

“Success Together”: Physics departmental practices supporting LGBTQ+ women and women of color

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Existing research on underrepresented/minority students focuses mainly on gender or race/ethnicity and ignores the intersection of identities of women of color and the experiences of lesbian, gay, bisexual, transgender, or queer (LGBTQ+) students. This research is also typically conducted at Predominately White Institutions. A large number of physics degrees earned by racial minorities have been earned from Minority Serving Institutions. This project examines the personal narratives of women of color, LGBTQ+ women, and women who exist at the intersection of these identities at Texas State, a Hispanic Serving Institution, to better understand the systems in place that helped them succeed through their physics degree. We define success to be recognition of self as a physicist and completion, or being near completion, of a physics degree. Participants reported that widely shared discussions around equity, department structures supporting collaboration, and a culture of teamwork helped them achieve success together

I. INTRODUCTION

Recent research examining the experiences of minority physics students has focused on participants from Predominantly White Institutions (PWIs). Few such investigations have been conducted at Minority Serving Institutions (MSIs), and even fewer have investigated students who identify as Lesbian, Gay, Bisexual, Transgender, Queer, or other sexual or gender minority (LGBTQ+). The recent APS report on LGBT climate in Physics [1] found that over a third of LGBT physicists who responded to their broadly-distributed survey were at risk of leaving their school or workplace (p. 7). The authors also note that they found no prior published studies on the experiences of LGBT people in physics, either in terms of general climate or measuring persistence in degree programs or professional pathways.

More broadly, recent research has found that women of color and sexual minorities are less likely to complete STEM degrees [2,3]. Researchers attribute this to a combination of factors: students in these groups more frequently having feelings of isolation, lack of support from faculty members and fellow students, increased cognitive load juggling multiple identities, and skepticism from themselves and others pertaining to their abilities to succeed in science [2-5].

In this study, we analyze the experiences of successful undergraduate LGBTQ+ women, women of color, and women who exist at the intersection of these identities in the Texas State University physics major, with the goal of identifying unique departmental practices that helped these students feel supported, recognized, and valued as they worked towards completion of their physics degree. Participants described their participation in a department that de-emphasized competition between individuals and emphasized collaboration helped them achieve “success together.”

II. BACKGROUND

Texas State University is classified as a Hispanic Serving Institution (HSI), which is an MSI that serves a significant Hispanic population [6]. The university’s student population was 37% Hispanic in Fall 2018, 12% above the minimum Hispanic enrollment for this classification [7,8]. In Fall 2018, women made up 59% of the student population [8]. In Fall 2011, the percentage of women enrolled in the physics major was only 8%, but after the introduction of the Learning Assistant (LA) Program to our physics department in Spring 2012, there was a steady increase in the percentage of women enrolled in the program, up to 28% enrolled in Fall 2018 [9] (See Fig. 1).

The LA Model is an undergraduate peer instruction program developed at CU Boulder and broadly adopted across the U.S. [10]. In this model, undergraduate LAs facilitate group discussions in transformed introductory

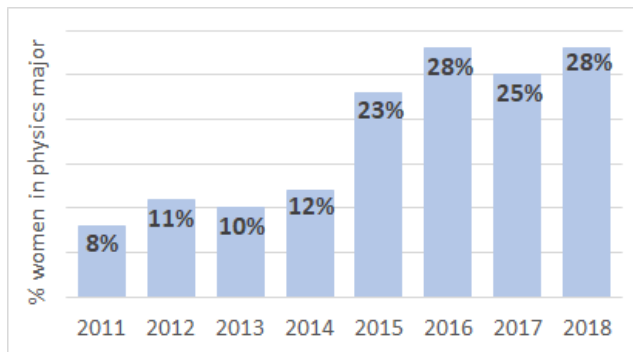


FIG. 1. Enrollment percentage of undergraduate women in the physics major at TXST, 2011-2018. Data from institutional report for Fall semester of each year.

courses. With the guidance of weekly preparation sessions and a pedagogy course, LAs support students to engage in productive collaborative learning [10]. At Texas State the LA Program is currently situated entirely in the physics department, and the required pedagogy course is an upper-division physics elective, *Physics Pedagogy and Cognition*. Over the past several years, the majority of graduating Texas State physics majors have had at least one semester of experience in the LA Program (e.g., 70% of the graduating majors in the 2018-2019 academic year).

III. METHODS

A list of physics majors with demographic information was provided by the department and a recruitment email was sent to those who fit into the desired study population. Students who identified as a sexual minority were found through in-person social networks made up of personal relationships between individuals at the institution. Individuals were asked to participate in a semi-structured hour-long clinical interview. All interviews were conducted by the second author, who identifies as a cisgender, bisexual woman of color. The first and third authors, who participated in the collaborative analysis of the interview data along with the second author, both identify as cisgender, heterosexual, White women. We asked interviewees about their social and academic interactions within the department and specifically what interactions they had that made them feel that their peers and department supported them in completing a physics degree. The interviews were video recorded and transcribed and the data were analyzed using the software package MAXQDA. Codes were collaboratively created by the research team according to emergent themes seen in all interviews to track positive, negative, and neutral experiences described by the participants.

IV. FACTORS SUPPORTING STUDENTS’ SUCCESS

In this paper, we analyze two of the interviews, with participants Fabiola and Nadya (pseudonyms). Fabiola identified as a cisgender, bisexual, White-passing Hispanic

woman. Nadya identified as a cisgender, heterosexual, mixed-race Guatemalan and White woman. The women were interviewed in the later parts of their physics degrees: Nadya was a senior in her final semester of classes, and Fabiola was a junior taking several upper division physics courses. Both had participated in the LA program, held officer positions in the Society of Women in Physics student club, and regularly engaged in physics-related outreach.

The themes analyzed in this paper were evident across all six interviews conducted to date, and were most clearly apparent in the interviews from Fabiola and Nadya when they were asked to describe their physics department and the components within it that helped them recognize themselves as physicists. We have grouped their responses into three related and sometimes overlapping themes: the LA Pedagogy course, department structures supporting collaboration, and a community founded on the culture of “success together.” Our analysis suggests the overlap of these themes leads to an experience of a comprehensive collaborative network of students and faculty. This experience strongly supported the successes of these women working towards their physics degree.

A. LA pedagogy course

Students who have been accepted as new LAs are required to enroll in the course *Physics Cognition and Pedagogy* (“Pedagogy”) during their first semester in the LA program. The seminar-style course consists primarily of group discussions about assigned weekly readings. Most readings are drawn from research on STEM instruction, student learning, and cognitive science (e.g., [11-13]). Late in the semester, the readings include articles highlighting implicit bias, stereotype threat, white privilege, and imposter syndrome (e.g., [14-16]). Two weeks are dedicated to these equity-related readings. (Note: the third author is the pedagogy course instructor).

In her interview, Fabiola went into detail about her pedagogy experience, specifically about the impact of the equity readings and related discussions: *“It was a really positive experience. ...We had a lot of very good and healthy conversation about, just everyone in the classes, individual experiences and how it differs based on how they identify, and everything that they deal with.”* She went on to say how the class positively impacted the environment of the department, making it more open to communication and more accepting overall:

“It’s really neat, because I know a lot of the people in my department do get to experience it. That’s part of the reason that I feel safer in the community in my department. I feel like we’re all a lot more informed, because of the class specifically.”

In a follow-up interview a few months after her first interview, she reiterated the importance of the shared pedagogy experience: *“[It] makes us all a little bit more aware of each other.”* Fabiola also described how she

became cognizant and developed a better understanding of her imposter syndrome in the pedagogy course:

“...I had never heard of imposter syndrome before pedagogy. I have really bad imposter syndrome. Hearing about imposter syndrome and being like, this isn’t just me being really bad at math... This is me actually feeling isolated by doing math. And it was a very distinct feeling. And once I kind of figured that out, I was like cool, that doesn’t necessarily solve the problem, but it makes me feel better about it. [It] made me feel more valid for struggling with certain things.”

When Nadya was asked to describe what made her department feel inclusive, she also discussed the pedagogy course: *“We went over like gender and whatnot. And, like, we went over how not to be a dick and... how to be a decent human being.”* She went on to say that she wished more people had the opportunity to learn about the issues that people still face in STEM, specifically women: *“A lot of my friends, they don’t understand...the issues that women face in STEM. Like whereas I really am... very strongly with the movement.”* She followed with a story:

“I remember like New Year’s Eve, ...I went off on a tangent because they’re like- they’re like, some guy said in the room, “Oh, sexism, it doesn’t exist in the world anymore.” And I’m like, “You -- let me tell you what.” ...I think it was after our first pedagogy class, so I was still in the [course management] site--pulling up documents left and right. Said, “Read this research, read that.”

These statements describe experiences of taking a course that brought biases and issues of society in STEM to the forefront in order to learn from them. Both Nadya’s and Fabiola’s interviews revealed two main ideas that are apparent through their experiences. These ideas include both of them feeling personally empowered by learning from the readings, and feeling safe in a community of students who have shared those learning experiences

B. Structures supporting collaboration

Many physics courses at Texas State are structured around interactive instruction and collaborative learning. Fabiola described how this made her physics department structure different from other STEM departments she had encountered:

“So the community itself is built much less competitively, I think, compared to some STEM communities I’ve encountered before. ...We do a lot of group work in class, and stuff like that, as opposed to individuals constantly being pinned against one another because we’re doing individual work.”

The interactive learning environments honed students’ ability to learn from each other and helped Fabiola get to know her peers and build relationships:

“...The entire curriculum is built around group tutorials and so you kind of get into the habit of, okay, you form a group with people ...Some of us would understand certain

concepts and some would understand others. Some of us could do the math and some of us couldn't, and so it kind of gave us a reason to talk and we could actually learn from each other..."

She emphasized the support provided during group activities: *"there was always time for us to go to the professors in class or there were [Learning] Assistants in class to be able to ask questions."*

In addition to this support, Fabiola described being supported by her instructors: *"I felt really lucky- and in my introductory course the professors were always really available, and so they were able to give me the time when I did have more questions. It was just very accessible."* The accessibility of faculty was also a theme in Nadya's interview. When asked to describe her department, Nadya specifically acknowledged faculty members being available during her interview with her student peer, the second author, which helped her appreciate the culture of the department: *"...the faculty, they actually care about you. All of them are just like, 'You can come to my office hour-'...I mean, you know this. But, like, [laughs] they're- they're, you know, 'You can come to my office hours whenever.'"* She described interactions with a specific course instructor: *"You would email him at, like, 2:00 a.m., he'd respond the next morning, and he'd be like, 'Come to my office,' and, like, walk -- help you, walk you through it."* She contrasted this level of availability and faculty support with physics departments at other universities. At a large university where she interned, students' contact with instructors was limited to course lectures: *"I'm like, 'How do you even get time to talk to the professor?' They're like, 'You don't. You really don't talk to the professor.'" Nadya compared this with the importance of faculty support in her own department:*

"And I'm like, 'That sucks,' because if it wasn't for, like, that one-on-one interaction with the professor[s] that we're so accessible for- like, you- there would be no way I'd be able to make it through this major, because it's- it's hard. What we learn is hard."

She also compared her experience with faculty to that of her other STEM friends, who did not attend Texas State: *"... the faculty cares. ...I've talked to all my friends. They're all STEM- like, my friends from high school, they're all STEM majors. None of their faculty is like what we have here."*

Interactive instruction and faculty availability allowed Nadya and Fabiola to connect to people in the department and feel supported in their efforts by their peers and instructors. In addition to this direct support, both described a sense of belonging to a community with a culture of supporting each other's success. This aspect is described in the next section.

C. Community founded on "success together"

The previous sections demonstrate the department structures support a culture of collaboration. Both Nadya and Fabiola described how this culture creates an inclusive

community founded on the idea of students succeeding together. Nadya first described how the students in the department work together to flourish: *"...your fellow classmates, like, they don't- they're not there to watch you fail. They want you to succeed. They want to help you. Everyone's pulling each other along, because we're all suffering together."* For Nadya, this was significant to her overall experience: *"...that's a big aspect of what I love about this department, is how much of a team it is."*

Fabiola described a similar feeling about the department. She first emphasized how her peers helped her feel supported:

"It's very friendly and it's a community and it's a very tight knit department. [...] I have a really good support system that has made me a lot happier in school than I was in high school...we all have common interests and we're really good friends and we have this community built around supporting each other to the best of our abilities."

Nadya described the group of peers she found through her involvement in the LA program and department clubs—*"meeting all these people, especially my fellow colleagues that are going through the same stuff as me"*—and how these connections helped her persist: *"Like, holding my hand saying, 'Oh my God we're gonna jump!'... that's definitely made a huge positive impact in my life. Especially- especially my degree. There's no way I would've been able to finish it without them."* A few minutes later, in response to a question about physics outside of Texas State, she reiterated the importance of these relationships: *"If I went to any other university, I would not have stuck with it for sure because I never would have made it. I wouldn't have had the support system I needed."*

In addition to peer support, Nadya described how faculty encouragement helped her feel like she belonged: *"Even just them being like, 'You can do this.' Just even that just gives you a good push, and... It makes you feel like you can do it, 'cause sometimes it feels like, God, this shit is hard."* Immediately following this, Nadya used the word "community" for the first time in her interview: *"...I just love the sense of a community. I don't know. It's- 'community.' That's a good word. ...It's a really good sense of community, and I've really found my place in it."*

Similarly, Fabiola described the department as "tight-knit" (quoted above) and demonstrated this idea by describing a specific experience where she and her fellow students—a lab group of four women—supported another student because she was struggling by herself:

"...She was struggling to work on one of the projects because her group wasn't there, and one of the women that I was working with [goes] 'No! We are women, we will all succeed!' And so we ended up working with this other woman for a little while. We helped her... because she was alone. We...went out of our way to support her..."

because that's what you do. That's just the community that we have built."

Fabiola's experience demonstrates how the community value of assisting a fellow struggling physics student was stronger than the course structure promoting competition between groups. She described the department culture succinctly in the statement: *"...the community itself is built much less competitively, I think, compared to some STEM communities I've encountered before. It's more about success together."*

Both Nadya and Fabiola emphasized the importance of their personal experiences involving students supporting each other to succeed rather than competing against one another. The way their physics department encourages teamwork and collaboration helped them build relationships with their peers and faculty members, and helped them feel supported; like they belong to a community bigger than themselves.

IV. DISCUSSION AND IMPLICATIONS

Through analyzing Nadya's and Fabiola's descriptions of their experiences in their physics department, we were able to see how these women felt recognized in the physics community in ways that supported them to continue toward their physics degree. The LA Pedagogy course provided empowering knowledge about social issues and created a shared experience of personal connection and heightened social awareness with many physics majors. Department structures supporting collaboration provided resources for learning, supported the development of joint problem-solving skills, and created the opportunity to build a network of students and faculty. The experience of being part of a community founded on the idea of students succeeding together created a sense of mutual support and a culture of team effort rather than individual competition, reducing the intimidation factor of difficult course material.

The themes described above represent some examples of what has worked in our physics department to support

women of color, LGBTQ+ women, and women who are at the intersection of these identities to thrive in pursuit of their physics degrees. These findings are consistent with previous research on physics identity and gender, which has shown that positive recognition by peers and authority figures is critically important to the development of physics identity [17,18]. The positive impact of the equity-related readings and conversations is similar to the finding that discussions about gender bias in high school physics classes significantly increases girls' positive physics identity [19]. The value of a culture of collaboration and team effort is also consistent with a parallel analysis of our own data, in which we find that the women we interviewed identified strongly with the idea that physicists are those who participate in the practices of physics [20].

These results can provide insight for physics departments seeking to become more inclusive. The collaborative structures implemented at Texas State are widely replicable. For institutions with existing LA programs, or those interested in implementing the LA model, inclusion of equity-related readings in the required pedagogy course for new LAs can help educate students about social issues and re-frame experiences of struggle. Departments without LAs can introduce these readings and discussions in other ways. These changes can create a supportive culture and nurture a community of students and faculty founded on the concept of "success together."

In future work we plan to conduct further analysis of coding patterns, including attention to overlapping codes. In addition, we plan to expand our research to other MSIs to explore differences and similarities in the experiences of women of color, LGBTQ+ women, and women who exist at the intersection of these identities in other physics departments.

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