The Chi-Sci Scholars Program: Developing Community and Challenging Racially Inequitable Measures of Success at a Minority-Serving Institution on Chicago's Southside

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The Chi-Sci Scholars Program: *Developing Community and Challenging Racially Inequitable Measures of Success at a Minority-Serving Institution on Chicago's Southside*[1]

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Ensuring that all students who want to pursue degrees and careers in science can do so is an important goal of a number of undergraduate STEM equity programs throughout the United States.[2] Many of these programs, which promote diversity and the importance of diversity in science, directly address the 2012 PCAST report, which notes that "1 million additional STEM Professionals will be needed within the next decade" and "women and members of minority groups now constitute approximately 70% of college students, but earn only 45 percent of STEM degrees." The PCAST report[3] also indicates that these students "leave STEM majors at higher rates than others and offer an expanding pool of untapped talent." Many of these programs recognize that it is important to provide students with a variety of support: financial, mentoring, research-based instruction, cohort development, and specific activities tailored to target population strengths and needs.

The Chicago State University (CSU) Chi Sci Scholars (CSS) program began in 2014 as a result of a grant from the National Science Foundation (NSF) S-STEM program and builds on the specific strengths of our population on the southside of Chicago. The overarching goal of CSU's CSS program is to increase the number of students receiving degrees in chemistry and physics by building science identity, creating a supportive cohort of peers, and providing financial support. Because of the population we serve at CSU, an implicit goal of the CSS program is increasing the number of underrepresented students entering the physical sciences. Interviews with students suggest that our activities aid in developing a community where students feel engaged and connected to one another and the department.

We describe adaptable activities with the goal of improving support systems for students at minority-serving institutions (MSIs). While our context focuses on an MSI,[4] many of the recommendations presented can benefit all students at many institution types. In addition to describing the program itself, we conclude with a discussion of commonly accepted tools in predicting and judging student success, as well as the shortcomings of these tools. Suggestions for creating more holistic measures of success are presented.

Background

CSU plays an important role in the Black community on the southside of Chicago. The majority of the CSU students (including CSS) come from the neighborhoods close to the university. The map in Fig. 1 shows the racial and ethnic segregation in Chicago, with the blue in the map representing the Black community, concentrated in the south and west sides. While a number of students come to our university because of specific programs, many of the students attending CSU *need* to attend CSU. Cost and ACT scores often play a factor in whether students can attend other institutions in the region or need to attend CSU or one of the City Colleges of Chicago. Additionally, single parents who need to pick up their children from neighborhood schools often require short commutes to pursue their education. As a regional university, CSU provides the southside community with academic programming, outreach, and diverse activities. The university family at CSU that includes students, staff, faculty, and administrators also possesses a deep understanding of the culture of the southside of Chicago. This cultural competency is often missing at predominantly white institutions (PWIs).[5] As one former CSU MFA student recently (2016) wrote in the LA Review of Books about their campus experience, "I head toward the library ... I absorb the universe of fades and dreads

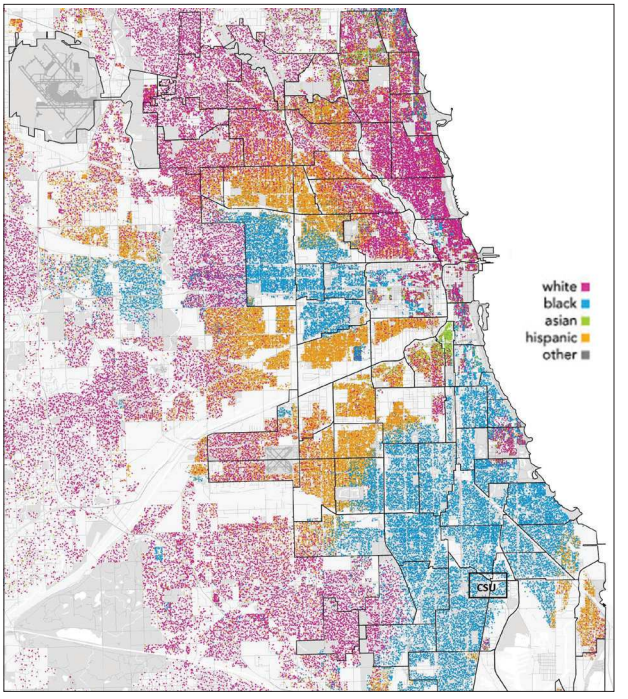

Fig. 1. Map showing race and ethnic self identification in Chicago, from 2010 (http://www.radicalcartography.net/index.html?chicagodots). Map courtesy Bill Rankin, www.radicalcartography.net/chicagodots.html.

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and afros and perms and weaves and naturals." [6] He went on to reflect on the ways that CSU stays with him: "You can't forget having class next to brown babies, because your cohort still shows up even when a sitter isn't in the budget, because the faculty here invited them to do so." This sense of community and culture plays a strong role in developing student identity in many of the majors CSU offers. It is a resource in the community that we can leverage to support underrepresented students in developing identity in science. For physics and chemistry majors at CSU, when they look at their peers in science classes, they see many students that look like them, coming from the same communities. They see Learning Assistants and student researchers that attend the same churches, went to the same high schools, shop at the same stores, like the same music.[7]

CSU also plays an important role in the national STEM landscape. CSU is approximately 80% African American and 70% female. This past academic year (F15/S16) the department graduated six Black physics majors, five of whom are African American. Of these six Black physics majors, half are women, a group particularly underrepresented in physics. The nation graduates roughly 150 African American physics majors each year. This means that CSU graduated a little over 3% of the total number of African American physics majors nationally.

Our Community of Chi Sci Scholars (CSS)

CSS operates on the idea that all students have the potential to succeed. CSS must be new students at CSU, coming in as first-year college students or transfers from other colleges and universities. They must intend to major in either chemistry or physics. There is no minimum GPA requirement for acceptance, although CSS need to maintain a 2.8 GPA cumulatively or 3.0 for the past semester (if their cumulative GPA drops below 2.8). Our scholars are diverse, along a number of dimensions. Some scholars are young, coming to CSU right out of high school, and others are older, often transferring from two-year colleges (TYCs); most students need to work, some to support themselves and others to support extended families and/or children; some scholars have stellar academic records and some have less than stellar academic records with a potential to succeed.

Building a supportive community through cohort development

The CSS program begins with a summer program modeled after the University of California - Berkeley Compass Project.[8] Typical summer program activities include: a scavenger hunt to familiarize students with the CSU campus, authentic science experiments with questions for which the answers are not known, opportunities for practicing mathematics skills, critical thinking questions such as Fermi problems, reading papers about learning, discussions with peer mentors, and a retreat (see below for more detail). During the academic year, CSS continue to meet, engage in leadership activities, and participate in outreach activities that support department efforts. Near the end of their first year, CSS begin research with CSU faculty. Scholars are also supported to attend and present at local and national conferences. For most CSS, their first conference is the Louis Stokes Alliances for Minority Participation (LSAMP) Spring Symposium on STEM. This regional conference, supported by the National Science Foundation, brings students and faculty from around the Chicago area to participate in science discussions, learn about effective learning strategies and study habits, think about careers, and present their research. The atmosphere is student centered, friendly, and encouraging for students who are new to research.

Fig. 2. CSS work on a science activity during a cohort-building session.

Establishing a community that supports you and believes in you is an essential component to successful STEM programs.[9] Such a community is especially important for CSS, as students of color must additionally contend with racism, racial stereotyping, and lack of cultural competency in the scientific community.[10,11] One of the overarching objectives in our program is to create a cohort of students who support each other holistically, through complex lives and situations. One student commented that "being involved in [CSS] creates accountability because you have this support system who can check you and keep you … focused. Having someone in your corner to say uplifting and encouraging things is important but also someone to say 'Are you staying focused on your goal?' or 'Are you doing what you need to do?' every once in awhile." This support system typically begins to form in the CSS program before the scholars' first academic year, in our summer session.

The summer session

The summer session is designed to help our scholars, who are new to CSU, build trust and collaboration skills. We employ a cohort model where students are together in the summer and are encouraged to enroll in next semester's courses together. The summer program is based on the successful Compass model, developed at the University of California, Berkeley.[12] Compass received the national award for Improving Undergraduate Physics Education in 2012 by the American Physical Society.[13] As the official start to the CSS program, the summer program sets the tone for the CSS cohort. We highlight three of the summer activities in this paper to provide a glimpse of what our summer session encompasses.

On the first day of the CSS program we present the students with their first Fermi problem.[14] Fermi problems

characterize much of what we do in the program: students are given an interesting task to solve where no one knows the answer. These are not standard chemistry or physics course questions or experiments. Our goal is to provide a more authentic experience of science. We emphasize the importance of process, analysis, critical thinking, and collaboration. One scholar commented that "I had the right answer but [our instructor] didn't seem to care because I didn't know why it was right. That's really different from high school." These open-ended problems give an added benefit of somewhat equalizing the playing field across variations in student science background: for most of our students, this type of problem solving is new.

An example of an experiment our students perform is the "tea bag rocket," a popular physics demo.[15] It provides a number of opportunities for students to develop models and consider how changing variables can affect what is happening. It also provides an opportunity for the chemistry and the physics students to bring in information from their respective disciplines.

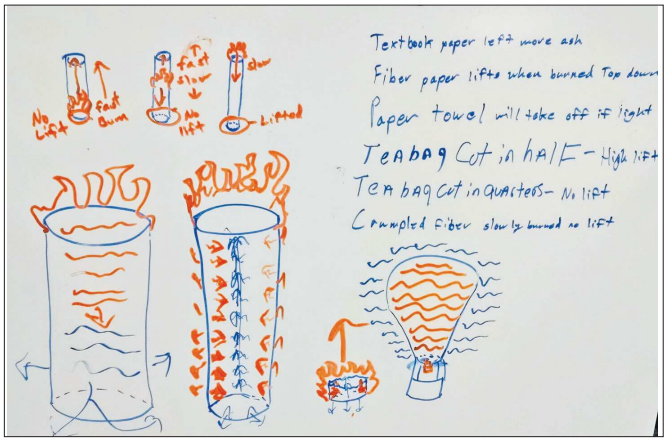

Fig. 3. Sample whiteboard from CSS as they develop experiments and models to account for the behavior of the tea bag rocket.

Exposing students to authentic science questions and experiments where no one knows "the answer" is also useful in developing trust and friendships among the scholars. We interviewed students after their experiences in the summer program. A frequent theme that arose in these interviews was the connection between community formation and the kinds of problems that students worked on. One student commented, "I think that working together on questions, experiments that none of us knew … we got really talking and getting to know one another." Another student mentioned that "... well, I guess it taught me how to be around other people ... so like if I needed to call Fidel to ask him about a class or something then it will be more easy for me to call him .... I guess [the summer session] broke down that barrier."

In addition to thinking about science, faculty and students in the CSS summer program spend time thinking about the process of learning and growth. During our last two summer programs the scholars have read a paper on growth mindset by Carol Dweck.[16] The paper has many practical takeaways for students. One student remarked how they see aspects of both fixed mindset and growth mindset in themselves and others. They commented that "if you have a preconceived notion ... you don't try." Many of our students have very sophisticated views on mindset and this can then be used as a resource as students engage in their academic semesters. One student commented that "science culture as a whole is not always focused on the growth mindset .... there is still [an idea that] if you're smart you'll do it." This student then contrasted this with their own personal view of science: "...I like science a lot because you can study real hard your whole life ... and you might never get the answer." The student went on to talk about how science involves synthesizing different pieces of knowledge together: "Over time ... somebody is looking back on all the knowledge that's been dropped ... and if I take that piece and that piece ... and put them together and find the solution they were looking for ... because they didn't give up." These CSS quotes convey a sense that science can be a frustratingly slow process at times, but that if someone works hard their contribution can still be a successful one.

CSS retreats

Short retreats have also been an effective tool to help build community. We started implementing retreats the second year of our CSS program and noticeable differences were observed in the community that formed. The incoming CSS as well as older cohorts of CSS acting as peer mentors are invited to attend to build community across years. The two faculty project directors also attend.

During our retreats, the goal is to "get away," and we have chosen to stay at economical retreat centers about two hours' drive from Chicago. The group arrives in the late afternoon and leaves in the late morning the following day. Retreat activities included hiking, playing games, cooking and eating together, discussing papers on mentoring, and discussing CSS leadership strategies. Our most recent retreat included an *unplanned* team-building exercise involving getting lost on a narrow, snowy inclined road. This required backing up a 15-passenger van in the dark about a half mile. The unplanned moments that happen when traveling together are often the most memorable and can build comradery.[17]

Fig. 4. CSS at our first overnight retreat in Michigan enjoying an outdoor BBQ.

One student stated that the activities at the retreat made the group feel almost like a family. He stated that "… we all ate together and ... like a family, you sit and eat with your family." In addition to getting to know their peers better, one student described the importance of knowing the faculty beyond the academic setting, stating that "being in the presence of professors in a more relaxed setting, where they share their experiences, makes the idea of further education … more attainable because you see the person behind the degree and title. Usually, when you meet people of power you see that position and not their journey."

Reflections on building community through CSS activities

Developing cohorts of students who trust and want to support each other through their academic careers is important for all students. One student summed up how the activities built community: "[I]t was interesting because you're coming to college and you don't know anybody yet, so we were interacting, we had to [discuss ideas] with people you don't know at all, and trust them that they know what they're doing. I met one of my friends there and we [interact every day]." It is also important to recognize that there is not a one size fits all model that we can take out of the box and expect to work at diverse institutions with diverse populations. Institutions first need to identify and understand their strengths and then leverage these strengths to build programs that address specific needs. For our program it was the sense of community and shared experiences among our students that were leveraged to build the CSS program and cohort-building activities.

Importance of expanding traditional student predictor and outcome variables of success

The importance of evaluating student potential for success expansively is central to our program. We have had examples of incoming CSS with high ACT scores leave without completing a degree and students with low ACT scores persist and thrive. Data on the success of our CSS are consistent with other research indicating that the common tools we use to gauge future performance in STEM are flawed, such as the standardized tests for college entrance or the GRE for graduate work.[18,19] Students with a range of ACT scores can be successful in our program. While our sample size is small, we have seen indicators that students who form links to research groups and actively participate in community activities will often persist to degree completion in spite of academic and personal challenges.

In addition to evaluating the potential of success expansively, it is also important to measure outcomes expansively. The common metrics used to gauge whether our students have succeeded are flawed. Many universities are judged on four- to six-year graduation rates. Graduation rate metrics are used throughout the country at all types of institutions, including large research universities, small liberal arts colleges, and comprehensive universities and colleges. Little discussion is given to potential differences in the socioeconomic status of the student body. For instance, in 2013, the state of Florida started tying state funding for universities to four-year graduation rates.[20] Many reports also normalize six-year graduation rates as a key outcome of success.[21] At CSU, many of our students work full-time jobs and many have families. Of our current CSS, over 30% have significant childcare responsibilities and roughly 50% work over 25 hours per week. Because of these commitments, as well as others, it takes many of our students longer to complete a degree. Differences in college and university populations suggest that using the same metric with the nation's diverse student population is inappropriate. It is also problematic to say that the student who takes 10 years to graduate while raising a family, taking care of aging parents, and holding a full-time job is not a success.[22,23] It is important to consider metrics of success where the diverse experiences of our students and the skills they have developed to overcome obstacles are not devalued.

Using four- to six-year graduation rates as an unquestioned success metric also has implications for racial equity. Links between race and socioeconomic status exist. For instance, in Chicago, a racist history of redlining (denying services and/or selectively raising prices for residents of particular regions due to racial or ethnic considerations), among other factors, has created segregation and disparate access to financial resources.[24,25] In a 2014 press release from the UCLA Civil Rights Project, it was noted that "[s]egregation is by far the most serious in the central cities of the largest metropolitan areas; the states of New York, Illinois, and California are the top three worst for isolating black students."[26] Black families are less likely to have the financial means of paying for their children's education, a key aspect of many successful four-year graduation experiences. In the 2014 report "The Color of Student Debt: Implications of Federal Loan Program Reforms for Black Students and Historically Black Colleges and Universities," the authors note: "Research indicates that family wealth has powerful impacts on college opportunities, exhibiting effects even stronger than those played by family income. Moreover, racial disparities in wealth are large, growing, and unlikely to disappear anytime soon. Black students—whose families disproportionately do not own homes or retirement accounts and who cannot rely on intergenerational transfers for support—are far more likely to borrow not only federal subsidized and unsubsidized loans, but also have fewer alternative sources of credit beyond Parent PLUS loans."[27]

What might more racially equitable success metrics look like? Measuring success in an undergraduate program is complicated and is something we are still working on in the CSS program. There are no easy answers, but we believe mixed methods, including substantial qualitative metrics that include interviews and classroom video data, are key. Qualitatively, we focus on sense of community, effective support, and student understanding of what it means to do science. Studying these variables is often more "messy," i.e., they are more challenging to analyze than the standard quantitative metrics commonly

used. However, our work suggests that they may provide a more accurate and equitable measure of success. As we presented, CSS have indicated feeling supported, engaged, and connected to one another. This idea of community and support is something we value at our institution and something we value in the science community. Additionally, CSS frequently developed sophisticated ideas about what it means to do science, mentioning that deep understanding of chemistry and physics concepts is more important than getting the "right answer." Quantitatively, we are still exploring various options. Quantitative metrics we are considering involve a combination of shorter term one-year student retention rates, surveys of students' stated reason for leaving CSU, and rates of students who return to the program after an absence. Such metrics allow for seeing "success" when a student leaves for a year to take care of a sick family member and eventually returns, or needs to be a part-time student for an extended time period.

Conclusion

One of the resources at many MSIs, HBCUs, HSIs, Tribal Colleges, and TYCs are a critical mass of students, who in many other scientific settings are marginalized. These types of institutions can leverage their students' shared experiences to put into place activities similar to the ones we describe here. PWIs can also benefit from these types of activities, but they may need to pay particular attention to making sure that students of color feel like they belong and create spaces for marginalized students so they do not feel isolated at their institutions.[28] In considering how to measure student success, we caution against student support programs, and universities more generally, judging themselves on success metrics like four- to six-year graduation rates because of the implications for racial equity. We encourage programs to engage in more creative measures that may involve mixed methods and more qualitative examinations of holistic student skills and experiences.

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