

# Practical Strategies to Mentor around Hidden Curriculum Pathways in Engineering

Idalis Villanueva Alarcón  
Department of Engineering Education  
University of Florida  
Gainesville, FL, USA  
i.villanueva@ufl.edu

**Abstract**—This research-to-practice paper discusses how hidden curriculum pathways in engineering can be used to mentor and professionally develop graduate students in engineering. Hidden curriculum is a relatively new term in engineering and is used to describe the transmitted inclusionary or exclusionary systemic messages that are structurally supported and sustained in engineering. While there is work around hidden curriculum in engineering, both nationally and internationally, only the author has conceived hidden curriculum as a pathway model. Work from the author and colleagues has shown that when exploring the hidden curriculum pathways, students situate their actions based upon what resources and sources of support they value. If they value a campus resource or a mentor, for example, they are more likely to enact change and use hidden curriculum for their growth in the profession. However, if they do not value the resource or mentor, there is greater risk for mentoring discords, which can ultimately lead to attrition. This paper expands upon these earlier findings to develop a set of practical tips of how individuals navigate hidden curriculum in engineering, more specifically from the perspective of the author.

**Keywords**—hidden curriculum, pathways, mentoring, practical tips, engineering, graduate education

## I. INTRODUCTION

For many individuals, starting a new educational path or career can be daunting. It involves a quick and accurate interpretation of the visible and invisible rules of a workplace or learning environment to navigate it successfully. In the context of engineering, and in particular, graduate education, learning about the hidden norms, rules, and messages of an individual's academic environment is largely dependent on the culture of the discipline of study, the sub-culture of the department, and the micro-culture of the laboratory and faculty they work for. This research-to-practice chapter is intended to introduce practical approaches to support graduate students in understanding and navigating hidden curriculum of their education and future careers. One unique consideration of this paper is the use of the pathways model developed by the author, as a launching point to engage faculty mentors and graduate mentees in reflective and empowering discussions.

## II. RESEARCH QUESTION

For this research-to-practice paper, the research question is as follows: *From the perspective of hidden curriculum pathways, what practical tips could support*

*graduate students in engineering as they navigate their academic environments?*

To answer the research question, the theoretical framework of hidden curriculum pathways, applied to engineering, will be used.

## III. THEORETICAL FRAMEWORK

### A. Hidden Curriculum

In the late 1960s, a sociologist by the name of Philip Jackson became interested in learning more about the behaviors of children in school. In his book, *Life in Classrooms*, he wrote about how children learned manners, tried to perform in accordance to standards, waited quietly for their turn, and met deadlines so that they can progress “satisfactorily through the school” [1, p. 33-34]. During the same time, sociologist Robert Dreeben also examined the norms of school and discovered that students are taught to bury much of their personal identity in response to the categorical treatments they receive within the school system [2]. Both scholars fundamentally discovered the existence of shaping powers in education; this term was later described as *hidden curriculum*. In the 1960s, hidden curriculum was described as the laws and rules that are created by majority groups, using rationality, to determine which behaviors are considered acceptable in society [3].

Approximately twenty years later, theorists like Henry Giroux and Anthony Penna [4], and Michael Apple [5] renewed research in hidden curriculum theory and expanded its definition to include what happens outside the formal curriculum in schools. Hidden curriculum definitions also expanded beyond rules and norms to include value and belief systems [4], [5]. The latter shift in the definition resulted in theorists' recognition that individuals do not learn in silos but rather learn in social settings and groups where individuals can influence others' view of an environment through their ideas and thoughts. For about 20 years, sociologists have used these definitions to describe hidden curriculum, primarily within K-12 systems [1]-[5].

In the mid-1990s, Frederic Hafferty and Ronald Franks [6], and in the early 2000s via Eric Margolis, [7] hidden curriculum was introduced in higher education scholarship. These scholars recognized that the constant reproduction of hidden curriculum negatively influences individuals, and power

inequities still exist within systems of education. These scholars recognized schools as systems that create structural mechanisms by which people in power can hold onto and reinforce their control over others.

Since then, hidden curriculum was introduced to other fields of high professional and societal impact like medicine, nursing, science, informational technology, and engineering [8]-[12]. The motivation for introducing hidden curriculum to students in these disciplines was to help them gain awareness of the influence that these hidden or unacknowledged messages have in professionals' overall conduct and attitudes towards the public. This approach to higher education allowed for instructors and trainers to develop curriculum interventions that can mitigate or transform targeted, negative messaging of a profession and create a counternarrative that includes positive messaging. For many fields, this change in messaging has resulted in positive outcomes (e.g., retention) for their students [8]-[12].

### *B. Hidden Curriculum in Engineering: A Pathways Model*

In engineering, hidden curriculum research is still relatively new, both in the United States and internationally. In the United States, Tonso [13] and Erickson [14] defined hidden curriculum in the early 2000s as a term focused on a gendered curriculum and used it to describe the disparate messaging for women engineering students and how these messages impact their overall sense of belonging. Internationally, Tormey and colleagues [15] situated hidden curriculum within the ethics of engineering education. However, much research on hidden curriculum in the context of engineering has primarily focused on gender issues and ethics [16]-[19]. Furthermore, this aforementioned research did not take action towards transforming hidden curriculum to a more positive direction.

To reframe hidden curriculum and use it as a counternarrative for engineering, the author re-introduced hidden curriculum as a pathways model by which structures and its effect on the individual can be better understood [20]. Through a validated instrument, UPHEME [12], four factors were identified as being predominant in this pathway: hidden curriculum awareness (HCA; Factor 1), emotions (EM; Factor 2), self-efficacy (SE; Factor 3), and self-advocacy (SA; Factor 4). HCA helps individuals recognize how information is transmitted and communicated; without HCA, no action or decisions can result [12], [22]. Emotions assist individuals to narrow down decisions, discover potential directions for self-preservation, and for processing of hidden curriculum [12], [21]. Self-efficacy is closely tied to emotions, and a person cannot decide upon an action unless they believe they can cope with a challenging scenario [11], [12]; lower SE can lead to higher avoidance or inaction [11]. SA consists of the outcomes that were taken by an individual to act on behalf of themselves or others to mitigate negative influences of hidden curriculum and transform them into positive forms of action or messaging [12].

More recent findings from the author and colleagues [11], [22], [23] has suggested that for graduate students in engineering, their awareness of hidden curriculum, paired with a recognition of resources to support their navigation of their academic environments, strongly influences whether they enact

the *status quo* or act toward change [21]. Interestingly, this level of discernment was not found amongst undergraduate engineering students [11], [22] who often opted to change their personal identities and competencies to fit within engineering environments. On the other hand, faculty in engineering were aware of hidden curriculum surrounding their professions [22], [23] and understood how resources could be used to navigate around hidden curriculum in their workplaces, if they wished to use them. The discord that both undergraduate students and graduate students in engineering may experience around hidden curriculum and the variation in strategies used by faculty, suggests a strong need to develop practical tips and strategies so that students can be mentored around this matter. This research-to-practice paper serves as an early step in this direction and is by no means is a comprehensive compendium of available tips and strategies, as this is still nascent topic in engineering [11], [12], [20]-[27].

## IV. METHODS

While analysis is still ongoing, the aim of this research-to-practice paper is to begin the conversation about interventions as data around hidden curriculum pathways model is currently being published [11], [12], [20]-[27]. The reason to select the author's model is that most of the research around hidden curriculum, both internationally and nationally, have addressed issues created by hidden curriculum but seldom focus on mechanisms to counter negative hidden curriculum. Second, the author and colleagues [11], [12], [20]-[27] are leading experts in hidden curriculum pathways in engineering and due to their intimate relationship with the topic, have first-hand understanding of how hidden curriculum impacts a diverse range of individuals. Finally, throughout the years, the author has been asked to provide tips and strategies to ignite conversations about hidden curriculum in engineering, using the pathways model. For these reasons, the analysis of the work was narrowed down to the author's work to date [11], [12], [20]-[27], although work from other scholars in and out of engineering [1]-[26] was used to compare against observations and findings made in this paper.

This study took an insider-outsider approach to the author's work [11], [12], [20]-[27] in that a naturalistic first cycle of holistic and thematic coding from the identified publications and their findings was conducted. These codes were consulted with and member-checked with another colleague to ensure that the tips aligned with existing findings as well as previous literature from other scholars [1]-[26]. One point of discussion between the author and colleague was the value that some of the tips provided in this paper can have in establishing a relationship of trust and rapport between the mentor and mentee. Another point of discussion was the value added to create equitable power dynamics between the mentor and mentee. Finally, the discussion centered around the importance of recognition and reflection throughout the pathways found in hidden curriculum in engineering. All talking points were used discussed at length until there was full consensus on the identified tips.

While the author recognizes that some of these tips may be susceptible to bias, there is also value in insider perspectives to legitimizing minoritized groups' voices and experiences in engineering [28]. For this work, the first-hand knowledge of the implications that hidden curriculum can have on individuals, based on the pathways model is needed to meaningfully interpret the tips provided in the paper. And, while this work is not an extensive systematic literature review of existing tips around hidden curriculum in and out of engineering, the provided customized tips serves as an expansion of existing scholarship from the author [11], [12], [20]-[27] and fulfills an ethical responsibility to use existing research to help fill the gap between research-to-practice that often escapes much scholarship in engineering education.

## V. RESULTS

### Strategies for attaining hidden curriculum awareness.

Based upon previous findings from hidden curriculum pathways model in engineering, individuals must learn to find hidden curriculum because often it is unrecognized or unacknowledged [12], [23]. HC awareness, the first step to the pathways models, defines how individuals learn practices, procedures, rules, relationships, structures, and physical characteristics in each setting and derives hidden messages or lessons of that given scenario or setting [22]. Whenever an individual sees a procedure or a process for the first time or when they are new to an educational or professional space, questions may arise in the process. They will have to learn how to navigate existing norms and procedures before they are able to navigate it successfully. A mentor can support a mentee to understand the environment in which they find themselves. Also, including examples or providing an exercise to help graduate students identify HC in engineering can provide intentional support through continual iterations and feedback that informs them how to apply these tips in future work/educational settings.

A similar strategy can be centered around clarifying expectations and intentions. This is extremely important when a mentee may need to understand how the task a mentor is assigning is tied to the mentee's professional success in the future. It also affords the opportunity for the mentee and mentor to reflect the level of appropriateness of the expectations to each other's goals, to find alignment or misalignment in the stated goals, and to better understand the roles and power dynamics that each person carries in the mentoring relationship [25], [26]. By clarifying expectations and intentions, both mentor and mentee are raising each other's awareness of unacknowledged hidden curriculum that may be present behind decisions, actions, or approaches. Over time, these awareness-raising strategies will help mentors and mentees to engage in open and continual conversations of trust and rapport.

Another strategy is to share the norms in engineering with an engineering 'outsider' [27]. For individuals outside of engineering, they may not completely understand the cultural values, beliefs, attitudes, assumptions, and biases of that discipline, department, or lab group. Bringing an outsider into the conversation can support a more meaningful discussion

with mentees about unclear hidden curriculum surrounding their education or professionalization [12], [23], [24].

Raising awareness around hidden curriculum may include considerations of the environment itself. Not all hidden curriculum identified should be discussed or occurs within the work setting. Some may encompass both personal life and work. These in-between spaces, or third spaces [27] can be excellent opportunities to breach topics that may be troubling a mentee. Consider finding 'neutral spaces,' such as parks and coffee shops, to have more open conversations with mentees about any hidden curriculum they may experience at the intersection of work and life. If needed, point them to appropriate resources (e.g., counseling). Strategies for attaining hidden curriculum awareness are summarized in Table I.

TABLE I. STRATEGIES FOR ATTAINING HIDDEN CURRICULUM AWARENESS

Strategy	Description
1.Create multiple opportunities for feedback for multiple procedures and processes	As new mentees or students join a research lab and/or course, create multiple, intentional opportunities for students to interpret instructions, syllabi, or any document that indicates the 'rules of the road'. Ask the mentee to highlight any questions and ask them how they would clarify these rules to future students. If the points made may benefit many students, consider bringing up these points on a faculty meeting or similar venues to discuss a more long-standing change to existing policies and procedures. Repeat this process regularly with newcomers or at a minimum, once a year, to ensure that the policies are continually updated and attuned to the needs of diverse students.
2.Clarity expectations and intentions	Consider adding clauses on the mentors' expectations and discussing students' expectations in any documents (e.g., syllabi, welcome or onboarding manuals, assignments, or project descriptions, etc.). This approach also offers the opportunity for individuals to understand the roles and power dynamics that each person has in the mentoring relationships [25], [26]. If time allows, include a "purpose statement" on each item where you want your intentions known.
3.Share the norms to an 'outsider'	Periodically, have peers or people of trust who are not in engineering to comment on policies and practices of the department (if it is public and not confidential). Ask them if they would be confused with the language and what areas could be further clarified.
4.Create co-curricular or informal, third space opportunities to share hidden curriculum	Consider facilitating co-curricular (e.g., professional development, lunch and learn events, 'ask the instructor' sessions) discussions about a given hidden curriculum topic with your mentees. If possible, consider carrying out these events in a third space [27], a space that is not home or work, so that a more honest conversation can occur. Third spaces can include, but are not limited to a park, a library, a coffee shop, etcetera.

While the strategies in Table I aim to uncover hidden curriculum, it is equally important to reflect upon each strategy and decide if it is appropriate for a mentee at a specified point during or across the mentorship. As a mentor, you should ask yourself about the nature of specified hidden curriculum and

whether it is considered ‘common sense’ information in your discipline. This can help situate if you may present biased information to a mentee or not. Also, consider if the information you provide to one mentee is the same you provide to another and ask yourselves if you are trying to understand the context of the mentee or rather clustering all mentees in one pool. The latter is important because there may be unintended, negative consequences to the ‘one size fits all’ mentality and potential deficit views from this form of aggregation. Remember that if hidden curriculum will lead to more negative outcomes than positive outcomes, it is best to leave it alone until a more meaningful and empowering strategy is identified.

### Emotions and self-efficacy strategies after awareness.

According to the pathways model, emotions and self-efficacy influence how students value or not value resources [21] and what decisions they make or not make with respect to their graduate engineering education [11]. In a study by Gelles and colleagues [21], graduate engineering students were asked to talk about hidden curriculum they experienced in engineering. From their experiences, students either valued resources or did not value resources to support their hidden curriculum decisions and subsequent actions (if any). However, students did not expand upon the nature or type of resources or how they valued them or not. Notwithstanding, it was clear from that study that the simple act of valuing a resource results in emotional and self-efficacy pathways lead a person to action or inaction. As described in Table II, some tips are presented below to encourage mentors and mentees to discuss resources and assess their value.

Consider complementing existing resources (e.g., student manuals, onboarding) to be tailored to the discipline or departmental culture of the mentee. Many campus resources are designed to be baseline documents to guide students through centralized procedures and processes. However, there may be nuances in the discipline or departmental culture that may warrant additional clarification (e.g., graduate student manuals). This is a great opportunity to center the mentees’ voices and concerns by including them in the conversation. Ask them to look over existing onboarding documents and to comment what additional items can be included as a supplementary material. Including mentees in the conversation will not only benefit the student but also the faculty as they help create more inclusive environments for their mentees. It also helps them to emotionally invest themselves in their working or educational environment and can boost their confidence in their ability to navigate such an environment.

Another strategy is to create mapping activities of resources. It is hard to understand how each office or resource operates in each environment. Take the time to co-develop a flowchart or a map of in and out of campus resources with a mentee. This may support both the mentor and mentee to have the self-efficacy to point others to important resources and support.

Considering rank ordering resources to communicate the value of each resource for a given students’ needs. This may help the students emotionally connect the importance of a resource to meeting their given need. Finally, encourage

students to reflect upon their emotional awareness to their engineering academics and research. Provide opportunities for reflection and include activities such as those in the Feelings project [29] to allow students to assess their emotional states, patterns, and behavior throughout their education and research.

TABLE II. STRATEGIES FOR EMOTIONS AND SELF-EFFICACY AFTER HIDDEN CURRICULUM AWARENESS

Tip	Description
1. Customize or complement onboarding procedures or processes	Ask students to comment on onboarding documents and add items they wished they knew about that was not evidenced in the manual or similar documents pertaining to their experience in the Ph.D. program.
2. Mapping needs with resources	As students develop educationally and/or professionally, their needs may evolve. With your mentee, co-develop a flowchart or a map of the needs met and resources existing in campus. In a similar vein, there may be out-of-campus resources that may benefit the student as well (e.g., graduate dissertation writing workshops, scholarships, internships). Co-create an in-campus and out-of-campus map of resources and continually add to the list as new students enter your program and/or lab.
3. Valuation of resources	From the first and second recommendations stated above, consider rank-ordering in terms of value the resources available. Identify if these resources are valued based on an individual need or a collective need. If necessary, share the list of resources and maps to your mentees with these disclaimers communicated in writing.
4. Encourage emotional awareness to their engineering academics and research	Provide opportunities for reflection or include activities that allow students to unpack emotions in each academic or research setting. Like the Feelings Project [29], consider including periodic checks, modules or activities (e.g., Wellness Wheels) to help students assess their emotional states, patterns, and behaviors to given scenarios.

It is important that as a mentor, you pay close attention to what value systems you adhere to in your discipline and research. Does your work and profession value individualism, competition, and meritocracy? How do these values translate to who your student mentees consider is the ‘ideal student’? In the same vein, what do you communicate and praise as positive traits amongst engineers? If possible, reflect upon and consider how you communicate, assess, and emphasize these values in your lab or course. If possible, identify ways to remove any form of communication in where a dominant view or a *status quo* may risk cueing exclusion rather than inclusion.

### Action strategies post hidden curriculum awareness.

Finally, in the pathways model, the transition from self-efficacy to self-advocacy is viewed as the last step of the model. In this step, individual mentees and mentors wrestle with decisions and actions, and situate how to advocate for any hidden curriculum issue identified in the process towards an intended outcome. Sellers and Villanueva [11] found that amongst (under)graduate students in engineering, individuals

view advocacy in one of three ways: inaction, negotiating self, and action. Action was viewed as an outward strategy and included actions such as mediation/conflict resolution, addressing issues directly, identifying other sources of support or resources, or increasing representation. Negotiating yourself involved inward strategies such as maintaining the *status quo*, changing or modifying skills and competencies, changing your mentality, or increasing effort. Inaction led to avoidant strategies such as avoidance or a sense of helplessness to take an action. As shown in Table III, many of these tips are aimed at either providing social persuasive opportunities or mastery experiences [11] for student mentees to develop their self-efficacy so that positive action can occur.

For actions, strategies like role playing, conflict resolution, mediation, and increasing representation can provide tools and demonstrated examples of how to act. These forms of persuasions may be the pivot point that many mentees may seek when deciding to tackle a given hidden curriculum or not. At the same time, because awareness of hidden curriculum may require decisions to negotiate themselves or not act, it will be important for a mentor to also consider and reflect upon what could potentially be deterring a mentee from taking such an action. The recommendations in the following table are meant to be points of reflection to support mentees during this process of decision-making and action.

TABLE III. STRATEGIES FOR ACTION AFTER HIDDEN CURRICULUM AWARENESS

Strategy	Tip	Description
Action	1. Practice conflict resolution and mediation.	As part of a lab meeting or a lesson in a course, consider providing case studies around conflicts that typically occur in course or laboratory group projects. Have the groups discuss if and how the conflict was resolved and discuss what hidden curriculum was addressed through the mediation or conflict resolution plan.
	2. Role playing to address issues directly	Role play several scenarios about an issue. Try to identify different roles (faculty advisor, student mentee, administrator) and discuss what worked and did not work while addressing the matter. Discuss the feasibility of a given hidden curriculum action based on the scope and number of people impacted by the matter. If pertinent, discuss how power inequities may have been at play while addressing this issue.
	3. Rubric for seeking others or resources	In the process of identifying needs, ensure that you have established a process (e.g., rubric) by which you can assess the utility and effectiveness of the resource in meeting the needs of an individual to address a hidden curriculum matter.

Negotiating Self	4. Increasing representation intentionally not performatively	Increase representation intentionally and not performatively. Think intentionally about the sustainability of increasing representation instead of just ‘opening the door’ for a few. Think about how policies, onboarding, succession planning, and other structures and systems can intentionally aim to improve representation.
	1. Minimize enacting of the status quo	If you find that your mentoring relationship is solely based on meeting metrics and deadlines that are systemically or structurally enacted/enforced, consider how at least within your mentoring circle you can minimize enacting this <i>status quo</i> . This may involve meaningful conversations about the future, including non-academic careers, the need for work-life balance, internal rules about mental health, among others. Ensure that in the process, you share what you have learned with others. Minimizing the <i>status quo</i> can be ignited by an intentional sharing of strategies and resources to challenge said <i>status quo</i> .
	2. Develop skills	As your mentees and mentors develop skills, consider that abilities and competencies are broader than just the technical ones. Consider how your groups can gather skills in public speaking, conflict management, social media presence and branding, marketing, human subjects research, among others. Consider skills to be more broadly attuned to the unique contexts and needs of the mentoring relationship.
	3. Changing mentality	Like the skills in the tip above, consider starting journal clubs, discussions, and inviting speakers to help audiences’ reflect about how to conduct research, how to teach, how to mentor students more inclusively, and other topics that may serve to support the overall culture and environment of the classroom and research lab. Ensure the discussions and speakers are not enactors of the <i>status quo</i> but rather changemakers.
Inaction	4. Targeted effort	Consider that effort is not solely to meet the deadlines and milestones established by a structure or system. Effort is time and time is ethical [26]. Consider that time dedicated to mentees to meet mental, emotional, psychological needs can serve to develop the whole individual to become their authentic selves.
	1. Mitigate avoidance	To minimize avoidant strategies, it may involve having an open conversation about the needs and concerns of a mentee. If a mentor feels that this conversation is outside of the scope of their ability or comfort (e.g., psychological), at a minimum, point them to campus resources.

	2. Mitigate inaction	Speak about consequences about not speaking up and about power inequities in speaking up. If needed, bring a discussant or expert guest speaker to discuss strategies to develop the tools to action, even if minimal.
--	----------------------	--

As with any step of the pathways model, reflection is key in trying to understand if the strategies are helpful or harmful to a mentee are important. Before considering any of these strategies, ask the mentee their thoughts about a given strategy and be open to listening if and how it can help or hurt the mentee. Actions without a critical consideration of the power dynamics that may be at play can unintentionally cause harm and it is important that as a mentor, you are cognizant of its consequences before starting any action.

## VI. IMPLICATIONS FOR PRACTICE

While the list of strategies shared in this research-to-practice paper is not comprehensive, the intent is to start a conversation with mentors and mentees. As mentors and mentees begin to have more open conversations, communities of trust may start to form. Through partnership, open communication, and training, a wider group of mentees and mentors will be equipped to learn about hidden curriculum, become aware of HC as well as use emotions and self-efficacy to advocate around HC while equipping relationships towards meaningful positive change.

As mentors and mentees consider identifying the tips and strategies to become aware and attend to hidden curriculum in engineering, consider critically and reflect upon each intention behind a given strategy. Even mentors with the best of intentions may inadvertently introduce bias, enact stereotypes, or assume aspects they should not about a mentee. Of course, the same can be stated about a mentee's views on a mentor. After all, mentoring is a dual relationship of trust [12] and grace.

In Table IV, some reflection questions are included for consideration for both the mentor and mentee. The intent behind these questions is to help them reflect upon and better understanding the unique experiences and walks of life of everyone. These questions also allow the mentor and mentee to create avenues by which positionalities and life experiences are centered and intentionally considered during a mentoring relationship. While it can be argued that the questions presented in the following table are transferrable to other disciplines outside of engineering, the author asks the reader to consider the questions provided within the contexts of the norms, values, beliefs, attitudes, and other realities of the field of engineering education and practice. Every field of study and discipline has its own cultures and engineering is not devoid from them. Consider adding the words 'professionally', 'personally', 'or 'educationally' after each of the questions presented and take notes on what you observe. You may be surprised at what you may uncover are hidden curriculum surrounding your and the mentees' experiences in and around engineering.

TABLE IV. REFLECTIVE QUESTIONS FOR MENTEES AND MENTORS AROUND HIDDEN CURRICULUM IN ENGINEERING

<b>For mentors</b>
1. Should I be recreating a copy of myself in my mentee? 2. How much do I know about my mentee, and do I understand where they are coming from? 3. Am I checking my biases as I provide guidance or mentoring to the mentee? 4. How am I contributing to the <i>status quo</i> of my discipline or department? 5. How can I mentor my student to change the <i>status quo</i> alongside me and after me?
<b>For mentees</b>
1. Am I understanding the context behind my mentor's guidance or mentoring? 2. Is the recommendation provided by my mentor attuned to the realities of my role or position? 3. Do I understand enough about the landscape of my working or learning environment to know how to act upon the mentor's guidance or mentoring? 4. How can I help other mentees and myself to navigate a given hidden curriculum in engineering? 5. How can I spread my knowledge about hidden curriculum to others not just at my learning or working environment but outside of it as well?

## VII. CONCLUSIONS

This research-to-practice paper is aimed to serve as a guide for engineering faculty mentors and graduate student mentees on how to navigate hidden curriculum. While the list is not comprehensive, the intent of this work was to provide ideas to start difficult yet impactful conversations with individuals within and outside of structures and systems in engineering. It is my hope that this document will serve as a conversation starter for more meaningful and positive use of hidden curriculum for sustainable and empowering change.

## ACKNOWLEDGMENT

This material is supported by the National Science Foundation (NSF) No. EEC-1653140 and 2023016, given to the author. Any opinions, findings, and conclusions or recommendations expressed in this material do not necessarily reflect those of the NSF. I would also like to thank Dr. Victoria Sellers for supporting the member-checking process and for providing editorial comments to this paper.

## REFERENCES

- [1] P.W. Jackson, *Life in classrooms*. Teachers College Press, 1968.
- [2] R. Dreeben, "Social relations in a secondary school. *Social Forces*," vol. 47, 1968, pp. 235–236.
- [3] J. Higham, "The Cult of the 'American Consensus': Homogenizing Our History," *Commentary* 27, 1959, pp. 93–100.
- [4] H.A. Giroux and A. Penna. "Social education in the classroom: The dynamics of the hidden curriculum," *Theory and Research in Social Education*, vol. 7, 1979, pp. 21–42.
- [5] M.W. Apple, "Analyzing determinations: understanding and evaluating the production of social outcomes in schools. *Curriculum Inquiry*," vol. 10, 1980, pp. 55–76.
- [6] F.W. Hafferty and R. Franks, "The hidden curriculum, ethics teaching, and the structure of medical education," *Academic Medicine*, vol. 69, pp. 861–871, 1994.

- [7] E. Margolis, *The hidden curriculum in higher education*. Psychology Press, 2001.
- [8] H.T. Allan, P. Smith, and M. O'Driscoll, "Experiences of supernumerary status and the hidden curriculum in nursing: a new twist in the theory-practice gap?" *Journal of Clinical Nursing*, 20(5-6), 847-855. <https://doi.org/10.1111/j.1365-2702.2010.03570.x>
- [9] A.R. Bejerano and T. M. Bartosh, "Learning masculinity: Unmasking the hidden curriculum in science, technology, engineering, and mathematical courses," *Journal of Women and Minorities in Science and Engineering*, vol. 21, pp. 107-124, 2015.
- [10] L. Hansson, "Science education, indoctrination, and the hidden curriculum. In *History, philosophy and science teaching*, pp. 283-306, Springer, Cham, 2018.
- [11] V.B. Sellers and I. Villanueva Alarcón, "What strategies do diverse women in engineering use to cope with situational hidden curriculum? 2021 ASEE Virtual Annual Conference, 2021.
- [12] I. Villanueva, M. Di Stefano, L. Gelles, K. Youmans, and A. Hunt, "Development and assessment of a vignette survey instrument to identify responses due to hidden curriculum among engineering students and faculty," *International Journal of Engineering Education*, vol. 36, 2020, pp. 1-21.
- [13] K.L. Tonso, "Plotting something dastardly": Hiding a gender curriculum in engineering. In *The hidden curriculum in higher education*, pp. 165-184, Routledge, 2001.
- [14] S.K. Erickson, "Engineering the hidden curriculum: How women doctoral students in engineering navigate belonging" Arizona State University Dissertation, 2007.
- [15] R. Tormey, I. Leduc, S. Isaac, C. Hardebolle, and I.V. Cardia, "The formal and hidden curricula of ethics in engineering education," *Proceedings of the 43rd Annual SEFI Conference*, 2015.
- [16] G. Nudelman, "The hidden curriculum in two employability skills development courses in a South African electrical engineering degree programme," *Journal of Education and Work*, vol. 33, pp. 360-374, 2020.
- [17] E. Pehlivanli-Kadayifci, "Exploring the hidden curriculum of gender in engineering education: A case of an engineering faculty in Turkey." *International Journal of Engineering Education*, vol. 35, pp. 1194-1205, 2019
- [18] M. Polmear, A. Bielefeldt, D. Knight, C. Swan, and N. Canney. "Hidden Curriculum Perspective on the Importance of Ethics and Societal Impacts in Engineering Education. 2019 ASEE Annual Conference & Exposition Proceedings, 2019.
- [19] S.C. Rea, K. Shiekh, Q. Zhu, and D. Nieusma, "The hidden curriculum and the professional formation of responsible engineers: A review of relevant literature in ASEE Conference Proceedings." Paper presented at 2021 ASEE Virtual Annual Conference Content Access, Virtual Conference, 2021.
- [20] I. Villanueva, "CAREER: Advocating for engineering through hidden curricula: A multi-institutional mixed method approach." National Science Foundation, 2017.
- [21] L.A. Gelles, K.L. Youmans, and I. Villanueva, "Sparking action: How emotions fuel or inhibit advocacy around hidden curriculum in engineering. European Society of Engineering Education (SEFI), 47th Annual Conference: Varietas Delectat...Complexity Is the New Normality, Proceedings, 2020, pp. 1566-1575.
- [22] I. Villanueva, I. Gelles, L., K. Youmans, and M. Di Stefano, "Hidden curriculum awareness: A comparison of engineering faculty, graduate students, and undergraduates," *World Engineering Education Forum*, 2018, pp. 1-6.
- [23] I. Villanueva, T. Carothers, M. Di Stefano, and M. Khan, " "There is never a break": The hidden curriculum of professionalization for engineering faculty. *Education Sciences*, vol. 8, 2018, pp. 1-21.
- [24] I. Villanueva, R.A. Revelo, and J.A. Mejia, "Professional development of Latinx engineers on hidden curriculum: An exploratory study," *IEEE Frontiers in Education Conference*, 2019, pp. 1-5.
- [25] L. Gelles, I. Villanueva, & M. Di Stefano, "Perceptions of ethical behavior in ethical mentoring relationships between women graduate students and faculty in science and engineering," *Proceedings of the American Society of Engineering Education Annual Conference & Exposition, Engineering Ethics Division*, June 24-27, 2018, Salt Lake City, UT, Paper ID # 21889, 2018, pp. 1-20.
- [26] L. Gelles, I. Villanueva, and M. Di Stefano, " "Mentoring is ethical, right?": Women graduate students and faculty in science and engineering speak out," *International Journal of Gender, Science and Technology*, vol. 11, 2019, pp. 108-133.
- [27] I. Villanueva Alarcón and V. Sellers, "Faculty Development in the Third Space: Influence of Hidden Curriculum Amid Engineering Educators," *Handbook of STEM Faculty Development*. Sandy Linder, Cindy Lee, & Karen High (ed.), (In-Press), 2022.
- [28] J.A. Mejia, I. Villanueva Alarcón, R. Revelo, & J. Mejia. (2022). *Legitimized Tongues: Breaking the Traditions of Silence in Mainstream Engineering Education Research*. *Journal of Women and Minorities in Science and Engineering*, 28, 2022, pp. 53-77. [10.1615/JWomenMinorScienEng.2022036603](https://doi.org/10.1615/JWomenMinorScienEng.2022036603).
- [29] I. Villanueva Alarcón, V. Sellers, R.M. Paul, and B. Smith. *Transforming engineering education: How engineers use social capital in response to hidden curriculum*. In *International Handbook of Engineering Education*; Aditya Johri (ed.), (In-Press).