LA program as a driving force for identity development through access to ideational resources

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In our research we invite multiply-marginalized physics students—Black, Indigenous, Women of Color and LGBTQ+ women—at Hispanic Serving Institutions to participate in semi-structured interviews about their experiences in physics. Interviewees were asked about their perceptions of their physics environments, available support systems, and how they would describe a physicist. Participants from Texas State University described multiple positive impacts from the Physics Learning Assistant (LA) Program. We analyze these narratives using the Critical Physics Identity framework to see in what ways LA participation overlaps with participants’ racialized and/or queer experiences studying physics. We present a case study of a single participant, focused on the ways in which the LA Program provided her access to relational resources (aspects of relationships that impact one’s connection to physics) and ideational resources (aspects of an idea that impact one’s connection to physics), and how these resources supported her identity negotiation and positive physics identity development.
I. INTRODUCTION

The goal of this paper is to begin to understand the ways the Texas State University (TXST) Physics Learning Assistant (LA) Program affects the physics identity development of multiply marginalized students, by analyzing interview data using the lens of the Critical Physics Identity framework (CPI) [1,2]. In this paper we present a case study of Frankie, a Hispanic woman interviewed shortly after she graduated from TXST with a B.S. in Physics, focusing on her experiences in the introductory course sequence for physics majors. We will illustrate how her relationships with peers, LAs, and instructors provided her with relational and ideational resources that shifted her physics practices and supported her positive physics identity development.

II. BACKGROUND & METHODS

The case study presented here draws from an interview of a TXST student. As discussed in prior work [3-5], TXST is a Hispanic Serving Institution where the racial demographics of the university are mirrored in that of the physics department; and where nearly half of declared physics majors identify as a racial or ethnic minority, allowing for students to study in a diverse learning environment [4].

This analysis is part of a larger interview study designed around the question “How do multiply minoritized/multiply marginalized physics students perform and discuss the intersections of their physics identities with their social identities?” [3-5]. The interviews in this study were video recorded and conducted by the first author, who, in being a racial/ethnic minority and a queer person, shares many of the same minoritized and marginalized identities. Interviews focused on the interviewees’ narratives about their experiences studying physics, and how their learning environments impacted their physics identity.

The team iteratively coded the transcripts using the Critical Physics Identity (CPI) framework [1,2] to explore the relationships between Physics LA Program structures and practices, interviewees’ interactions with the Physics LA Program, and their physics identity development.

A. TXST Physics LA Program

The TXST Physics LA Program is based on the model developed at University of Colorado Boulder [6], with an emphasis on building and supporting a sense of community [7]. Unlike the opt-in model used at CU-Boulder in which individual faculty choose whether to apply for LA support, at TXST LAs support all sections of the three-course introductory physics sequence for majors. The primary LA role is assisting small groups of students during the “lecture” class meetings, often while groups are working on materials from Tutorials in Introductory Physics [8]. All LAs and LA-supported faculty meet together for collaborative weekly preparation sessions on Friday afternoons. The first ~30 minutes of this time is spent with LAs and faculty from all courses discussing common issues and concerns; this is followed by time for each course team to work together to debrief and prepare for the following week. At the time of these interviews, physics was the only TXST department with LAs, and the required pedagogy course for first semester LAs was a physics-specific course, taught by the third author.

While all majors are welcome to apply to the Physics LA Program, typically more than half of applicants are physics majors or minors. Because the introductory sequence for physics majors also serves majors from other, larger departments (e.g., engineering, chemistry), most physics majors have the opportunity to serve as LAs, and in fact the majority of our B.S. graduates have LA experience by the time they complete their degrees. We also make a special effort to recruit women physics majors into the LA program. Previous research has found that participation in the LA program supports students’ development of physics identity [7], and that being a part of the program helps them find “success together” [3].

B. Critical Physics Identity Framework

The Critical Physics Identity (CPI) framework [1,2] was developed by the second author to deconstruct the experiences of Black physicists to show how structures and systems in the field impact their physics identity development. The CPI framework combines two identity frameworks from the education research field: Hazari et al.’s physics identity constructs (interest, performance, competence, and recognition) [9] originating from Carlone & Johnson’s science identity framework used to indicate the “stuff” of a physics identity [10], and Nasir’s racialized identity resources (material, relational, and ideational) used to examine how resources provided by the localized environment can encourage or discourage Black students’ connections to a practice [11]. With the CPI, we can use these combined constructs to examine more deeply the complex factors that contribute to how marginalized physicists view themselves in the context of, and connection to, the physics field.

The CPI weaves together the Nasir and Hazari frameworks to more accurately understand the lived experiences of racialized physicists. Under the umbrella of the CPI framework, the identity resources and physics identity constructs work with each other to describe a person’s physics identity. While this framework was originally operationalized using the narratives of Black physicists, we find the CPI an extremely useful lens for critically examining the many institutional, systemic, and cultural ways physics perpetuates racism, sexism, homophobia, and transphobia [2].

By analyzing the sections of the interviews that discuss the TXST LA Program using the CPI, we are able to discern
what components of the program are supporting multiply marginalized populations in their physics identity development. Here, we use the framework to gain a deeper understanding of Frankie’s experiences and their impacts as she describes her journey through her undergraduate physics courses.

In Frankie’s narrative, we focus on the relational and ideational resources that Frankie uses to negotiate her place in, and connection to, physics and more specifically the physics classroom. Relational resources are defined as aspects of a relationship with others in the physics context that impact one’s connection to physics. A single relationship has the capacity to provide an individual with multiple relational resources in different ways and in different times of their physics journey. Similarly, ideational resources are defined as aspects of an idea (e.g., ideas about oneself, one’s place in physics, or what is valued in physics) that impact one’s connection to physics. Ideational resources are not solely developed in the physics environment, and students often come into the classroom with a number of ideational resources already [1,2]. Often these ideational resources inhibit students’ connection to physics; we often see this dissonance in how students describe a physicist, or in how they describe their own physics identity.

We code elements of Frankie’s story using these resources to illuminate the ways in which both the introductory course structures and the relationships she develops in these classes impact how she positions herself in the classroom, her understanding of what is valued, and how these ideas shift over time.

III. ANALYSIS

Frankie, who self-identified as a Latina/white and bisexual woman, was interviewed shortly after graduating from TXST with a B.S. in physics. During her time as an undergraduate at TXST, Frankie completed the LA-supported calculus-based introductory physics sequence and served as an LA for multiple semesters. In her interview, Frankie shared a narrative about her time in the introductory course sequence that gives us rich insight into how the resources to which she had access helped her increase her connection to the field and develop her physics identity as a student and as an LA.

Frankie’s description of her first three semesters in the TXST physics department is a story of increasing engagement: with peers; with student-centered structures in courses; with physics content; and with the LA program. Because the TXST Physics LA Program supports all sections of all three courses in the introductory sequence for majors, Frankie had multiple semesters of support for developing positive relationships with peers, and continuous reinforcement of new ideational resources about how to engage with physics and what it means to be a good physics student.

Frankie arrives in her first physics class with specific ideas about what characteristics are necessary to be a successful student, and specific perceptions of who physicists are. She knows that women are highly underrepresented in physics, and recognizes that she is one of very few in the classroom. It is important to note that Frankie speaks less about her race and ethnicity than her gender in our interview, possibly because of the department’s large representation of Latina/o students; Frankie was more likely to be the only woman in a class than the only Latina/o student.

As her comfort increases as she understands the expectations of the space, her ideas of what it means to engage in the classroom and be a successful student shift. She begins to intentionally push herself to be more active in this space, and grows more confident and more outspoken in her peer groups. This extends into becoming an LA herself, and making herself do things as a student that she knows she needs to get better at to be a good LA. Joining the LA Program amplifies the ideational resources she first encounters as a student. By the end of her introductory sequence, Frankie’s new ideational resources have driven her to radically shift the way she practices physics and the way she connects to physics, reflecting a strengthened physics identity. In the following sections, we deconstruct Frankie’s story to go into more detail about the factors that supported Frankie’s development over the introductory sequence.

A. “Kinda shy at first”

Frankie describes herself as “shy at first,” coming into her first introductory physics course with the intention of “sitting in the front and being that good student.” When she realizes that the in-class work will be in small groups with other students, she immediately seeks out a partner who shares some of her identities as a Latina/white woman, who she calls, “the little Hispanic chick.” Frankie took up little vocal space in discussions, rarely taking the initiative to speak first and content to follow the lead of the more outspoken group members. Still, because of her performance in class, her professor recognized her competence and encouraged her to apply to the LA program; however, Frankie did not feel confident enough to do so at the time.

Frankie’s initial ideational resources related to her own positioning in the classroom, her personal characteristics, and her perceptions of what practices are valued in the physics classroom inform how she plans to engage in her first introductory class. She immediately recognizes that her identity as a woman puts her in the minority in her majority-male class: “as a woman, in my physics classes obviously there wasn’t a whole lot of us, so I was kinda shy at first.” Her initial shyness aligns well with what she believes are the characteristics of a good student, being quiet and attentive. She did not enter the class with an expectation that she would have to engage with her peers in a sustained way. However,
as the TXST LA Program is integrated fully into every introductory course, students are asked from the start to form groups and talk to each other immediately challenging Frankie’s initial ideational resources:

“I’m kinda shy in general, I’m not one to go up to people and start a conversation. I remember just sitting in the front and being that good student, being like I’m just here for class. But then in physics, you have to work with people, so they’re kind of like, ‘Hey, you have to talk to somebody.’”

In this quote we see the start of a shift in how Frankie sees her connection to physics in the physics classroom, primarily with the idea of what practices are valued. In a more traditional lecture setting Frankie would be completely right about what is valued, but she realizes that in this space the way to be a “good student” is talking and working with people to make sense of physics concepts. This is somewhat at odds with how Frankie sees herself, which we coded with the ideational resource personal characteristics: Frankie sees herself as someone who is unlikely to initiate conversation.

Frankie negotiates this dissonance by seeking out specific individuals with whom to work:

“In our group I at least always had one other lady with me. I think that was always my key, I was like, ‘Okay, if I have to work with a group I’m gonna try to work with either someone I know,’ but I was like, ‘Okay, I don’t know anybody,’ so then I was like, ‘Okay, I’m gonna try to work with a lady.’”

This is a key element in understanding the relationships that Frankie seeks, which provided the relational resources that give her access to additional ideational resources during her introductory course journey. One of the first relationships we see is that between Frankie and someone she describes as “the little Hispanic chick who’s also pretty fair skinned like myself.” This relationship persists throughout her first semester Mechanics course and into her second semester E&M course. In talking about her second semester in the intro sequence, Frankie describes how this relationship supported her:

“We happened to be in the same E&M class the following semester, so that was really great. Then I was like, ‘Okay, we’re comfortable, we can work together.’ …I could see the difference…after one semester, I guess I started feeling more comfortable with myself and in the classroom, because I was like, ‘Okay, we have to do group work. We’re all here doing the same thing.’ I got over it. I don’t know if it was because I also had someone in my group that I knew, that I knew would back me up…but I felt like I could speak out more.”

Her relationship with this student who had similar racial and gender identities as her impacted Frankie’s connection to physics, providing a relational resource that increased Frankie’s willingness to engage in group interactions since she had someone she “knew would back [her] up.” We see that this relational resource helped Frankie situate herself in the practice of doing group work with others, and led to her speaking up more, enacting practices consistent with her new ideational resource of what is valued in physics. Later in the interview, Frankie reiterates the importance of supportive peer relationships for engaging in meaningful learning during group work.

B. “This is what we should be doing.”

Frankie also describes her relationship with another member of the Mechanics course, the “EE (Electrical Engineering) major.” This EE major “very much took charge” of the group conversations, which is a personal characteristic Frankie says she did not have; rather, she was “glad to follow along” in the group, having “more times where I was just like, ‘Oh, okay, that sounds like that’s right.’” At this point we see Frankie leaning into the personal characteristic resources she came into the class with, which are more aligned with where she is comfortable, while working on negotiating her position and place in the group.

From her actions in this relationship with the EE major in Mechanics, we are able to see a clear shift when she starts to discuss her position and characteristics in later semesters. In Frankie’s second semester of the introductory sequence, Electricity & Magnetism (E&M), she is able to continue her partnership with the “little Hispanic chick” from Mechanics. In addition, she has a [Latina] woman as the course instructor, which also makes her feel comfortable in the classroom. Here she finds herself speaking up more in class, feeling more able to take up space in group discussions and advocate for different ways of thinking. There is a slight change in how Frankie interacts with her group in E&M. Where in Mechanics she primarily played support, agreeing with the other members of the group, in E&M she feels able to speak up more, taking up more verbal space:

“The following semester [after Mechanics] I definitely felt like I was like, ‘No, I think this is how we do it, this is what we should be doing.’”

We can see how her personal characteristics have become more in tune with what she sees is valued in this environment: engaging in group discussions, speaking up, offering new ways to approach problems. Along with this, she is beginning to reposition herself within her physics classes as someone who not only learns, but teaches.

Acting on her increased confidence in “how we do it” and on encouragement from one of her LAs in E&M, Frankie applies to be an LA for the following semester. She is accepted and works as an LA while also enrolling in her final introductory course, Waves & Heat.

At the same time, Frankie is aware that she still has room to grow in aligning herself to what she sees is valued in the physics department. There is a conscious action taking place—she has models of the characteristics she wants to have in the LAs that work in the classes she is in, and she applies to be an LA knowing that she “has to apply [herself] more, [she] has to be more comfortable talking.”
C. “For the children.”

In Waves & Heat, Frankie has none of the peers she had worked with in the previous two introductory courses. The “little Hispanic chick” Frankie has in the past two semesters of the intro sequence isn’t in her Waves & Heat class, so Frankie tries to find other women to work with. Sitting in the back of the Waves & Heat classroom is a group of all women that includes two women she calls her “physics moms.” Frankie wants to join them, but the “girl group” is full, and they sit in the back of the classroom where she prefers the front, so she looks for new folks to work with.

She finds Nathan (pseudonym), who is a transfer student, and who, in her words, is “a big dude,” and “intimidating, because he’s just very serious.” We note here that Nathan is also Hispanic, but that Frankie does not mention this in her interview as a factor in choosing to work with him. Like Frankie, Nathan doesn’t know anyone else in the class, he is new to the university as a whole. Frankie is excited because, “[He’s] not gonna be able to leave me to go talk to [his] friends.” Nathan’s newness helps Frankie feel comfortable getting to know him and working with him:

“Because he was new, we had a lot to talk about, so it made me... I felt like I was able to get comfortable with him enough to where we always worked together. I could be like, ‘Hey, I don't know what the fuck I'm doing, come help me.’ where with some people you don't really know, you're not comfortable being like, ‘Hey, I don't know what the fuck I'm doing, show me.’ …But [Nathan’s] really sweet, and he really knows his stuff, so he was able.”

This is Frankie’s third semester in an LA supported course, but Nathan’s first. Although she’s lost the relational resource provided by her comfortable relationship with the woman she worked with throughout Mechanics and E&M, the collective value of group work itself is an ideational resource strong enough for Frankie to push herself to invest in a new relationship until it becomes similarly comfortable.

Throughout her time in the introductory sequence, we see Frankie’s incoming ideational resources shifting and changing into ones that align more closely with the values of the LA Program. Her interactions with the program as a student and, eventually, as an LA, act as a motivator for her to continue developing these skills until she feels confident enough to do it for others:

“It was also me trying to push myself. I was like, ‘Okay, I have to be an LA, I have to talk to people I don’t know all the time, I have to be able to work in my own group doing all of these things before I can do it for the children.’”

Being an LA while still in the introductory course sequence has her wanting to work on her confidence in speaking up, both in her own class and in the class for which she is LAing. Her motivation to improve so she can “do it for the children” implies that she thinks it is important to work on speaking up not just in order to be a successful student, but also as a valuable thing to do with the students she is teaching. The resources Frankie draws upon that support parts of her physics identity internally she is then able to provide in order to nurture and support beginning physicists, helping them engage in the same meaningful collaborative learning environment she experienced.

Frankie’s participation in the LA Program reflects a growing connection to physics through a commitment to the idea of student-centered community and collaborative physics learning, seen as she aligns herself with the ideational resources provided by the TXST LA-Supported physics classroom. We interpret this as a positive growth in her physics identity.

IV. DISCUSSION AND TAKEAWAYS

Because Frankie, like every TXST physics student, experienced LA-supported introductory courses, she gained access to relational and ideational resources that supported the growth of her physics identity. Frankie leveraged these resources in a way that helped her shift her ideas about how she wanted to engage in physics with her peers, ultimately deciding to become an LA herself.

Frequent opportunities to interact with people at different levels of power is one way that the TXST LA Program creates an environment where students can be vulnerable enough to get out of their comfort zone. Frankie was able to build the relationships she talked about in her interview because of the LA classroom model of collaborative group learning. In doing so she was able to evolve her ideas about who she is and how she does physics in and outside of the classroom to ultimately develop a stronger physics identity and a stronger connection to the TXST physics department.

Frankie’s story teaches us about the impact that a shift in ideational resources can have on the development of one’s physics identity, and the influence that relationships can have on the access one has to valuable ideational resources. This is important for all physics students, but particularly critical for those who are multiply marginalized in the field, whose ideational resources often look different than those of their cisgender, heterosexual, white male peers from the larger story that is popularly told about who does physics. These negative ideational resources may prevent stronger connection to physics both prior to beginning their studies, and during their physics journeys.

From this analysis we are able to see the ways a comprehensive LA program is an environment that can provide valuable relational and ideational resources to help multiply marginalized students strengthen their positive physics identity and thrive in the physics community.

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