Examining Self-Efficacy, Science Identity, and Sense of Belonging Within a Cohort-Based STEM Program

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Since 2010, the National Science Foundation (NSF)–funded Science, Technology, and Math Preparation Scholarships (STAMPS) project has provided financial and community support for undergraduate students at the University of North Carolina at Greensboro (UNCG) in STEM majors. In this article, the authors explore the impact of STAMPS on how cohorts support students' sense of belonging, self-efficacy, and science identity. A mixed-methods design approach enabled the collection of multiple types of data that could be used to examine participants' experiences. Key findings suggest that participation in the STAMPS program has increased students' self-efficacy, science identity, and sense of belonging. Students reported feeling a bolstered self-efficacy primarily due to interactions with other students, faculty, and scientists during class, field trips, and presentations. Peer and faculty mentors and STAMPS events were most frequently cited as being responsible for impacting science identity. UNCG-specific and STAMPS events assisted in the formation of students' sense of belonging.

The United States relies on science, technology, engineering, and mathematics (STEM) for competitiveness, innovation, and problem-solving. With continued challenges in environmental resources, health care, energy, national defense, food safety, and accessibility, a competent STEM workforce continues to be a priority (President's Council of Advisors on Science & Technology, 2020). Even with gains in the number of students who earn STEM bachelor's degrees over the past 15 years (National Science Board, 2020), jobs for competent scientists remain unfilled (President's Council of Advisors on Science & Technology, 2020). These efforts are increasingly salient in Greensboro, North Carolina, where economic activities such as tobacco farming, cigarette manufacturing, furniture making, and textile manufacturing are being replaced with the educational, health, and social services sectors (City of Greensboro, 2018).

Research has demonstrated that affiliation with a cohort increases students' persistence and retention (Chang et al., 2011; Tinto, 1997). Since 2010, the National Science Foundation (NSF)–funded Science, Technology, and Math Preparation Scholarships (STAMPS) project has provided financial and community support for undergraduate students at the University of North Carolina at Greensboro (UNCG) in STEM majors. Utilizing a cohort model, the UNCG STAMPS project has built a supportive community of students and faculty with the aim to broaden students' knowledge of the interconnectedness of STEM disciplines, career opportunities, and exposure to cutting-edge research. Students and faculty attend interdisciplinary lectures, visit scientific labs, engage in opportunities with graduate students, network with other students to form a community of scientists, and participate in a freshman seminar course. In fall 2017, a new iteration of the project was initiated and expanded to include an educational research component examining how STAMPS supports students' sense of belonging, self-efficacy, and science identity.

Background and context

UNC Greensboro

UNCG is one of four doctoral-granting institutions of the 16 University of North Carolina (UNC) campuses. UNCG was established in 1891 as the first public college for women in North Carolina (University of North Carolina at Greensboro, 2021). With more than 20,000 students, UNCG is a Doctoral R2 (research-intensive), community-engaged campus. It is diverse, with a student body that is approximately 67% female, 35% Black,

11% Hispanic, and 52% from low-income households. Additionally, approximately 23% of the UNCG student body identifies as lesbian, gay, bisexual, transgender, queer, or another sexual or gender minority (LGBTQ+). UNCG is the most racially diverse of the UNC system's historically White campuses and is designated as a Minority Serving Institution with a core value of inclusiveness and racial equity (University of North Carolina at Greensboro, 2020).

STAMPS project

The UNCG STAMPS project selects participants, STAMPS Scholars, based on their significant promise for success in the sciences and math and measurable financial need. The project goals are to

- graduate all STAMPS Scholars into STEM careers or graduate school,
- support a diverse community of STEM learners,
- create and sustain a supportive environment for STAMPS Scholars, and
- discover what works to accomplish the other goals (and why) and share this knowledge broadly.

Here is an overview of the core programmatic structure of the STAMPS project:

- *Cohort:* STAMPS is designed as an integrative experience for scholarship students.
- *Three-credit course:* STAMPS Scholars, STEM faculty, project organizers, and STAMPS faculty mentors are part of a yearlong course. Scholars learn about undergraduate research opportunities, fundamentals of research, current research directions, and alternative careers in STEM. The course is taught by STAMPS principal investigators (PIs). The two STAMPS co-directors, the PI and the project director (also a co-PI), took the lead in the development of the course structure for all of the courses with input from the other co-PIs. All PIs attended class and were available to students.
- *Faculty and peer mentors:* Long-lasting mentor-mentee relationships help students develop professional characteristics and build the confidence necessary for success after college (Goonewardene et al., 2016). As such, all STAMPS Scholars are assigned a faculty and peer mentor.
- *Undergraduate research opportunities:* Undergraduates engaged in research show significant gains in understanding, confidence, content knowledge, and creativity, all of which greatly increase their interest in graduate education (Lopatto, 2007; Maton et al., 2012; Seymour et al., 2004). Research opportunities are highlighted during the STAMPS course and via mentor-mentee meetings. STAMPS Scholars toured labs in their first year, which was often enough to encourage them to join research labs. For example, the tour of the Joint School of Nanoscience and Nanoengineering resulted in two students joining labs. Other students worked with faculty in biology, chemistry, and computer science.
- *Advising:* STAMPS Scholars have a tailored group advising and orientation session. The project provides tips on how to navigate a STEM degree, interact with advisors, plan math and science course sequencing, and take advantage of educational resources. Advisors and faculty mentors receive training that helps them better understand how students from low-income backgrounds might perceive their career aspirations (Carlson, 2016).
- *Science seminar series:* All of the school's STEM departments sponsor weekly seminar series. STAMPS Scholars attend select departmental presentations as a group. For several of these speakers, STAMPS hosts postcolloquium discussions for Scholars.
- *Overnight trips:* STAMPS Scholars visit national science and engineering facilities, including overnight trips to the National Aquarium, the National Zoo, the National Institute of Standards and Technology, the Goddard Space Flight Center, and the Smithsonian Institute and museums.

The focus of this article is on STAMPS project cohorts 1–3. Cohort 1 began in fall 2017, Cohort 2 began in fall 2018, and Cohort 3 began in fall 2019. Much of what is reported in this article covers the first-year experiences of each cohort.

Programmatic changes as a result of the COVID-19 pandemic

In early March 2020, UNCG decided that all classes would move to an online format and that students living in on-campus housing would be required to vacate due to the burgeoning COVID-19 pandemic. As such, the STAMPS course moved online, with the initial meeting devoted to discussing concerns about the pandemic, the university's response, and how best to continue STAMPS. As a result of those discussions, the program staff scheduled a series of virtual speakers and facility tours and added a monthly virtual "social hour" for all STAMPS students.

As the pandemic worsened, many of the summer research opportunities

available to STAMPS students evaporated. However, research opportunities resumed beginning in summer 2021.

STAMPS Scholars

Across all cohorts, the most common majors were biology, chemistry/biochemistry, and computer science. Cohorts were divided fairly evenly between male and female students. The percentage of students who identified as people of color remained relatively constant from year to year.

STAMPS research

The purpose of the research program has been to explore the impact of STAMPS on how cohorts support students' sense of belonging, self-efficacy, and science identity. The guiding research question for this project was as follows: How and in what ways are self-efficacy, science identity, and sense of belonging related to STAMPS participation? Three constructs were examined to determine the success of the STAMPS project.

Self-efficacy

Self-efficacy is defined as "the exercise of human agency through people's beliefs in their capabilities to produce desired effects by their actions" (Bandura, 1997, p. vii) or students' beliefs in their ability to set up an experiment correctly (Trujillo & Tanner, 2014). We examined this concept across domains, not just within STEM. When discussing this concept, Bandura (1986, 1997) and others discuss how motivation, as related to persistent activation of behavior, is directly related to the ability to project future outcomes of choices, is greatly beneficial in ongoing goal-setting and reflection, leads to self-corrective behavior, and helps an individual make changes in an attempt to avoid negative outcomes.

TABLE 1

Demographic characteristics of STAMPS Scholars.

Group	Cohort 1	Cohort 2	Cohort 3
Gender			
Male	11	9	9
Female	9	10	6
	20	**19**	**15**
Major			
Biology	8	6	6
Chemistry/Biochemistry	4	5	3
Computer science	6	5	2
Physics	-	3	1
Geography	-	-	1
Mathematics	1	-	1
Other	1	-	1
Race			
American Indian/Alaska Native	-	-	-
Asian	3	2	2
Black/African American	5	5	5
Native Hawaiian/Other Pacific Islander	-	-	-
White	8	8	8
Not reported/Unknown	3	-	2
Two or more	1	4	1
Ethnicity			
Hispanic/Latino	3	2	2
Not Hispanic/Latino	17	17	13

Science identity

Science identity, as a construct, is concerned with individual self-concepts that focus on scientific accomplishment and association of self with science. Peterson et al. (1980, p. 169) recognized that "self-concept is related to other important variables such as academic performance, classroom behavior, and grades."

Sense of belonging

To understand the motives behind students dropping out of higher educational institutions, Tinto (1975) formulated a model of considering where a sense of belonging within social and academic settings fits into reasons a student may end academic pursuits. He used an approach modeled after a theory of suicide that indicated that suicide was "more likely to occur when individuals are insufficiently integrated into the fabric of society … [with increases in likelihood attributed to] insufficient moral (value) integration and insufficient collective affiliation" (Durkheim, 1961, as cited by Tinto, 1975, p. 91).

Data collection methods

Researchers employed a mixed-methods design for this study. Multiple data collection methods and sources were used. All research activities were approved by the UNCG Institutional Review Board (#16-0456), and all participants signed consent forms. Each source of data incorporated in this article is described in further detail in the following sections.

Self-assessments

STAMPS program participants completed online self-assessments at the beginning and end of the academic year (August and May). Students rated their perceived self-efficacy (Charleston & Leon, 2016; Simon et al., 2015), science identity (Chemers et al., 2011; Hazari et al., 2013), and sense of belonging (Smith et al., 2013). The self-assessments included both open- and closed-ended items. Closed-ended questions consisted of 5-point, Likert-type scales from "strongly disagree" to "strongly agree." The self-efficacy subscale consisted of 10 items ($\alpha = 0.89$), the science identity subscale contained 10 items ($\alpha = 0.86$), and the sense of belonging subscale consisted of 10 items ($\alpha = 0.75$).

Satisfaction surveys

Students completed end-of-the-semester satisfaction surveys that gauged the quality of and their satisfaction with program components. Participants were asked about interactions with faculty and peer mentors, events, the usefulness of course activities, their career intentions, the number of hours worked per week for pay, and the number of hours per week devoted to studying. The surveys also included both closed- and open-ended questions.

Interviews/Focus groups

Researchers conducted semi-structured focus groups to explore STAMPS participants' experiences, reactions, and opinions. During their first year, all Scholars participated in two focus groups, one at the end of both their first fall semester and the spring semester. These focus groups were conducted during the STAMPS course.

Data analysis methods

A mixed-methods design approach enabled the collection of multiple types of data to examine participants' experiences (Creswell, 2013). For the quantitative component, SPSS was used to perform an analysis of the self-assessment and satisfaction survey data. Survey items were reverse-scored where appropriate to retain consistency so that higher scores mirrored positive responses. Descriptive statistics were calculated for each cohort's self-assessments at the beginning and end of their participation in the course. Interviews and focus group recordings were selectively transcribed and cleaned to eliminate identifying information. Content analysis was employed for the qualitative data. Three members of the research team coded and analyzed the data. Coding began with team members individually identifying and labeling the data related to the research questions (Strauss & Corbin, 1997), then team members gathered to discuss their initial codes, indicating similarities and differences. Initial codes were clustered based on recurring patterns to create broader categories (Saldaña & Omasta, 2016). Themes were shared with the project team for feedback on initial findings. This process led to the identification of themes that expanded the initial quantitative analysis and allowed for triangulation.

Findings

The main purpose of this research was to examine the impacts of the UNCG STAMPS project on participants' (i) self-efficacy, (ii) science identity, and (iii) sense of belonging. Key findings in this study suggest that participation in the STAMPS program has increased students' self-efficacy, science identity, and sense of belonging. Each construct is discussed in the following sections.

Self-efficacy

On a scale of 1 to 5 (1 = strongly disagree; 5 = strongly agree), across all three cohorts, the average preprogram self-efficacy score was 3.74; the average postprogram score was 3.84. Figure 1 highlights changes in self-efficacy self-assessment scores by each cohort.

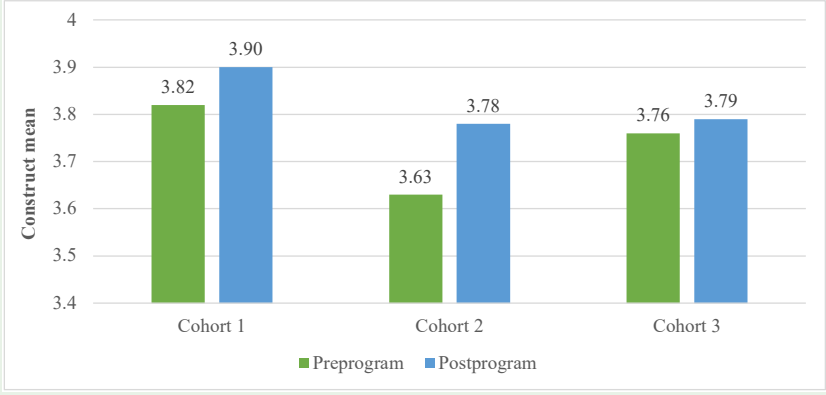
Students reported feeling a bolstered self-efficacy primarily due to interactions with other students, faculty, and scientists during class, field trips, and presentations. Data suggest that these interactions have played a major role in students' having greater belief in their ability to accomplish tasks needed to stay in their major and at UNCG. For example, in an interview, one student commented, "STAMPS has allowed me to become [more] confident in being a STEM major."

Interactions with other students

Multiple students reflected on the role their interactions with cohort members and peer mentors played in their perceptions of self-efficacy. In a focus group, students commented on their interactions with others with similar interests in STAMPS. They felt that those interactions helped make their

FIGURE 1

Changes in self-efficacy across the three cohorts.



major fun, helped build the communication skills they needed to function within their discipline, and led to an increase in self-confidence. One student reflected on the importance of feeling validated for her intelligence and perseverance and how that helped encourage her to be self-efficacious. The following are a sample of quotes about interactions with other students from focus groups, interviews, and open-ended comments on surveys when students were asked about the ways in which the program has impacted their belief in their abilities:

- "It has been nice having peer and faculty mentors to associate with and turn to for advice."
- "The best part of the program was when they bring former STAMPS students to talk during Monday class meetings, particularly [the] student at Google."
- "The peer mentor interaction has been really useful, especially as a woman in STEM."
- "It's also the fact that these people [cohort members] are science majors like you or in the STEM field. So, you can actually talk to them about stuff. When you have friends who are English majors, history majors, and dance majors, you can't really talk to them about the stuff you learned in class or about something interesting you learn. So, it's also a situation where we could actually talk about science, and it's pretty open."

Interactions with faculty

STAMPS Scholars frequently listed their interactions with faculty as one of the most important aspects of the project. Here are a few representative quotes about interactions with faculty related to self-efficacy:

- "What motivates me are people like faculty because they are welcoming. They are happy to talk to students, and it's good to have other people to talk to in your area."
- "STAMPS provides me with support structures."
- "The money draws me in, but the networking made me stay."
- "I guess with the faculty, it gives me someone to help me if I need something, and if I leave the program, they still always are there, but I guess I will not be attached to them like I am now. So, I think in my next three years having them on call is helpful."
- "STAMPS professors are very helpful and want to help their students be successful."

Participation in activities

Scholars also pondered over the extent to which the STAMPS project provided them with opportunities to participate in activities that they might not have had the chance to participate in had they not been in the program. Many students discussed how STAMPS provided more resources to assist with homework and certain scientific analysis and tasks associated with class activities. Taken together, these experiences outside of their core or major curriculum increased students' belief that they could succeed in their courses. Here are a few representative quotes about participation in activities related to self-efficacy:

- "STAMPS exposes STEM majors to different things they never would have been able to see without STAMPS."
- "I was very worried about understanding scientific literature, but doing it in STAMPS helped."
- "I enjoyed shadowing the scientist. It has opened my eyes on how scientists work, and it is amazing to see that this facility has many different [kinds of] research happening at the same time. It is truly an amazing sight to see. I did not understand all the terminology, but being there physically was a different perspective."

The self-efficacy items most commonly mentioned in relation to participants' persistence in STEM majors were students' confidence in their ability to succeed in math or science classes, good knowledge of basic concepts in math and science, making a grade of B or better in all math

or science courses, and confidence in their ability to master the skills being taught in math and science classes. As previously mentioned, the project impacted students' science identity and sense of belonging.

Science identity

Looking across all three cohorts, the average preprogram science identity score was 3.76; the average postprogram science identity score was 4.01. Figure 2 highlights changes in science identity self-assessment scores by each cohort.

Science identity is key to understanding the multiple ways STAMPS students see and describe themselves as a member of STEM- and field-specific communities. Peer and faculty mentors and STAMPS events were most frequently cited as being responsible for impacting science identity.

Peer and faculty mentors

All students reported their mentors as positively impacting their identity and decisions to stay in STEM majors. One student reflected on the decision to leave their major, then changing their mind after talking to their peer mentor:

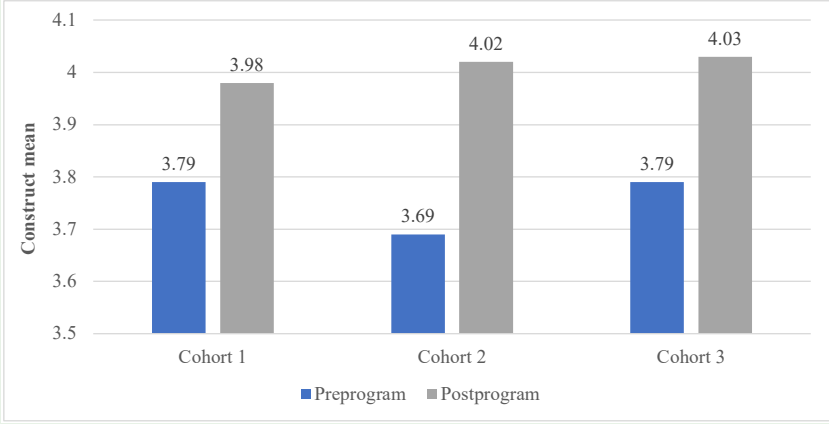
> *Yeah, my peer mentor is very helpful, because I was thinking about changing my major, like outside of STEM. But she changed my mind once she said I should stay and give it some thought. "You just think about what you want to do once you're older, and your future career." So, she really helped me with that, and I decided just to keep my major after talking to her. So, she was helpful.*

Multiple students cited their relationships with STAMPS faculty and other scientists they were introduced to through STAMPS as influencing their identity. Here are a few representative quotes about faculty related to science identity:

- "I think it helps having a connection with all these scientists, because one thing I learned about STAMPS is that connections are everything in the science field. So, the connections really help—especially with things like graduate school or applying to research opportunities."
- "I think it took me a long time to bond with people, but once I did, the activities became fun because I could like talk to people and talk about science to people."
- "Yeah, I have to agree that having the mentors, it kind of gives me the resources to be able to work throughout my major and to kind of figure out exactly what I want to do in computer science."

FIGURE 2

Changes in science identity across the three cohorts.



STAMPS events

The main project components mentioned as impacting science identity (in addition to mentorship) were the curriculum, extracurricular activities, and field trips provided by STAMPS. Here are a few representative quotes about STAMPS events related to science identity:

- "Going to all the events. You get to see firsthand what some of them [scientists] do. So, it's like a lot of people are very skeptical, because you don't really know [in STEM] what you're gonna be doing or what type of jobs that are really out there. But you could work at a lab, you could work on the river, you could work at a planetarium, but it's more openings than you'd think. You don't have to be a doctor, and you just don't have to be a researcher in a lab."
- "I found this trip to the Joint School for Nanoscience and Nanoengineering (JSNN) to be fun. It was interesting to see all the different types of research being conducted, and I learned about how scientists do research. I also learned about the different research opportunities I can take at the JSNN. This trip changed my views on science and research. I thought because I was a chemistry major, I should only do research in chemistry, but science is very

interconnected. I think after going on this trip, I will start looking into research opportunities that are not only in chemistry."

- "The field trip was very helpful because all these graduate students are working in these labs or in these buildings, but there are different opportunities out here, and not only just the medical field. You can do work in labs, do all these things, can do seminars and stuff like that."
- "STAMPS has reaffirmed the direction [within STEM] I wanted to go."
- "Attending some of the seminars have provided me more enlightenment and thinking towards being a scientist."

Similar to self-efficacy, mentorship played a large role in influencing science identity. Further, field trips and other extracurricular activities allowed participants to see what their STEM careers have the potential to look like.

Sense of belonging

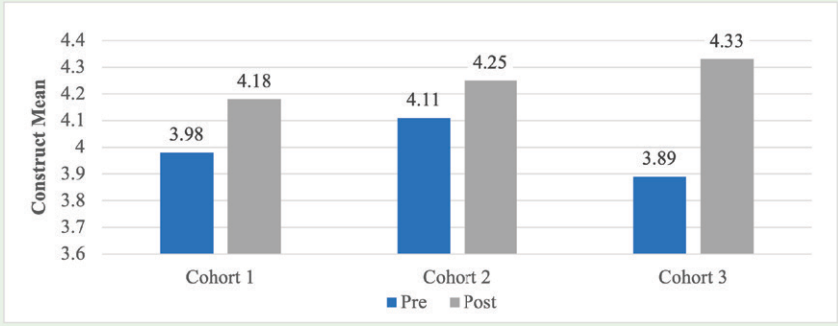
Looking across all three cohorts, the average preprogram sense of belonging score was 3.99; the average postprogram sense of belonging score was 4.25. Figure 3 highlights changes in sense of belonging self-assessment scores across all cohorts and by each cohort.

Sense of belonging, and feelings of being valued and included, increased from the preprogram to postprogram assessments, and students reported that STAMPS played a role in these feelings. However, it is important to note that many students also listed UNCG-specific events that assisted in the formation of their sense of belonging. During focus groups and interviews, several students mentioned connecting with fellow students at an event at a STAMPS professor's house and how that influenced their sense of belonging. Several conversations and connections between students and faculty were shared by students, including conversations about shared stressors and struggles, involvement with student groups outside of STAMPS, and discussion of methods for supporting fellow students. Here are a few representative quotes from focus groups, interviews, and open-ended comments on surveys:

- "We [STAMPS Scholars] do have those connections that other people might have a harder time to figure out, and it's like we don't have to provide as much information because they already know who we are. It's deeper than a student-teacher connection; it's just like one big group."
- "Well, I guess like I always feel like I belong, you know, there's so many STAMPS events for all these different types of people. … This makes you feel like you belong on campus."
- "First semester I wasn't very involved in the [STAMPS] class, but in the second semester, I became more involved and started going to everything. I enjoy it, and I kind of regret not participating first semester in the activities that they plan, because now it's like we're bonding more."

FIGURE 3

Sense of belonging across the three cohorts.



The majority of STAMPS Scholars have not yet graduated; as of the writing of this article, one student has graduated. However, we have been tracking Scholars' retention in STEM majors. In Cohort 1, 11 of 19 participants are still in STEM majors as defined by the NSF. In Cohorts 2 and 3, 15 of 18 and 12 of 14 participants, respectively, are still in STEM. Overall, of the 51 participants, 41 (80%) are still enrolled at UNCG in a STEM field. Of the 10 not remaining in an NSF-defined STEM field, eight remain enrolled at UNCG. These rates are significantly higher than the approximately 60% 4-year rate of persistence in all STEM majors at UNCG.

Conclusion

Our research focused on assessing UNCG STAMPS Scholars' self-efficacy, science identity, and sense of belonging. We found that participation in the STAMPS project has positively impacted scholars in each of the three areas through having meaningful exposure to scientific research, developing mentor-mentee relationships, building knowledge

about the interconnections of STEM disciplines and careers, and providing academic and financial support. Although none of our findings were statistically significant, we suspect this is only the case due to small sample sizes. Furthermore, our findings are aligned with previous literature on the advantages of cohorts in STEM disciplines (Tinto, 1997) and the benefits of actively engaging a community of peers and faculty (Goonewardene et al., 2016) so they can cultivate and nurture their STEM interests with like-minded individuals. The experiences of STAMPS Scholars speak to how a cohort model supports students' self-efficacy, science identity, and sense of belonging, thereby increasing the likelihood of persistence and retention in STEM majors and college more broadly. This finding is particularly salient given the high rate of students who leave STEM majors after their first year of college.

These findings also offer considerations for course design tailored to STEM undergraduates. First, we found that overnight trips facilitate student engagement in STEM. However, local field trips and activities also expose students to research and career paths and help them develop a sense of science identity. Second, consistent with the literature (e.g., Packard, 2004, 2016), both faculty and peer mentoring have impacts on retention in STEM majors. We recommend facilitating connections with peer and faculty mentors early to help students navigate academic life and career decision-making. Our study shows that there are multiple elements of the STAMPS project that contribute to a student's identity as a scientist and persist in STEM majors, consistent with other programs that target students from underrepresented backgrounds (Packard, 2016).

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References

Bandura, A. (1986). The explanatory and predictive scope of self-efficacy theory. *Journal of Social and Clinical Psychology*, *4*(3), 359–373. https://doi.org/10.1521/jscp.1986.4.3.359

Bandura, A. (1997). *Self-efficacy: The exercise of control.* Freeman.

Carlson, S. (2016, November 27). When college was a public good. *Chronicle of Higher Education*. https://www.chronicle.com/article/when-college-was-a-public-good

Chang, M. J., Eagan, M. K., Lin, M. H., & Hurtado, S. (2011). Considering the impact of racial stigmas and science identity: Persistence among biomedical and behavioral science aspirants. *The Journal of Higher Education*, *82*(5), 564–596. https://doi.org/10.1353%2Fjhe.2011.0030

Charleston, L., & Leon, R. (2016). Constructing self-efficacy in STEM graduate education. *Journal for Multicultural Education*, *10*(2), 152–166. http://dx.doi.org/10.1108/JME-12-2015-0048

Chemers, M. M., Zurbriggen, E. L., Syed, M., Goza, B. K., & Bearman, S. (2011). The role of efficacy and identity in science career commitment among underrepresented minority students. *Journal of Social Issues*, *67*(3), 469–491. https://doi.org/10.1111/j.1540-4560.2011.01710.x

City of Greensboro. (2018). *City of Greensboro conditions and trends.* https://www.greensboro-nc.gov/home/showdocument?id=37474

Creswell, J. W. (2013). *Steps in conducting a scholarly mixed methods study.* https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1047&context=dberspeakers

Durkheim, E. (1961). *Suicide* (J. Spaulding & G. Simpson, Trans). The Free Press.

Goonewardene, A. U., Offutt, C. A., Whitling, J., & Woodhouse, D. (2016). An interdisciplinary approach to success for underrepresented students in STEM. *Journal of College Science Teaching*, *45*(4), 59–67.

Hazari, Z., Sadler, P. M., & Sonnert, G. (2013). The science identity of college students: Exploring the intersection of gender, race, and ethnicity. *Journal of College Science Teaching*, *42*(5), 82–91.

Lopatto, D. (2007). Undergraduate research experiences support science career decisions and active learning. *CBE—Life Sciences Education*, *6*(4), 297–306. https://doi.org/10.1187%2Fcbe.07-06-0039

Maton, K. I., Pollard, S. A., McDougall Weise, T. V., & Hrabowski, F. A. (2012). Meyerhoff Scholars Program: A strengths-based, institution-wide approach to increasing diversity in science, technology, engineering, and mathematics. *Mount Sinai Journal of Medicine: A Journal of Translational and Personalized Medicine*, *79*(5), 610–623. https://doi.org/10.1002/msj.21341

National Science Board. (2020). *The state of U.S. science and engineering 2020*. https://ncses.nsf.gov/pubs/nsb20201

Packard, B. W.-L. (2004). Mentoring and retention in college science: Reflections on the sophomore year. *Journal of College Student Retention: Research, Theory & Practice*, *6(3)*, 289–300. https://doi.org/10.2190/RUKP-XGVY-8LG0-75VH

Packard, B. W-L. (2016). *Successful STEM mentoring initiatives for un-*

derrepresented students: A research guide for faculty and administrators. Stylus Publishing.

Peterson, K., Kauchak, D., & Yaakobi, D. (1980). Science students' role-specific self-concept: Course, success, and gender. *Science Education*, *64*(2), 169–174. https://doi.org/10.1002/sce.3730640206

President's Council of Advisors on Science & Technology. (2020). *Recommendations for strengthening American leadership in industries of the future.* https://science.osti.gov/-/media/_/pdf/about/pcast/202006/PCAST_June_2020_Report.pdf?la=en&hash=019A4F17C79FDEE5005C51D3D6CAC81FB31E3ABC

Saldaña, J., & Omasta, M. (2016). *Qualitative research: Analyzing life*. Sage Publications.

Seymour, E., Hunter, A. B., Laursen, S. L., & DeAntoni, T. (2004). Establishing the benefits of research experiences for undergraduates in the sciences: First findings from a three-year study. *Science Education*, *88*(4), 493–534. https://doi.org/10.1002/sce.10131

Simon, R. A., Aulls, M. W., Dedic, H., Hubbard, K., & Hall, N. C. (2015). Exploring student persistence in STEM programs: A motivational model. *Canadian Journal of Education*, *38*(1), 1–27. https://journals.sfu.ca/cje/index.php/cje-rce/article/view/1729

Smith, J. L., Lewis, K. L., Hawthorne, L., & Hodges, S. D. (2013). When trying hard isn't natural: Women's belonging with and motivation for male-dominated STEM fields as a function of effort expenditure concerns. *Personality and Social Psychology Bulletin*, *39*(2), 131–143. https://doi.org/10.1177/0146167212468332

Strauss, A., & Corbin, J. M. (1997). *Grounded theory in practice*. Sage.

Tinto, V. (1975). Dropout from higher education: A theoretical synthesis of recent research. *Review of Educational Research*, *45*(1), 89–125. https://doi.org/10.3102/00346543045001089

Tinto, V. (1997). Classrooms as communities: Exploring the educational character of student persistence. *The Journal of Higher Education*, *68*(6), 599–623. https://doi.org/10.1080/00221546.1997.11779003

Trujillo, G., & Tanner, K. D. (2014). Considering the role of affect in learning: Monitoring students' self-efficacy, sense of belonging, and science identity. *CBE—Life Sciences Education*, *13*(1), 6–15. https://doi.org/10.1187/cbe.13-12-0241

University of North Carolina at Greensboro. (2020). *Racial equity at UNCG.* https://racialequity.uncg.edu

University of North Carolina at Greensboro. (2021). *The history of UNCG*. https://www.uncg.edu/about-uncg/why-uncg/history-of-uncg

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