

Listening to Nonbinary Chemistry Students: Nonacademic Roadblocks to Success

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Cite This: <https://doi.org/10.1021/acs.jchemed.1c00498>



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ABSTRACT: We conducted semistructured interviews to investigate the experience of two nonbinary students in an undergraduate chemistry program. Students described experiences with struggling with identity, hiding identity as a form of defense, discrimination by peers based on perceived gender, perceptions of unsympathetic instructors, and mental health struggles. They also identified the following factors that helped them succeed in their education: desire to learn, connecting with peers, and active support from mentors. Based on these findings, we recommend that instructors engage with topics outside of traditional course content, facilitate peer collaboration, acknowledge that there could be trans, nonbinary, and Two Spirit individuals in the classroom, and recognize that not all students are the same. Chemistry educators who implement these strategies will create a more respectful learning environment for trans, nonbinary, and Two Spirit students.

KEYWORDS: *general public, collaborative/cooperative learning, minorities in chemistry*

INTRODUCTION

Trans, Two Spirit, nonbinary, and otherwise gender diverse individuals have been traditionally ignored or underrepresented in science. Though there have been more studies in recent years on the experience of “LGBT” individuals in science, technology, engineering, and mathematics (STEM) and college in general, binary trans individuals are severely underrepresented, and oftentimes the abbreviation “LGBT” is used to only refer to lesbian, gay, and bisexual individuals.¹ Within STEM, LGBTQ professionals experience widespread workplace inequalities versus their non-LGBTQ colleagues,^{2–4} and queer students view science majors as being “less appropriate” for non-straight, non-cis students as opposed to majors in arts or other disciplines.⁵ More generally, in colleges, trans students experience gender-related stress (e.g., incorrect name on institutional identification, transphobic classroom climate, worry over gender presentation, having to reexplain pronouns to the same person many times, etc.) that their cis peers do not.⁶

Students experience instruction differently. Evidence shows participation in collaborative instructional settings, such as peer discussion or laboratory work, may be influenced by students’ identities. Both student–instructor and student–student dynamics are important considerations for educators striving to create inclusive chemistry programs. For example, previous research has investigated the differential participation of men and women in whole-class discussions in biology.⁷ Additionally, gender predicts the extent to which students value active learning pedagogies such as clickers in chemistry.⁸ A large body of quantitative research suggests chemistry academic achievement differs between women and men, and researchers are investigating the role of academic preparation and sexism in creating these differences.⁹ It is reasonable to

predict that nonbinary students, who may experience greater degrees of exclusion than women, face even greater disparities. Equity initiatives should do more to identify and address these disparities.

Inequities are particularly problematic considering recent goals of making STEM fields more inclusive and welcoming, which is often happening without consideration of the unique needs of these historically marginalized groups. Therefore, it is important to identify unique nonacademic roadblocks that these groups face in academia that may prevent them from succeeding in science undergraduate programs. To address this gap, this study focuses on the experience of nonbinary chemistry undergraduate students.

In this work, several terms are used which may be more or less familiar to readers. For the sake of clarity, we offer the following definitions. Trans or transgender refers to someone who does not identify with the gender they were assigned at birth. Some nonbinary individuals may identify in this category. Cis or cisgender refers to someone who identifies with the gender they were assigned at birth. Nonbinary, or “enby”, describes a gender identity that does not fit into exclusively man or woman. In our study, participants used male/man and female/woman interchangeably, which is common. However, the terms male and female describe sex, while man and woman describe gender identity. It is important to use the correct terminology for clarity and consistency.

Special Issue: Diversity, Equity, Inclusion, and Respect in Chemistry Education Research and Practice

Received: April 30, 2021

Revised: September 25, 2021

However, we have chosen to leave the participants' quotes as they were, since they are their own words.

Queer is an umbrella term referring to the LGBTQ community. Some people (one of the authors included) feel that the term "queer" is more inclusive, as it refers to LGBT individuals plus other identities that may be left out of the LGBTQ+ abbreviation (e.g., asexual/aromantic, nonbinary, intersex, etc.). Individuals who do not have an identity that would fall under the term "queer" should avoid using the term, as it has historically been used as a slur and can be upsetting for some individuals in the community when used by nonqueer individuals to describe them. Two Spirit is an identity encompassing gender, sexual orientation, and/or spiritual identity for Indigenous individuals. Note that not all Indigenous people who identify as LGBTQ+ also identify as Two Spirit. Two Spirit is a very culturally specific term used by Indigenous individuals.

METHOD

Positionality Statements

We include positionality statements in acknowledgment that research is not objective and is influenced by researchers' personal, social, and political positions.¹⁰

Bec Chan. I identify as a queer nonbinary person of Chinese descent. I have completed my undergraduate degree (BSc in chemistry) and have lived experience of the gender-related stress faced by gender-diverse students. As such, I am especially sensitive to the experiences shared with me by the participants in this study.

Jaclyn J. Stewart. I am a cis, straight, White woman. My education is in chemistry and educational psychology, and I strive toward using inclusive teaching practices. My own learning and career have benefited from being a member of my institution's Equity and Inclusion Scholars Program, which builds capacity for equity research. I have no lived experience of the gender-related stress faced by gender-diverse students.

Methodology

We conducted a qualitative observational study using a narrative inquiry approach.³³ We used semistructured interviews to elicit students' experiences. We created six open-ended prompts, and participants could respond freely.¹¹ The interviewer asked for clarification and elaboration as necessary. We asked about participants' decisions to join a particular program of study, their experience with teaching assistants and faculty members, classroom experiences, their thoughts about forms and documents, their comfort in campus spaces, and nonschool experiences.

Participant Recruitment

This study was conducted in compliance with ethical standards for research involving human participants, and informed consent was obtained from each participant. Approval was granted by the University of British Columbia Behavioral Ethics Review Board (H20-03095). The research was conducted in early 2021, during the COVID-19 pandemic.

Participants were required to self-identify as trans, Two Spirit, nonbinary, and/or gender diverse—this group is traditionally ignored or under-represented in science, and the purpose of this study was to identify unique challenges these groups face in science education at our institution. Participants also had to self-report completion of at least one first- or second-year science course at UBC.

It may be helpful to readers to share the methods of recruiting that did not work for us. We recruited participants through an invitation in our Faculty of Science weekly student newsletter. The newsletter was delivered to 2,539 students with third-year standing and 2,377 students with fourth-year standing in the Faculty of Science. In the newsletter, we invited students who identify as nonbinary, trans, and Two Spirit to participate in an open-ended survey, which included a question asking people if they would be willing to be contacted for a follow-up interview. We did not receive any responses to our survey. Not all recipients carefully read the newsletter, but there may be other reasons why people did not volunteer. Students may have experienced survey fatigue, not had the time to do a survey, not feel comfortable volunteering, or thought the incentive was insufficient.

We had some success recruiting interview participants with email messages targeted to specific academic programs. Prospective participants were invited to an interview via email. Students in third- and fourth-year biology (~950 students) and chemistry (~236 students) programs were sent a recruiting email message by a program coordinator or director. From this, two students volunteered to be interviewed. The two interview participants both identify as nonbinary.

The Canadian 2019 census suggests 0.11% of people living in Canada under the age of 35 identify as nonbinary and 0.35% of the entire Canadian population identify as transgender or nonbinary.¹² A recent demographic study of general chemistry students found that 1.7% of general chemistry students in a public university in California identified as transgender or nonbinary.¹³ Our 2021 institutional undergraduate experience survey had a 13% response rate and estimated that 3% of our overall student population identified as trans or nonbinary, 66% identified as cis women and 31% as cis men. Our institution does not have information available for specific programs of study. Stress from the COVID-19 pandemic, having to participate from home (where family or roommates may overhear responses), and academic demands likely presented barriers to participation in our study.

Participants were interviewed via videoconferencing using a privacy law-compliant institutional Zoom account (Zoom.us). The participants were asked to generate their own pseudonym or nickname which was then used to refer to them in our report. Interviews lasted approximately 1 h each. Participants were given a \$20 gift card of their choice as a thank-you for their participation.

Analysis

The audio from the interview was recorded via Zoom to facilitate data analysis. The audio files were then uploaded to our institutional Microsoft OneDrive storage (privacy law-compliant cloud storage) and transcribed with the aid of the transcription function in Microsoft Word. Rough transcripts were edited and checked for errors manually.

Analysis was performed by reading through interview transcripts several times and identifying topics the participants spoke about most often, both individually and collectively (In Vivo coding).¹⁴ Quotes about each of those topics were gathered, which enabled us to identify themes.

We obscured details that may identify individuals without changing the specific meaning of the reported experiences. The interviewer contacted participants and confirmed that their quotes and paraphrased quotes included in the report correctly

conveyed what the participants meant to say. Participants were given 2 weeks to respond to the report draft with any desired clarifications/changes. Changes desired by the participants were made, and the participants were given an opportunity to approve the final version.

Learning Context

Our institution currently enrolls 59,507 students; 8,428 undergraduate students are in the Faculty of Science. We offer several majors and honors chemistry programs including several combined majors (e.g., chemical biology). Students experience small- and large-class sizes and lectures and laboratories from first- to fourth-year. The permanent faculty members in our department are 32 men and 10 women in the research stream and 6 men and 6 women who are in the teaching-focused educational leadership stream or full-time lecturers.

RESULTS

This section presents the main themes identified in responses from the participants on nonacademic roadblocks they faced so far during their studies. Our narrative approach maintains the integrity of participants' stories. Including participants' own words conveys their experiences in a powerful way. We grouped the data according to themes to assist the reader in considering what actions they can take to make their own institutions more inclusive.

What Prevents Nonbinary Students from Succeeding in Science?

Struggling with Identity. June is an upper-year student in a chemistry-related program. They identify as trans and nonbinary and describe their gender as being outside of masculinity and femininity, not a mix of the two. Trying to figure out their gender and discomfort with their body was difficult and took several years.

For...a good chunk of my...um, class, I was—or for—for school in general, I was trying to pin down what was going on with my gender identity. When I came to school, I had no...idea that I could be nonbinary, and I just felt really uncomfortable in my body and didn't know what that meant, and so, [for] the first few years of school for me, [I] was trying to...excel at my classes, but at the same time trying to address...what was going on with my mind and my gender and my body and trying to do those things simultaneously without any kind of support was...quite difficult.

Though they've become more comfortable with their identity, June says that it makes them feel out of place in chemistry, and it is something that prevents them from concentrating fully on their studies:

[...] it's a whole extra load that you have to carry on your brain at all times and you're in these... complex classes where you don't feel—you feel like you're not supposed to be there and...at the same time, you're trying so hard to prove that you can be there and it's just—yeah, it's exhausting. 'cause I feel like I haven't been able to, until maybe this year, I haven't been able to just simply enjoy what I'm learning.

Ares is an upper-year student in a chemistry-related program. They identify as genderfluid (i.e., their gender is not fixed in one category or identity) and androgynous and feel most comfortable with a masculine presentation:

When I first learned about gender fluidity, it was back in Grade 10, and then I just wanted to present more masculine at that time. So I cut my hair short and I looked...very...not cis...let's just say. It was very—I was very happy at the time, I was really happy presenting that way.

Though they're confident in their identity, they struggle to find acceptance with their family due to cultural expectations (Ares is Chinese Canadian), which has put a strain on their mental health:

[...] Especially my dad would be like, 'Stop looking like a boy,' or 'Stop just like, doing that, grow out your hair and wear some more feminine clothes.' And yeah—at that time I also bought a lot of clothes from the mens' section. I mean I still do! But I think they fit me better now but um...I don't know. That kind of showed me how this family works, if that that makes sense.

Hiding Identity as a Form of Defense. Both Ares and June feel the need to hide their identity from peers and instructors in order to avoid discrimination.

When they initially emailed the researcher, Ares said that they use she/her or they/them pronouns. However, at the beginning of the interview they told the interviewer they greatly prefer they/them pronouns, but feel like they also need to use she/her to avoid being disappointed when being misgendered. Ares had been presenting as more feminine so they could "pass" as cis while looking for research positions at UBC:

I think maybe later on, when I was looking for research positions, I really felt like—I don't know! I—I knew logically that they couldn't really discriminate against me, but subco- on a subconscious level, I feel like people do judge a little bit. And then if I was—I know, I presented pretty—more androgynous, maybe in [previous years], but when I realized I needed to—I wanted to get those positions I kind of fell more into the binary, if that makes sense, just to keep up the stereotype.

Ares is currently doing research, and they feel that they're "very much performing" a gender that their colleagues will accept.

June says that they feel open about talking about their gender in courses they're taking for their arts minor, but they mostly keep their identity private among their science peers:

It's felt more like, this is just a personal thing. I need to just keep this to myself and if everyone perceives me as a girl, whatever. Like—just gotta chug on through this, you know?

Though they never had an instructor that openly discriminated against queer and trans people, June has had instructors who have made sexist and/or homophobic remarks during lectures. This has made them feel reluctant to go to their instructors' office hours, and more cautious about who they share their identity with.

It's disappointing as hell because—I think my academic experience could have been...just a lot less stressful had I not had to selectively [tiptoe] around certain professors and gone to see some of them or hidden my identity or whatever, it's just an extra layer of [...] emotional baggage, like I always have to carry around this protective shield. It feels like, hide my identity or I hide from certain people in order to keep myself safe. And, that's an unfortunate burden to have to bear.

Discrimination by Peers Based on Perceived Gender.

June and Ares both experienced discrimination from their peers—mostly male students who seemed to treat them differently because they perceived them as being women. June says their knowledge has been treated as less important or valuable than that of their cis male peers. This was especially difficult to cope with because they hadn't been able to find a fellow nonbinary science student who could sympathize and connect with them:

Well, there have been moments where I've been explaining something to a peer, and them being like, 'Yeah OK whatever,' and when they talk to someone else who says the exact same thing, they're like, 'Ah yes! That's great!' So I've had...I guess, experience where particularly male students have kind of viewed my take on a problem or a potential solution to a problem as—not as good as other male peers. [...] I've felt pretty out of place, just because I don't see anyone, really, like me, or I haven't heard any stories of other nonbinary [science] students, which has made it difficult.

Ares finds that their peers who are cis men are more uncomfortable with them than they are with peers who are cis women, and that this makes them more uncomfortable:

Yeah, I think...a lot of...cis male students are uncomfortable. Like they...you can kind of tell in their energy that they're just not as comfortable with it as compared to...cis female[s], or cis women. Um...It might be just a cis male thing, but...yeah, every time I've been paired with a group project, and it's lots of cis males, it's just [that] they have an energy that they don't know how to interact with me. So as a result, I don't know how to interact with them, 'cause I don't know how comfortable they are with me.

However, they mention that after the initial discomfort, most peers become comfortable around them.

They also note that they had difficulty deciding which washroom to use when they presented as more androgynous, and would seek out a lower traffic washroom to avoid discomfort:

When I was presenting less cis. I definitely had trouble choosing a washroom. Like, I definitely knew that I shouldn't go into the male's washroom, but at the same time it felt wrong going to the women's washroom. But then you have to pee at some point. So I would always go...if I had to, I would go to one that...wasn't as popular, so then I would see less people going to the washroom. [...] I know where the gender neutral, private, one person, one stall washrooms are, but before that I would always like dread going to the washroom in the chem building.

It is worth noting that the “gender neutral” washrooms in the chemistry building are not easy to find for the first time, and they're far from the most used lecture halls and lab spaces. The university has an online map of gender-neutral washrooms, but not everyone knows it exists. Some instructors include a link to the map on syllabus.

Perception of Instructor. Ares does not expect their instructors to do much with respect to improving the classroom environment. They mentioned that they tend to email their instructors instead of going to office hours in-person due to convenience. As a result, they were able to get help when they had the capacity to ask for it. Ares also found that when they interacted with instructors in person, they were

treated differently—in a positive way—when their appearance was more androgynous:

Yeah, I think environment-wise, I think the teachers, the process and everything, they're—they're doing fine, they're just there to teach the material—I don't really expect them to do...much. Like every time I've interacted with them they've been very nice and respectful, and they don't...if anything, I feel like they're even nicer? If you...like, look quote, unquote, look, gay, look, LGBT or if you look like...nonbinary, for example, they kind of played [it] up. So I think that aspect is fine.

June, on the other hand, had a more negative perception of their instructors. They expressed frustration about the behavior of certain instructors, such as making sexist remarks during lectures. June experienced additional stress from not being able to get help when they needed it, and from having to put effort into avoiding their instructors:

I never had a professor that was outwardly discriminatory towards queer or trans folks, but I've definitely had professors who have made sexist remarks in class or whatever, and I'm just like, I'm not gonna ask you for questions, you're just gonna, I don't know, mock my existence or something.

Both Ares and June took similar second-year science courses at UBC, but had strikingly different perceptions of their instructors.

Mental Health Struggles. Both participants cited mental health as a major obstacle to learning. June mentioned briefly that mental health issues were a major problem for them:

Yeah, I think that my mental health...um, issues have been the majority of my struggles when it comes to academic work.

Ares has been struggling with mental health issues—depression and anxiety—for many years. A few years ago, they felt very depressed and skipped classes, causing them to fall further behind on coursework. Ares also identified that they've been feeling more anxious in recent years—something that hadn't been a problem since graduating from high school—due to an increased focus on grades, and to make up for their poor performance in previous years:

I'm pretty sure I'm definitely still depressed, so no change there. I think I actually developed...So, I had anxiety. Maybe in the end of high school I was doing [program] and it was really stressful. Very...academically rigorous, right? So I got a lot of anxiety then. And then I think the anxiety started creeping up again, now mostly 'cause I'm more focused on my grades and because of how bad I did in my beginning years, I have to make up for it now, right? So I think...it is something that I have to deal with. But...that's just life.

They identify the strain on their mental health as being mostly caused by school pressures and expectations from family:

I can't rank which one is more damaging to my mental health, 'cause I feel they all just work synergistically to make it worse.

When asked whether they had ever sought help or counseling for their depression, Ares said it is been something they've always handled themselves. They said that lack of money and emotional capacity was preventing them from seeking help:

Yeah, I think, yeah, most of the times I've tried to deal with it, I dealt with it alone. Mostly 'cause I've heard bad things or—just like horror stories about UBC counseling for example. And I can't really afford to get my own...-therapist...right now 'cause I'm a student. I have like negative dollars in my bank account. So I can't really afford to do that and I—and at the same time I'm not, I guess I'm not emotionally ready, because like, to find a therapist you have to be very open as well and...I don't have that time...to do that, so instead I just set it aside and focus on other stuff when I can. But yeah, I—I think it might not be the best for me.

What Can Help Nonbinary Students Succeed in Science?

Desire to Learn. Both participants were very clear that their interest in chemistry and science is what drew them to the field in the first place.

Ares had started in a different specialization, but later decided that they wanted to switch to a program that would allow them to combine chemistry with other fields that they were interested in. In a sense, they regret making the switch due to their poor academic performance (caused by mental health issues), which could prevent them from pursuing a graduate degree.

June really wanted to enjoy chemistry more and loved what they were learning in their classes. But they had an unpleasant co-operative education experience, in chemistry, where they witnessed “microaggressions [by their coworkers] against people who were [...] more gender diverse in presentation,” which made them feel unsafe about telling anyone about their identity or sexuality. This experience made them feel unwelcome in chemistry, and they plan to leave the field after graduation:

And I really wanted to enjoy chemistry more because I love chemistry! And like yeah, like learning about, um like all—in all of my [chemistry] classes like, I was like, this is the coolest stuff ever and I love being here, and then being in that such like—being in a workplace, I just felt so out of place and it was just so disorienting because it was like, I love my work. But I feel like I'm not supposed to be here, like. Yeah, and—yeah, there's just—I did not really have any peers to like, talk that through.

The course content itself did not present an obstacle to either student, they were interested in the material and, when they had the capacity, worked hard to succeed.

Connecting with Peers. Both participants mentioned feeling more included, or at least less isolated, in biology classes, which seemed to be more diverse in terms of gender representation.

Ares said that when they can see more “visibly LGBT” students in a room, they feel more comfortable and tend to be friends with those students. They had a positive experience in one of the first lab courses they took, in which a classmate they did not know said hello to them and asked to be their lab partner. This made them feel included in the lab, and they eventually became friends with that classmate.

June wished that they had met another student who was trans or nonbinary sooner:

I think I just would have felt more comfortable had I had, just someone to talk to? That I knew who was also in the same field who was trans and was going through...something like that, or potentially was not going through something like that and had a wonderful group, and was like, 'Hey,

don't worry about it. There are other places where you will feel more like you're part of the team and not just [an] imposter.'

They finally met another trans/nonbinary student a few years ago, which they consider to be a “major thing”.

Active Support from Mentors. On their second co-op placement, in a related field, June had a chance to work with other queer and trans individuals, which was a great experience. Though their supervisor did not have much experience using they/them pronouns (when talking about an individual in the third person), she tried really hard to refer to them correctly, which made June feel safer:

I had a supervisor who was not well-versed in using they/them pronouns. But she tried really hard and I really appreciated that. [...] I felt definitely more safe and like I could be myself in [that] setting.

June was equally interested in chemistry and this related field, but has decided to pursue the related field because of the more positive environment created by their co-workers and supervisor.

Recommendations

June and Ares suggested some specific changes for making science education more inclusive.

More Engagement with Topics Outside of Traditional Course Content. Ares thinks that they make a lot of their peers who are cis men uncomfortable because those peers do not have a lot of gender education. They see gender education being treated as “more of a liberal arts kind of matter” and want to see science students engaging with topics outside of their program and to be exposed to other streams of thought:

Especially in sciences, we do not really get educated on things outside of science, and then—even electives. You can choose your own electives, so you can go take a philosophy course on logical reasoning, or modal logic, and just satisfy that requirement without ever having to engage in any other streams of thought. So I think...more emphasis on branching out outside of your degree is important, especially for people who do not...typically do that. But yeah, I don't know how else you would promote that.

Encouraging Collaboration with Peers. Creating relationships with fellow scientists is not something that June has ever heard talked about in their classes. They believe that more emphasis on collaborating with as opposed to a one-way relationship emphasizing what can be extracted from peers would be a good way to make science education more welcoming:

We don't really talk about the science community, it's more just about the research in our class. And like, yeah, I understand learning about theory and...potential methods and all that stuff, but I think at the same time...if we're being trained to be scientists, we should also be trained on how to create relationships, because—you aren't a scientist alone, I think, a lot of science is collaborative, so being able to grow that ability to be collaborative instead of extractive would be a big asset, I think, for a lot of folks in science.

Acknowledgment within the Classroom. Both participants think that a little bit of recognition within the classroom would make students like them feel safer and more welcome in science.

Ares notes that their instructors sometimes include “fun” references into their lectures in which they talk about current research or real-world applications of course concepts. They think some references to trans and queer people in STEM would establish that science is a safe space, and that it would introduce the idea that trans and queer people exist in science and chemistry to their cis peers:

I don't know, I feel like just one [reference] to feel trans inclusive, or whatever. Just something that's casual and not heavy would make it more...I don't know. I feel like it would make me feel like, 'Oh yeah, you go!' and do fist pumps in my head. But it's also kind of important to establish that this is a safe space for trans people, it's a safe space for queer people. And it's also a way to kind of...I don't know, bring that concept in to people who do not typically...see that in their daily lives, right? ...Yeah, and we exist, and we exist in the chem building. I don't know. But yeah.

In their classes, June notices that when research on or by “women” is highlighted, a correlation between sex and gender is often enforced as well. Shifting the language used to talk about that sort of research could help open the conversation to include trans and nonbinary people:

They'll be like, 'this is a trait in women', and they'll go into how the...dual X chromosomes will affect this, and I think just opening up the space for like, 'this could be women, but this could also be other genders who are experiencing this with two X chromosomes'? You know? Like not constraining examples to like, 'this is a woman's only example' or whatever. [...] I've noticed in my classes that they'll try and bring up examples from both men and women. Because, of course, a lot of the majority of research done has been done [on] men, so of course they want to bring to the forefront these studies done on women. But I think that...it recreates just that binary that we need to work at taking down.

Recognition That Not Everyone Is the Same. June points out that every scientist and student has unique factors that affect the way they interact with the world, and that this is often overlooked in the pursuit for objectivity. More recognition that a scientist or student's personal life can affect their professional work is needed:

I think that also just ties in with science's hardcore desire for objectivity, it feels like there's no place to bring in—I guess—talks about how we're doing or gender and sexuality, and just all of that stuff, because it's like...that is so personal and this is only about this synthesis and we shouldn't be talking about that. [...] We don't really delve into the fact that...any scientist or student has a whole...constellation of other factors affecting their ability to be...a scientist and to—how they think and how they interact with the world. Everyone is coming from a different world view, and so to tout that everyone is the same is just such a fallacy.

DISCUSSION AND CONCLUSION

We identified several barriers that influenced nonbinary students' academic learning: having to struggle with their identity, hiding their identity as a form of defense, facing discrimination by peers due to their identity or perceived identity, their perception of their instructor(s), and mental health issues. Having a strong desire to learn, connecting with peers, and active support from mentors helped nonbinary students succeed in their science education. Our participants'

experiences were influenced by their gender identity, and likely other factors that have been shown to influence students' experiences, including class sizes,¹⁵ curriculum design,^{16,17} course design,^{18–20} instructional approaches,²¹ and course assessments.²²

Our institution's strategic plan includes Inclusive Excellence as one of its main goals.^{23,24} As part of meeting this commitment, the Trans, Two-Spirit, and Gender Diversity Task Force was created in 2020 to identify areas for attention and improvement to address inequities directly impacting T2SGD individuals. The task force is developing “actionable recommendations to address gaps in systems, policies, procedures, and practices that address the human rights concerns of T2SGD individuals”.²⁵ The Inclusion Action Plan²⁶ includes direction for encouraging and supporting instructors and teaching assistants to apply inclusive teaching and assessment practices. The Student Diversity Initiative (SDI) is one of the major ways our institution is actioning and funding work to support these strategic priorities. The SDI aims to “embed UBC's core values of equity, diversity, and inclusion throughout the operations, systems, culture and organizational structures that directly impact the campus experience for diverse students.”²⁶

The teaching and learning support units offer workshops on inclusive teaching and antiracist teaching. These workshops are also included in an optional year-long teaching development program for new faculty members. Those involved in faculty and staff hiring are trained in equitable hiring practices and implicit bias. There is clear institutional support for diversity, equity, and inclusion and a recognition that good teaching is inclusive teaching. However, the results from this study show the effects are not yet felt at the student level. Therefore, more work needs to be done to make T2SGD students feel more included. Institutional leaders at all levels have a role to play in shifting practices toward being more inclusive. Reporting mechanisms for discrimination and harassment need to be better communicated to students and the procedures must prioritize safety for the students.

Recently, the student health plan doubled its coverage for mental health, from \$500 per year to \$1,000. This is for care outside of the university counselling service, which is free. One would expect that increased support for students to select their own mental health care provider is especially helpful to gender diverse students. This increase in coverage is an important improvement.

Ares and June's stories suggest changes instructors could implement to make science more inclusive. For example, engaging with topics outside of course content, encouraging students to collaborate with their peers, acknowledging trans and nonbinary students inside the classroom, and recognizing that not all students have the same background and personal factors influencing their work. Many educators strive to show a diverse set of scientists in their instructional materials, and we encourage educators to discuss the identities that may be invisible, so that students in the class see themselves in the role models. Projects such as 500 Queer Scientists and Scientists Spotlight are excellent instructor resources.^{27,28}

Gender-diverse students struggle with feeling they need to hide their identity, which uses significant cognitive resources and causes anxiety.^{29,30} Acknowledging trans and nonbinary gender identities communicates to students that they are welcome in the class and that their instructor is comfortable with gender diversity. This also signals to other students in the

class that diversity is valued. When a gender-diverse instructor reveals their identity, it sends a message of care and results in more authentic relationships with students.³¹ All instructors can communicate to their classes that gender diversity exists and that gender-diverse people can be scientists. Instructors can also explicitly communicate their support for gender-diverse students by publicizing institutional resources. For example, publicizing mentorship organizations and clubs on the course website. Learning management systems either allow for specifying pronouns or editing preferred names with pronouns, and instructors should encourage all students to indicate their pronouns. Faculty members should advocate for institutional change to ensure gender identity questions on institutional and research forms and surveys use inclusive language.³²

When instructors do not overtly acknowledge gender diversity, students are left to guess where and with whom they are safe. Inclusion is not the lack of explicit discrimination and exclusion; it needs to be proactive. These students' stories show us that we need to do more to explicitly include diverse students to help them feel included and thrive in their chemistry learning environments.

Though this study had a very small sample size, we wanted to ensure that the voices of the nonbinary students who participated were heard because they are so often neglected within science and academia at large. If possible, a similar study should be conducted in which binary trans (i.e., trans men, trans women) and/or Two Spirit science students are represented alongside nonbinary students to get a better sense of the issues facing gender diverse students at large. We are following up on this study at our institution by developing and evaluating a gender diversity in chemistry toolkit for instructors.

LIMITATIONS

As justified earlier in the paper, our sample size of two may be seen as limiting the validity of our conclusions. However, our goal was not to identify how widespread these issues are, since even if one student experiences this, it is a problem. Their experiences are real and point to actionable improvements we could make to our learning environments. Due to the emotional labor required in conducting and participating in this research, we urge readers to believe these students. We urge other researchers to consider exploring these issues in their own context, ideally with a sample size that allows for a phenomenological approach and qualitative data saturation.

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Notes

The authors declare no competing financial interest.

ACKNOWLEDGMENTS

The authors live, work, and study on the traditional, unceded, ancestral lands of the Musqueam, Squamish, and Tsleil-Waututh peoples. The authors would like to thank our participants for trusting us to tell their stories.

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