WIP: Latina Engineering Students' Experiences in Work-Integrated Learning

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Abstract - **In this Work In Progress (WIP) research paper we explore the experiences of Latina engineering students during their industry placements, focusing on the factors that contribute to their success or hinder their progress. Latina engineering students face unique challenges when navigating industry placements, as they often confront issues related to gender, race, and cultural background.**

Using a qualitative research approach, semi-structured interviews were conducted with a group of 12 Latina engineering students who had completed industry placements in their undergraduate studies. The data was analyzed using Illeris' Model of Learning as a theoretical framework. Illeris postulated that learning happens on an individual dimension yet is always set in a social context. We used a combination of deductive and inductive coding to analyze the transcripts. The participants shared their thoughts and reflections on their experiences, discussing the challenges they faced, the support they received, and the value they believed they brought to the organization they worked for.

The findings reveal that Latina engineering students report learning on the individual, cognitive, and affective dimensions of the Illeris' model. Yet they often encounter interactions that communicate stereotypes and biases in the workplace, which lead to some reporting feelings of isolation and imposter syndrome as the work cultures are not always welcoming to this group of students. The students highlight the importance of mentorship, networking, and self-advocacy in overcoming these barriers and thriving in their industry placements.

Moreover, the study sheds light on the role of cultural background and identity in shaping the experiences of Latina engineering students in industry placements. Participants discussed how their heritage and values influenced their interactions with colleagues and supervisors, as well as their approach to problem-solving and teamwork.

Overall, this research contributes to a better understanding of the unique challenges and opportunities faced by Latina engineering students in industry placements, offering insights for educators, employers, and policymakers on how to support and empower this underrepresented group in the engineering workforce.

Keywords—Latina engineers, Work-Integrated Learning

I. Introduction

Latina engineering students face unique challenges when navigating industry placements, as they often confront issues related to gender, race, and cultural background. This study aims to explore the experiences of Latina engineering students during their industry placements, focusing on the factors that contribute to their success or hinder their progress.

According to the Census Bureau (2020) 25 percent of the US population will be Latinx in 2050, however, currently, U.S. Latinos might constitute just 9.4% of the engineering workforce, yet their representation among undergraduate engineering students is notably higher at 15.8% as of 2021[1]. In 2015 only 2 percent of engineering students was Latina [2]. Percentages of Latinas in engineering are slowly increasing.

Research reveals that students who are at the intersection of gender and minority-status face unique challenges in their studies, and careers in engineering. With the increasing attention on diversity in engineering education and engineering industry, there is an increasing amount of research into gender differences in personal attributes, such as self-efficacy [3] and identity [4]. Research into student success shows that women often report different experiences in engineering learning environments than men, and that women from underrepresented groups face compounded difficulties.

Using a qualitative research approach, semi-structured interviews were conducted with a group of 12 Latina engineering students who had completed industry placements in their undergraduate studies. The data was analyzed using Illeris' Model of Learning as a theoretical framework. Illeris postulated that learning happens on an individual dimension yet is always set in a social context. We used a combination of deductive and inductive coding to analyze the transcripts. The participants shared their thoughts and reflections on their experiences, discussing the challenges they faced, the support they received, and the value they believed they brought to the organization they worked for.

The findings reveal that Latina engineering students report learning on the individual, cognitive, and affective dimensions of the Illeris' model. Further, they often encounter interactions that communicate stereotypes and biases in the workplace, which lead to some reporting feelings of isolation and imposter syndrome as the work cultures are not always welcoming to this group of students. The students highlight the importance of mentorship, networking, and self-advocacy in overcoming these barriers and thriving in their industry placements.

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II. Socialization As Learning

Socialization is a semi-conscious process through which individuals learn and internalize cultural norms, values, beliefs, and behaviors of a social group to become members of that group [5, 6]. As such socialization is an important part of work-integrated learning, as students learn not only to address real-life problems by using the knowledge they learned in their coursework, but they also need to learn to navigate this new environment. Korte and Lin [7] observe that many studies into organizational socialization are based on frameworks of social capital yet postulate that the concept of social capital is problematic: "There are conflicting conceptualizations throughout the literature depicting social capital as various types of agency, resources, position, power, trust, relations, or networks. There is circularity in models of social capital depicting it as both an antecedent and consequent (page 410)".

In this study we chose to see socialization as an individual learning process that is strongly rooted in a social context, and that is driven by interactions between the individual and their environment. We use the model of learning by Knut Illeris [8] who introduced a model of learning that is based on a broad conception of learning by integrating cognitive, emotional, and social factors into an interdependent system. In Illeris' model there is a strong interdependency between internal learning processes that emerge from interactions between the cognitive and affective dimensions of learning, and external interactions with the social environment. Illeris postulates that learning can never take place without individuals interacting with their environment. The cognitive dimension involves acquiring knowledge, and the application thereof, problem solving and the development of technical skills [9, 10]. The emotional of affective dimension concerns motivation [11] self-awareness, and self-efficacy [12], as well as personal development and resilience [13]. The social learning dimension involves any kind of socialization and communication process that occurs when people collaborate [14] in teams [15], such as mentorship and professional networking [16].

III. Methods

We use a qualitative study design to explore and understand the supports and challenges Latina students encounter in Work-Integrated Learning (WIL) experiences. A qualitative study helps us understand experiences by allowing us to explore the details and context of people's thoughts, feelings, and behaviors [17]. Through methods like interviews, we can delve deeper into individuals' perspectives and uncover the nuances of their experiences. This approach helps us gain insight into the complexities of human experiences and provides rich, descriptive data that enhances our understanding. The study was approved under IRB number 2162997-1.

Our participants include Latina engineering students who had participated in some level of work-integrated learning (WIL) experiences. The study was conducted at UTEP, and the participants are predominantly in their junior and senior years, providing a comprehensive view of their experiences throughout their undergraduate studies. Recruitment was facilitated through the UTEP Career Center, specifically targeting engineering-focused advisors and Engineering Student Success programs. We also utilized posters and flyers placed in the engineering and computer science buildings, which included a QR code for easy sign-up. The combination of these methods ensured a diverse and representative sample of Latina engineering students who had engaged in WIL experiences. We specifically chose participants who:

- Are Latina/Latinx;
- Identify as women;
- Study engineering;
- Participated in co-ops, internships, or other engineering work experiences.

We did semi-structured interviews that took about an hour. In these interviews we explored the students' reasons for pursuing work-integrated learning experiences, what they experienced in terms of learning, if and how they felt prepared

for their experiences, and how they felt their cultural capital helped or barred them from being successful. All interviews were audio-recorded with the participants' permission. Following the interviews, the recordings were transcribed, and the transcriptions were anonymized. We interviewed 13 students in total.

In this paper we present a preliminary analysis of a randomly selected subset of 5 transcripts. We started developing a codebook that is based in Illeris' model of learning, and we present the preliminary outcomes. We used thematic analysis [18] to identify themes and patterns within the data. We started by creating three codes that represent the three main dimensions of learning according to Illeris' model of learning: learning has a cognitive, emotive, and social dimension. The model recognizes both the cognitive and emotional dimensions of learning yet emphasizes that learning always occurs within a specific context. This means there is inherently a social and interactive aspect to learning, where the learner engages with the external world. We started with these three dimensions and identified themes within these dimensions based on the data. Every dimension was adopted by a team member, and they would create codes in vivo before categorizing these codes in overarching themes. Every theme was discussed by the entire team. The codebook has not yet been finalized, and the main themes the team agreed on will be in the final version.

All names in the text have been anonymized.

IV. Results

A. Cognition in Work-Integrated Learning

Latinas often make important academic choices based on their career goals and advice from mentors. For example, Zara started studying computer science because she was interested in biomedical research. But after talking with advisors, she changed to industrial and systems engineering to better understand the field and avoid making mistakes. Zara reflected, "So I talked to my advisors and I switched my major into industrial and systems engineering." Likewise, another participant, Piku started with software engineering but switched to data analysis after realizing she enjoyed coding and preferred data analysis during a research assistant job. This change in focus shows how people rethink and change their learning environment based on new experiences. This is what Illeris (2003) calls cognition, which is about learning new things and skills or adapting to new things. Both Zara and Piku's experiences show how they used new information to change their academic path, which is part of learning.

Work-integrated learning experiences provide Latinas with essential opportunities to apply their academic knowledge in practical settings, thereby enhancing their cognitive skills. Zara's co-op and internship experiences at a large automotive company in Texas and an engineering company in the Midwest are prime examples of how practical application can solidify learning. Through these roles, she not only applied her Python skills but also developed a comprehensive understanding of industrial processes. She mentioned, "My basics in Python have helped me a lot for industrial engineering and understanding more of the basics of the algorithm side learned in computer science." Another participant, Elsa's experience in juggling multiple roles, such as working at the front desk, conducting research, and starting a podcast, demonstrates her ability to apply theoretical knowledge in diverse practical settings. She shared, "I was working at the front desk and doing the research with a campus professor. At the same time, I really love podcasts, so I decided to start a podcast for the department." This multitasking and practical application of skills are central to cognitive learning, as described by Illeris, showcasing the synthesis of academic and practical experiences. According to Illeris [8], cognition involves the practical application of learned skills, and this practical exposure is crucial for skill development. This is evident in Elsa and Zara's experience as they bridge the gap between academic knowledge and industrial practice.

For Latinas in WIL experiences, facing and solving problems helps them learn better. Ana's experience of learning to manage time effectively while balancing her internship with schoolwork highlights her realization of how she needed to get better at organizing her tasks. Initially, she struggled to juggle her responsibilities but gradually adapted by acquiring better time management strategies. She mentioned, "At first, it was difficult. I had to learn to really establish my understanding of what I'm able to do and time management." This reflects the cognitive development that occurs through tackling practical challenges, which exemplifies Illeris's concept of learning through challenges and problem-solving. Zara's reflection on her learning approach, where she initially did the bare minimum to achieve high grades, reveals the cognitive challenge of transitioning to a deeper understanding and active problem-solving. Similarly, her task of developing a coding application at Tesla required her to engage in complex problem-solving, demonstrating her cognitive growth through real-world challenges. These experiences underscore the role of problem-solving in cognitive development and the importance of confronting and navigating difficulties. Illeris [8] notes that cognitive learning is not just about acquiring knowledge but also about applying it to solve problems and overcome obstacles, which Zara's experiences clearly illustrate.

For Latinas, the integration of knowledge and interdisciplinary learning play vital roles in cognitive development. Elsa's combination of engineering and project management reflects this integration. Her academic journey, which included various interdisciplinary projects, allowed her to apply engineering principles in management contexts, enhancing her cognitive abilities to handle complex tasks. Similarly, Piku's work in data analysis and software engineering demonstrates how interdisciplinary skills can be merged to contribute effectively to projects. This integration of knowledge from different domains enriches cognitive learning and prepares Latinas for versatile roles in the workforce. Illeris [8] highlights that cognition involves synthesizing knowledge from various fields to create a comprehensive understanding, which is evident in both Elsa's and Piku's academic and

professional experiences. Bella's transition from feeling unprepared and nervous to gaining confidence through mentorship and practical experience in her internships also showcases the integration of cognitive learning and interdisciplinary application. By navigating different roles and responsibilities, Bella developed a broader skill set and a deeper understanding of her field, aligning with Illeris' emphasis on interdisciplinary cognitive development.

In our observations, we noticed that cognitive learning often intersects with social environments, reflecting the interconnectedness of individual learning and social contexts. Simply we can say learning happens not just by yourself, but also when you're with other people. Zara's experience of networking with peers during her internships highlights this intersection. She mentioned, "I felt like I was networking a lot with other colleagues from my age or around my age, going to college, seeing their perspective of being an industrial engineer or a mechanical engineer." Her cognitive learning was supported by these social interactions, providing a rich environment for professional growth. This interaction not only expanded her technical knowledge but also her understanding of various career paths and professional practices. According to Illeris [8], learning is a comprehensive process that involves not just the acquisition of knowledge but also the context in which this knowledge is applied and integrated, often through social interaction and collaboration.

Similarly, Zara's efforts to improve her English communication skills were significantly influenced by her social environment. She noted, "So going into this internship, I also practiced a little bit more my English just because I was not really comfortable talking in English as much." Her interactions with colleagues who corrected her language use provided real-time feedback and practice opportunities. This example underscores how cognitive and social aspects are intertwined in the learning process. Illeris [8] emphasizes that cognitive learning involves continuous interaction with the environment, which in this case, includes social and linguistic feedback loops that enhance learning outcomes.

Ana's experience of relying on teamwork to complete tasks further emphasizes the role of social interactions in enhancing cognitive learning. She said, "It was kind of those situations where Gabby would just throw us like, hey, this company is coming and get it done. And everyone just had to rely on each other to get the job done." This scenario demonstrates how working collaboratively in a team setting can enhance individual cognitive development. Through teamwork, Ana was able to learn from her peers, adapt to new challenges, and integrate different perspectives into her problem-solving process. Illeris [8] highlights that learning involves both the individual and the environment, and effective learning often occurs in social settings where individuals can exchange ideas and collaborate on solutions.

These examples illustrate the double coding of cognitive learning and social environments, underscoring the importance of collaborative and supportive settings in WIL experiences. The cognitive dimension of learning is enriched and often depends on the social context in which it occurs, as peers, mentors, and social interactions provide crucial support, feedback, and new perspectives that enhance the learning process. This interconnectedness aligns with Illeris's [8] framework, which posits that cognitive development is deeply embedded within the social and emotional dimensions of learning.

B. Affective/Motivation Dimension in Work-Integrated Learning

Latina engineering undergraduate students' motivation to become professional engineers and successfully participate in WIL was evident. Students shared two types of motivations for wanting to pursue WIL experiences including exploring and creating opportunities for the future.

Students were interested in exploring the kinds of engineering and the available work experiences to discover their field in the profession. This is clear when one interviewee, Zara, realized while she was studying a technical subject, not engineering that she wanted to explore the engineering field and find her passion, “I wasn't doing bad in my classes. I just didn't feel the passion my other classmates had. And I was like, I wanna feel that, I wanna be passionate of what I'm doing.” Bella took every WIL opportunity to explore as she explained, “That summer I had another internship aligned so I went from internship to internship, and I was at [company] as avionics manufacturing engineer. So, big jump from, I mean, I've always done like big industries and they're all different industries, but they're all very, very different. And this summer I am going to [company] as a materials reliability. So excited!” These Latinas were excited to find their place in the engineering industry.

Further, the Latina engineering students we interviewed were highly motivated to create experiences and networks that would serve them well after graduation by doing an excellent job in their WIL. Bella wanted her “work to speak for itself,” and Elsa reflected those sentiments when she stated, “And I'm like, okay, so am I doing enough? Am I meeting the expectations of the people that are hiring me? Do I have the skill set that they want?” These students, while highly motivated and technically savvy, still worried whether they met and more importantly exceeded expectations and moved many like Bella and Elsa to be agents in their own learning. Bella did not hesitate to reach out to the Spanish speaking technician in one WIL to ensure she would learn as much as possible. Her use of language and wording helped her to create those learning opportunities, as exemplified in the following, “And like instead of being like, can you do this for me? It's like, I need help doing this and I want to learn it. Can you help me? And right away, like he would drop everything he was doing.”

Elsa chose to proactively find ways to deepen her knowledge and skills base and shared her trepidation and metacognitive process to solving her perceived lack of skill, “the depth of my knowledge was really more in biomedical engineering. So, I was worried that I wasn't going to know

enough about mechanical engineering to be successful in the role. And so, I just remember asking everybody, "Okay, what should I re-up on? What are some of the technical things that you're doing, and are there trainings?" Along with their motivation and being agents of their own technical learning, these Latina engineering students had many affective learning experiences that may have tested and strengthened their self-perceived attributes such as resilience, self-efficacy, self-worth, and the ability to manage uncomfortable situations that, unfortunately, are common to women engineers in workplaces that are male dominated, white environments.

Piku's self-talk quashed any self-doubt as she frankly revealed when she shared, "So I saw the other interns at the onboarding event and they were coming from like prestigious universities. Many of them knew about my university. So, I was like, don't get intimidated: you are here because you deserve it." She further shares that "You need to be, of course, honest with yourself, but try to be like: I can do it, like, convince yourself you are capable in the same way than any other student." Self-efficacy, self-worth and resiliency are critical to the women in engineering. Ana described her WIL and her approach to working in a male dominated environment in the following:

> "I mainly am surrounded around other male students, it's very rare when I do have more female students than men, same at the lab. But it really doesn't matter, faze me, or does it bother me. So, I grew up in a household where I was told: Oh, you can't do that because you're a woman. So that's kind of what led me to choose this career path, just to give myself like an ego boost. Because I like to prove people that even though I am a woman, I am very much capable of doing the same as a man. So being in an environment that's male dominated, doesn't bother me whatsoever, if anything motivates me to be better."

Piku shared that she understood the field she chose would mean few women and even fewer women of color, "I had like that resignation of like, I'm going to be alone. And maybe I'm going to be the only woman. So you cannot be scared. Like you need to go there and be brave, you know." However, there are times when even their bravery is enough as demonstrated by Piku's poignant words, "If you're the only woman in your accent is unique at that meeting. Of course, you're gonna feel scared if you're a entry position level, you know, like, yeah, it was that as an intern, I didn't even felt comfortable sharing my thoughts or my opinions in a room full of elder men's sharing their expertise."

Latinas, like Piku, do not feeling comfortable sharing their ideas or who they are as a person as Ana describes in the following: "part of my internship is managing management. So I had to learn how to speak with people, I have to learn to how to interact with them and meet them on the same level. So I really learned how to cue personal things such as my culture, religion, feeling on the side, just due to the fact of how my professional set up and how you have to stay on a neutral basis when it comes to that."

These Latina undergraduate engineering students are highly motivated in many ways including exploration of engineering fields as well as creating professional networks for their future in engineering. Moreover, they are agents of their own learning, taking the lead to find the expert who can teach them or finding the resources they need to grow their knowledge and skills.

C. Social Dimension in Work-Integrated Learning

The environment in which Latinas in STEM participate in work-integrated learning opportunities is crucial in the shaping of their experiences. According to Illeris, "The social dimension is the dimension of external interaction such as participation, communication and co-operation. It serves the personal integration in communities and society and thereby also builds up the sociality of the learner" [8]. The environment in which Latinas participate in WIL opportunities is essential for integration into the workplace. Latinas face many challenges ranging from overcoming cultural and socio-economic barriers, utilizing language as a tool for connection, and navigating the workplace in male-dominated technical fields. Understanding the nuances of the environment as it pertains to this research is key in supporting Latina's in their professional growth within STEM Fields.

Latinas in STEM deal with imposter syndrome, often compounded by their cultural background and socio-economic differences between themselves and their peers. One participant, Bella, reflected on such feelings, stating:

> "There were kids who have had like their life figured out from like since they were really young and they have like parents that are either engineers or doctors, lawyers, they were like, they were at a very different, tax bracket than my parents were, and I was growing up and just grew up in a very different way. So, they got a lot of advantages. They went to schools that maybe prepare them a little bit better knowledge-wise for me was just like more experience wise. So, you can find like a lot of differences, and I have like big imposter syndrome in the beginning of, oh, this is crazy. Like, what am I doing here?"

These socio-economic disparities contribute to a sense of imposter syndrome for Latinas in these environments. The same participant recalled orientation at her internship "I

remember the orientation leaders were talking about this is the most diverse intern class we ever had, and I look around and everyone is either white, Asian, or Indian. "Without the representation of other Latinas, the idea of being alienated or isolated in the workplace becomes more evident.

Just as see oneself in the profession, language can serve as a vital tool for building connection and rapport with others who speak the same language. The ability of Latinas to communicate in Spanish can bridge cultural gaps and build a sense of closeness and home among colleagues. Bella shared that she was able to find a mentor through the shared language: "he ended up helping me . . ., and we would always speak Spanish, and I think that's the one thing that helped me a lot because the other intern didn't speak Spanish." The ability to connect through language can facilitate more collaboration and teamwork for Latinas in the workplace. Language commonalities may also mean similar cultural backgrounds that may constitute the build blocks for mentoring of Latinas and other underrepresented engineering interns. Mentors who share similar backgrounds can provide relevant guidance and support. Zara was able to connect with her mentor due to a shared ethnic identity as noted in the following:

> "So, I was actually the only Latina on my team, and my manager was Latino. So, bonding with my manager in that sense as well was great." Another interviewee described the support she felt because of her shared gender identity with her mentor my authority figure was a woman. She was an industrial engineer as well. So, she really really opened my eyes to industry and how things work, and I was more on the forecasting side. So, I felt like she . . . Really, I really was appreciated as a woman, and she wanted to me to flourish more there and to understand what was happening, and that internship I felt like appreciate it as an intern."

The ability to find representation within the organization structure and tap into that to find effective mentorship helps Latinas navigate the workplace environment. Some workplaces and specific managers are already building these support systems in place as seen by Zara's recollection that her manager wanted more representation on her team: "She knew I was a girl, and she specifically told me, like, Yeah, I chose you cause you're an industrial engineer, and I'm an industrial engineer, and I want a female intern. So, I surrounded you by other girls. But I want you to also feel welcomed by other guys." This also enables them to build their confidence and professional identity at Latinas in engineering. These kinds of supportive environments, created specifically to encourage Latina self-efficacy and a sense of belonging are invaluable to build a more diverse engineering profession. However, navigating instances of inappropriate behavior in the workplace is still an unfortunate reality for Latinas in engineering. These types of uncomfortable situations require careful handling to maintain a professional relationship and ensure personal safety.

Bella recalled when her mentor crossed professional boundaries as follows: "My mentor was kind of uncomfortable. I think he was like 35ish and he was still not married. He didn't have a girlfriend or anything. So, I don't know if he was like going through a crisis or I should get a girlfriend by now. So, he would have like uncomfortable talks with me or like do some things that I was just like, oh, I don't feel so, so comfortable with what you're doing which, maybe if it was like a guy and a guy obviously like you can't do that type of stuff". This resulted in Bella relying more heavily on individuals outside of her mentor and immediate organizational structure and highlights the complexities where professional repercussions and personal comfort are at risk.

Zara recalled having to change her wardrobe when going into the field as she stated, "Most of them were males, only the girls were left in the second floor. Working wise, just cause they also wanted to. It was a different like. It was a rougher environment. You felt, you know, when somebody's looking at you wrongly and stuff like that. So, I started wearing more loose clothes. I had to start buying loose jeans, and my work attire for (work) on a daily basis was loose jeans and a hoodie just to feel more comfortable". Her experience of having to change clothes to avoid uncomfortable situations with her male coworkers is not just about comfort but is a strategic decision to avoid being the focus of inappropriate comments or behavior.

All our interviewees grappled with internal and external structures in the professional environment that moved at least one interviewee, Bella, state that "It's like, no, like you still need to bring this stuff up. First of all, so other interns don't deal with stuff like that." Yet, the motivation to move forward in their careers as engineers was evident and inspiring.

CONCLUSION

To better understand the value as well as the challenges Latinas experience in WIL, we embarked a qualitative study using the model of learning by Knut Illeris [8] who introduced a model of learning that is based on a broad conception of learning by integrating cognitive, emotional, and social factors into an interdependent system. The rich tapestry of these Latina undergraduate students WIL experiences used common threads throughout. We found that the cognitive dimension of learning is enriched and often depends on the social context in which it occurs, as peers, mentors, and social interactions provide crucial support, feedback, and new perspectives that enhance the learning process. The affective or emotional dimension of Illeris' learning model includes motivations and couched in this theoretical framework, our interviewees revealed highly motivated individuals who are willing to explore and create learning opportunities. Their results also indicate an understanding of to the present state of WIL in engineering fields and appear to create networks for their future careers.

Finally, while Latinas face many challenges ranging from overcoming cultural and socio-economic barriers, utilizing language as a tool for connection, and navigating the workplace in male-dominated technical fields, they are using their cultural capital in ways that help them maneuver through unwelcoming WIL environments. We take inspiration from our interviewees and look forward to learning more about their experiences.

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