the classroom, and she attributed this development to interacting with other people in any setting. Alex similarly described how students learn leadership “when they start being involved in different organizations. . . where they were exposed to these situations where leadership is required. That is when they started learning more about how to be a leader.” Her response indicates not only that leadership can be learned, but can happen at different stages in life, which contrasted with other students who believed leadership capacity was determined early in life.

## 6.2 How is Leadership Defined? Trait Versus Behavioral

Student reflections on the definition of leadership were elicited through the specific questions about leadership definition and emerged organically throughout the interviews. Within the theme of how students define leadership, two categories were identified: trait and behavioral. The boundary between the categories was defined by who a leader is (trait) versus what a leader does (behavioral). Trait-based definitions of leadership focused on the characteristics of a leader. Students in this category described a leader-centric perspective in which leadership is defined by the characteristics of the person who has a formal leadership role. Behavior-based definitions focused on the actions of leader-

ship, which could either emphasize an individual leader or the team.

Insight into students' trait-based definition of leadership was often elicited when they were asked to define leadership or describe an instance in which they observed leadership. As an example, Tobias defined leadership by the traits of a leader.

"What do I know about leadership? It's a quality that you need to have to be successful in your career, doesn't matter what kind of career you go into, whether it's at McDonalds or you work for the CIA, you need to have the leadership quality and I guess what a leader is would be like someone that is professional, that is level headed, intelligent, sociable, and humble."

Students who described this definition of leadership also expressed that a leader's traits command respect. Tobias described the project manager from his previous internship as "the man of the hour. He stood up, he commanded, and everyone just listened. . . He had a good commanding voice. . . He didn't show any fear."

Other students emphasized the actions and behaviors that exemplify leadership. For example, Shelby provided the following description of leaders:

"I feel good leaders are people who would be able to tell people what to do but also be respected because you can only tell people what to do for so long. . . But I feel a leader needs to be able to know people's strengths, and work to those strengths. In order to most efficiently get things done."

Shelby associated leadership with the ways in which people communicate, optimize human resources, and maximize efficiency.

The second way in which behavior-based definitions of leadership emerged was a focus on the broader behavior of the team, not an individual. This team-centric view of leadership was identified in Phil's responses to a situation that typified leadership he witnessed when he shadowed his brother in medical school for a day.

"So, I got to see what happened for a day. And they had, I think it was, 50 students in one room and they were examining a cadaver. And, 50 students on one; that's quite a ratio. That's a pretty good ratio but they managed to do everything they wanted to within an hour and a half, and they were designated four hours to do it, so that was extremely impressive. And they should have taken four hours."

For Phil, the functioning of a group of medical students in efficiently completing a task exemplified leadership. Alex also thought leadership relied on "assessing everyone's strengths and weaknesses" because she described how effective leadership relies on everyone involved in the team.

### 6.3 Who Can Lead? Positional Versus Situational

There was a dichotomy in student perspectives regarding who can lead: some believed leadership is only practiced by those in formal roles while others thought everyone can be a leader in different settings. These two views reflect positional and situational leadership, respectively. When asked to define leadership in his field, Max responded, "obviously being like a project manager." Max conflated leadership with a formal title and managerial role. Similarly, Kaitlyn described "the concept of leadership, [is] kinda being in charge of the whole project." Similarly, Kim described how leadership is important to learn based on the job students want to have, and if they aspire to be a superintendent later in their career, they needed to develop strength in leadership. Her perspective reflects the perceived relationship between leadership and position.

In contrast, other students believed leadership does not have to be associated with a role. Tobias epitomized the boundary between the positional and situational leadership in commenting:

"How would you define leadership? I guess, I was going to say as a project manager role but I guess you don't really have to be a project manager to be a leader or have a leadership role. You have to be able to be somewhat knowledgeable on your subject and if you don't, you need to understand that it's okay to ask questions to people who do."

His first instinct was to define leadership within civil engineering as a project manager, suggesting a normative assumption. Upon further consideration, he untangled being a leader and having a particular position. Like Tobias, Charles described a change in his understanding of leadership.

"I used to think leaders are thin-cut fries, but now I think leaders are like potatoes. You can have leaders in the form of curly fries and wedge fries, crinkle cut, all that. But I remember when I was younger, I used to think the highest form of leadership, like the president of the United States."

Charles' comment reflected the transition toward the second pattern within this theme: who can lead is the product of the context, not the title. The situational view of leadership recognizes that different individuals can act as leaders in various settings, regardless of their formal role. For example, Beca expressed:

"You're expected to be a leader. . . I think it's not really a skill that should be overlooked, 'cause it's, you're gonna have to use it. Everyone's gonna have to use it eventually."

Similarly, Alex described how she was part of organization at her institution in which she served as a liaison between the college of engineering and

students, including giving campus tours and doing outreach activities. Within the organization, every meeting included a talk about leadership. Through this experience, she determined “everyone is a leader in their own way.” This perspective is also recognized leadership operates at different scales. Although leadership can be associated with powerful positions and major tasks, Shelby described:

“I feel even the simplest form of leadership, like getting a study group together, that takes some form of leader because without one person making a group chat or something, it’s never going to happen. And I know that’s such, so simple and stupid, but at the same time it’s necessary to get anything done. So I feel just through that with my peers and stuff, anytime I’m with a group, whether it be making plans to study, or anything that. I feel I’m essentially practicing leadership.”

Her comment shows the different situations in which leadership can be practiced but calling them “simple and stupid” suggests such instances do not fit the normalized perception of what leadership looks like.

## 7. Discussion

The aim of this study was to explore civil engineering students’ conceptualizations of leadership through the lens of the hidden curriculum to make visible their taken-for-granted ideas about what it means to be a leader. Three themes were identified in the interviews regarding how leadership is learned, practiced, and defined: (1) perceptions ranged from leadership being innate to a skill that can be developed, (2) leadership can be exercised based on a formal role or contextual situation, and (3) leadership can be defined through the traits and behaviors of leaders.

The findings indicated a split in students’ perceptions of whether leadership can be learned. While two participants expressed leadership is innate, the others commented it can be learned, with varying degrees of difficulty based on predisposition and experience. The dichotomy reflects the broader discourse regarding whether leaders are born or made [37]. That debate, however, has been settled in leadership studies through the recognition that leadership can be learned [38, 39, 40]. For example, the skill conceptualization of leadership posits leadership is a set of “competencies that people can learn or develop” [41] (p. 116).

The civil engineering students in the interviews defined leadership through the traits or behaviors of leaders. The trait perspective of leadership aligns with the innate qualities of leaders that was dominant during the first half of the 20th century [37]. This leadership paradigm used historical examples

of famous individuals to construct an archetype of a leader, known as “Great Man” theories. Student responses showed evidence that such notions of leadership are still prevalent in defining leadership by citing the characteristics of (male) figures such as pastors and bosses they knew who led through their physical presence, commanding voice, and fearless attitude. This notion of leadership, however, is at odds with contemporary understandings since the field of leadership studies “has left behind the ‘Great Man’ with his traits of height, skin color, and, well, masculinity, and we have moved to a more nuanced and complex examination of the construct of leadership” [38] (p. 72). Moving beyond trait theories, the next conceptual period in the historical progression of leadership studies emphasized behavior theory, which was dominant in the mid-1900s [15]. This conceptualization of leadership based on what a leader does was also reflected in the data. This perspective expressed in the interviews could be leader-centric, with a focus on the individual’s actions, or team-centered, with a focus on the functioning of the group.

The findings indicated students’ understanding of leadership in terms of who can practice leadership. This theme sorted into two categories: positional and situational. Positional leadership captured students’ association between leadership and a formal role of authority while situational leadership represented the ability of anyone to assume leadership based on the context. The positional view of leadership aligns with the early stages of leadership development among college students [42]. In their six-stage model of leadership identity development (LID), Komives and colleagues found students in stage 3 held positional views of leadership while those in stage 4 viewed leadership as non-positional. The move between stages 3 and 4 was identified as a key transition for college students [42]. The data from the present study indicated that the participants were on both sides of this transition.

Looking across the findings indicates the ideas civil engineering students have learned about leadership. Students are constantly learning about leadership, inside and outside school, intentionally and unintentionally. The complex and continuous nature of this learning process shapes their subconscious understanding of leadership. In making the case that leadership can be learned and should be taught in higher education, Brooks and Chapman [38] stated,

“Our students were learning about leadership long before they got to our classrooms and a week of lessons on the limitations of traits is not enough to upend a lifetime of experience-based learning. They – and really all of us – have been bombarded with examples of



leadership in everyday life. Whether it is listening to the pastor at church, organizing a game of pick-up basketball, or reading the latest presidential executive order, our students are inundated with data points that contribute to an informal, internalized understanding of leadership (p. 72–73).”

Students learn through implicit and often inadvertent messages about what leadership is and who leaders are. This perspective aligns with the concept of the hidden curriculum because “while the hidden curriculum is not necessarily tied to schools and schooling, it is always and everywhere tied to learning” [43] (p. 136). The objective of this work is therefore not to trace the roots of where and when students form ideas about leadership. Instead, the implication of this study is the recommendation to uncover these taken-for-granted conceptualizations about leadership and the need to support engineering educators in addressing them through the formal and informal curriculum.

Situating the findings from the present study in leadership literature indicates some perspectives held by the civil engineering students may limit their leadership development. If students believe leadership is innate, they might not be open to learning about it or pursuing opportunities to develop their leadership ability. For example, John stated, “I know they have leadership classes but I’ve never been a part of one, and I don’t plan to, just because I don’t really think that’s necessary.” If students hold trait-based conceptualizations of leadership, they will have a narrow idea of who can be a leader. If students believe only those in positions of authority are leaders, they might not feel empowered to exercise their own leadership without a formal role. Prior research also found an association between undergraduate civil engineering students’ perspectives on the importance of leadership-coupled professional competencies and their leadership development [44]. Students who assigned higher importance to these competencies demonstrated evidence of being at more advanced stages in leadership identity development, which were defined by non-positional views of leadership.

Limited perspectives of leadership, like those that emerged from the interview data, run counter to contemporary theory that situates leadership as a holistic process in which all collaborators contribute [15]. Although not in alignment with leadership research, the perspectives students articulated were in line with conceptualizations in civil engineering. For example, a critical review of literature in civil engineering and construction indicated the preeminence of trait and behavior conceptualizations that emphasize the individual leader rather than the process of leadership [15]. Furthermore, a rhetorical analysis of the Civil Engineering Body of

Knowledge Version Two indicated traditional conceptualizations of leadership that emphasize traits and behaviors while Version Three suggested a shift toward more contemporary ecosystem understandings of leadership based on teamwork [45]. Similarly, a systematic review of literature in construction research indicated the preeminence of vertical leadership, as opposed to shared or horizontal leadership, in the field [46]. This conclusion aligns with the students who expressed a positional view that situates leadership at the top of the organizational hierarchy. There is also a small but growing body of work that is examining leadership from the perspective of practicing engineers. For example, one study with construction executives generated a framework of competencies that define leadership, indicating that leadership is a set of skills and abilities that can be cultivated in education and practice, as opposed to being innate [2]. Other work has indicated resistance among practicing engineers to identify as leaders due in part to a misalignment between engineers’ identities and traditional notions of leadership [47]. Thus, there is need to support students’ understanding of leadership as competencies and identities that are an inherent part of engineering practice.

Although students may have formed their ideas of leadership through the hidden curriculum before reaching college, engineering programs and educators can take a role in addressing them. Martin [43] asserted that when the hidden curriculum is found and “contains harmful learning states, we must try to root them out” (p. 145). The first step in this process is awareness for both the educators and students. The hidden curriculum only remains hidden until it is uncovered, and students and educators are made aware of it [43]. Given the key role of undergraduate engineering education in developing leadership and teamwork outcomes [3], faculty members can help students recognize and challenge these notions. This process can begin by underscoring that leadership can be learned. Faculty can also provide opportunities for students to reflect on their ideas about leadership and make their assumptions explicit. Faculty can scaffold this understanding by offering opportunities for students to practice leadership, such as through group projects and class discussions. The intentional integration of leadership in the formal curriculum can help counteract potentially adverse effects from the hidden curriculum. Leadership in the formal curriculum is particularly important because classroom experience has been found to have the strongest relationship with engineering students’ leadership skills relative to other experiences, such as out-of-class activities [13].

As the site of professional socialization and

institutional training, the undergraduate experience is formative in engineering students' development through formal and informal mechanisms. In addition to addressing and challenging tacit notions of leadership in the curriculum, faculty members can recognize their role as "the primary socializing agents" for undergraduate students [48] (p. 19). Faculty members communicate the norms and values of the profession, so teaching and embodying contemporary notions of leadership will transmit their importance to engineering students. Peer interaction is another facet of socialization [49], and faculty can support this engagement to facilitate leadership development through student participation in student-led organizations and activities. Within these informal settings, there are also interventions for students to expand their awareness of leadership development and their preconceptions. For example, students could take an inventory or assessment on their leadership perspectives and reflect on the results. Leadership training within these activities could also help students uncover the hidden curriculum and develop their leadership competence.

Integrating leadership training into engineering curricula must be done intentionally. Leadership educators have long valued active learning strategies; however, instruction falls short without a tether to educational objectives. Unless engineering faculty recognize what they are teaching about leadership and why, instruction is likely to be less effective. The Council for the Advancement of Standards in Higher Education identifies four areas of leadership development essential for leadership learning at the post-secondary level including Foundations of leadership, Personal development, Interpersonal development, and The development of groups, organizations, and systems [50]. Because leadership is a dynamic, human experience, many leadership educators favor more integrated taxonomies of teaching and learning to implement curricular strategies for leadership development. Fink's taxonomy of significant learning [51] is often employed to frame leadership development, given its simultaneous consideration of intellect, belief, and application.

Fink [51] established six categories to guide significant learning. Fink's first category *Foundational Knowledge*, refers to the remembering of discrete facts and information. The second is *Application*, or connecting learning to practice. This is followed by *Integration*, which is the ability to make connections across people, groups, ideas, and contexts. Up to this point, one might point out, Fink's taxonomy feels very much like previous frameworks such as Benjamin Bloom's cognitive domain. Fink's next two categories *Valuing human*

*dimensions of learning* and *Caring*, diverge from a purely cognitive paradigm and acknowledge the importance of the affective portion of leadership. Like so many constructs in leadership studies, these elements are often dismissed as so-called "soft skills," but Fink implores educators to understand that people experience significant learning when they value those they work with and care about the material. Fink concludes with the last category *Learning to learn*. Preparing students for the high-level tasks to self-regulate and actively seek self-authorship within their workplace and community is central to developing the leadership competencies that are sought in the field of engineering.

Faculty in engineering must be prepared to engage students in active learning and recognize the role of case studies and role-playing problem-based learning in their classroom. Further, they must understand what objectives such pedagogies seek to attain. Using frameworks such as Fink's taxonomy of significant learning [51], faculty members can connect students with industry perspectives to demonstrate the importance of leadership to engineering practice. Employing the experience of engineering professionals can help students value the importance of leadership [2, 4, 52], and students may benefit from hearing of its value from their future employers and colleagues. This perspective can lend credibility and relevance. Educators and programs can incorporate this approach through industry partnerships, such as guest speakers and internships.

### 7.1 Future Work

This study illuminated additional directions of inquiry. Future work could take a longitudinal approach to examine how students' understanding of leadership changes throughout their undergraduate education. The first interview, to occur when students first enter college, could explore notions of leadership with the aim of distilling the effects of the hidden curriculum in students' K-12 experience. Interviews at additional points in time could be used to track the evolution of their understanding to better localize the impact of the hidden curriculum in undergraduate engineering education.

Future work could also explicitly examine gender differences in students' beliefs about leadership. The participants who believed leadership cannot be developed (John and Phil) and the participants who noted that it is difficult to become a leader without an innate skill (Albert, Max, and Charles) were all male. A small qualitative study is not intended to be generalizable, but future work could use a larger sample with more diverse students to explore if the perspectives in this study are representative of engineering students and further

explore the link between gender and beliefs about leadership. Future work could also use an intersectional approach and critical theory framework to investigate leadership beliefs among specific groups who may be less studied in engineering education research such as Black students and female students [53]. Such research could reveal if the dichotomies uncovered in the leadership beliefs of the interviewed students are particular to demographic groups within engineering students.

## 8. Conclusion

This research examined how undergraduate civil engineering students define leadership and understand its development through the lens of the hidden curriculum. Findings from the 13 semi-structured interviews indicated a split in the

sample between those who believed leadership is (1) innate versus learned, (2) trait or behavior-based, and (3) positional versus situational. The findings illuminate students' beliefs about leadership. These perspectives on leadership develop throughout life, both inside and outside of the classroom. The undergraduate experience can take a crucial role in recognizing and challenging the aspects of the hidden curriculum that may be adversely affecting students' leadership development. By making these beliefs explicit and intentionally integrating leadership into the formal and informal curriculum, engineering educators can support students' professional formation and workforce preparation.

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