PURM
Perspectives on Undergraduate Research & Mentoring

CSTEP: Reflections on Undergraduate Research within a Support Program for STEM Students

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Introduction

There has been increasing concern about disparities in science, technology, engineering, and mathematics (STEM) degree attainment across racial and ethnic groups. Improving the success of students of color in STEM fields remains a critical priority, particularly in light of changing demographics, an aging workforce, and intensifying global competition. Although diversity within the U.S. STEM workforce increased between 2011 and 2021, representation among historically underrepresented groups remains disproportionately low: Hispanic (15%), Black (9%), and American Indian and Alaska Native individuals (less than 1%), compared to White individuals (64%) (National Science Foundation [NSF], 2023). Additionally, these underrepresented groups continue to experience lower median earnings relative to their White or Asian counterparts. These persistent disparities highlight not only issues of access, but also challenges related to persistence, belonging, and opportunity within STEM pathways.

These inequities are particularly evident in higher education STEM fields. In 2020, underrepresented minority (URM) students collectively earned only 26.4% of bachelor's degrees, 24.4% of master's degrees, and 16.4% of doctoral degrees in STEM (NSF, 2023), figures that remain misaligned with national population demographics. Disparities in retention further exacerbate this gap, as Black and Latino students are more likely to switch out of STEM majors or leave college prior to degree completion compared to their White peers (Chen, 2009; Riegle-Crumb et al., 2012). For many URM students, these challenges extend beyond academic preparation and reflect broader structural and psychosocial barriers encountered within STEM environments.

The COVID-19 pandemic intensified existing inequities across the educational pipeline. Approximately 41% of high school seniors from historically underrepresented backgrounds reported uncertainty about attending college in Fall 2020 (SimpsonScarborough, 2020). This period underscored the fragility of STEM pathways for URM students and the critical importance of institutional programs that offer continuity, mentorship, and community during periods of disruption.

In response to long standing barriers faced by URM students, federal initiatives such as the McNair Scholars Program and the Louis Stokes Alliance for Minority Participation (LSAMP) have been established to expand access to research opportunities, mentoring, and academic support. Among the most widely cited models is the Meyerhoff Scholars Program, launched in 1988, which reports undergraduate STEM retention rates exceeding 90% (Sto Domingo et al., 2019). These initiatives illustrate how structured, well-resourced programs can meaningfully improve persistence and success among underrepresented students in STEM.

At the state level, New York's Collegiate Science and Technology Entry Program (CSTEP) similarly seeks to increase the number of historically underrepresented and economically disadvantaged students pursuing STEM careers. Through academic support, mentoring, undergraduate research opportunities, financial assistance, and professional development, CSTEP addresses barriers that often limit engagement and persistence in STEM fields. While CSTEP has frequently been described in terms of access and outcomes, less attention has been given to how students themselves experience undergraduate research within the context of such support programs.

Pace University is a private, non-sectarian institution founded in 1906, with approximately 12,800 students enrolled across two campuses. The university has been nationally recognized for its role in promoting upward mobility, ranking first among private, non-profit institutions in *The Chronicle of Higher Education*'s list of colleges with the highest student-mobility rates (Chetty et al., 2017). Experiential learning is a central feature of the university's educational model, with undergraduate research serving as a key component of the "Pace Path." For students participating in CSTEP, undergraduate research represents not only an experiential learning activity, but also a space for mentorship, identity development, and community-building.

Pace University received a CSTEP grant in Fall 2021 to support underrepresented and/or low-income undergraduate students in STEM disciplines, including Biochemistry, Biology, Chemistry, and Forensic Science. Scholars receive financial stipends, participate in weekly enhancement seminars, and engage in mentoring activities designed to support academic and professional development (Mojica et al., 2025). Undergraduate research with a faculty mentor is strongly encouraged, with additional funding provided to support research-related expenses. Within this framework, research is positioned not as an isolated academic requirement, but as one component of a broader support network designed to promote student success.

The value of undergraduate research has been widely documented in STEM education literature. Participation in research can provide students with opportunities to apply classroom knowledge, develop technical and communication skills, and engage more deeply with scientific inquiry (Hathaway et al., 2002; Hunter et al., 2007; Lopatto, 2010). For students from historically underrepresented backgrounds, these experiences may also provide access to mentoring relationships and professional networks that contribute to academic and career development (Eagan et al., 2013; Ghee et al., 2016). Within CSTEP, however, undergraduate research is experienced alongside other forms of support, including financial assistance, professional development programming, peer networks, and academic enrichment activities.

While many studies have examined the outcomes associated with undergraduate research participation, fewer have explored how students experience research when it is embedded within a structured support program. Even less frequently are students positioned as co-authors reflecting on their own experiences alongside faculty mentors. This Dialogue addresses that gap by presenting the perspectives of CSTEP scholars and their faculty mentor on the role of undergraduate research within a broader ecosystem of support. Rather than evaluating CSTEP as a program, the manuscript

highlights how mentoring, community, academic support, and research opportunities collectively influenced students' experiences and engagement in STEM.

Student Information

This Dialogue is co-authored by CSTEP scholars and their faculty mentor to foreground student perspectives on academic development, mentoring, and undergraduate research within the context of a structured STEM support program. Attending to positionality is important because the reflections presented here are shaped by students' educational experiences, backgrounds, and participation in CSTEP, as well as by the institutional environment in which those experiences occurred.

The student authors are current and former participants in the Collegiate Science and Technology Entry Program (CSTEP) at Pace University. They represent a range of STEM disciplines, including Biology, Biochemistry, Chemistry, Environmental Science, and Forensic Science, and reflect diverse academic pathways and career aspirations. Although students entered the program at different stages of their undergraduate careers, all participated in activities designed to support academic achievement, professional growth, and persistence in STEM.

As members of CSTEP, students engaged in a variety of program activities, including mentoring, academic enhancement workshops, professional development seminars, networking opportunities, and experiential learning experiences. Undergraduate research represented one important component of these experiences, but it was situated within a broader framework of support that encouraged students to explore career pathways, build professional skills, and develop connections with faculty, peers, and STEM professionals.

The faculty mentor contributes to this Dialogue from the perspective of both a research mentor and a faculty member involved in supporting CSTEP scholars. This perspective is informed by sustained engagement with students from diverse backgrounds and by experience facilitating opportunities that promote academic success, professional development, and access to STEM pathways. Importantly, the reflections presented in this manuscript emerge from students whose educational journeys were shaped by both opportunities and challenges. Many balanced demanding coursework with employment, family responsibilities, commuting, and other obligations. Participation in CSTEP provided resources, guidance, and a sense of community that helped students navigate these competing demands while remaining engaged in their academic and professional goals.

Rather than serving as an evaluation of CSTEP, this Dialogue presents reflective narratives that illustrate how students experienced mentoring, community, professional development, and undergraduate research within a supportive program environment. These perspectives provide insight into the ways structured support programs can contribute to students' confidence, engagement, and persistence in STEM.

An overview of the student authors' disciplinary backgrounds, academic status, and participation in undergraduate research is provided in Table 1. The reflections that follow center student voices and highlight the role of support systems in shaping educational experiences and opportunities in STEM.

Table 1. Overview of Student Authors Contributing to the Dialogue

Student	Major	Ethnicity	Status
1. Tamara Duval	Forensic Science	African-American	Graduated and in graduate school
2. Daphne Hernandez	Biology	Hispanic	Graduated and working
3. Olaoluwasubomi Johnson	Biochemistry	African-American	Graduated and working
4. Brandon Pedroza Ceron	Forensic Science	Hispanic	Graduated
5. Kayla Lucas	Forensic Science	Hispanic	Graduated
6. Jennifer Molina Salazar	Forensic Science	Hispanic	Senior
7. Tamara Meneses	Forensic Science	Hispanic	Senior
8. Anne Roy	Biochemistry	African-American	Graduated
9. Madison Negron	Chemistry	Hispanic	Senior
10. Tayo C. Dube Falodun	Environmental Science	African-American	Graduated

Student Reflections

Finding Community and Support through CSTEP

As student authors, we have collectively reflected on our experiences as participants in CSTEP, a program that provided academic support, mentoring, professional development, and opportunities to explore STEM beyond the classroom. Although we entered the program with different academic interests, backgrounds, and career aspirations, we shared a common experience of navigating STEM pathways while benefiting from a structured support network designed to promote student success. Prior research has shown that comprehensive support programs can play an important role in promoting persistence and achievement among students from historically underrepresented backgrounds in STEM (Eagan et al., 2013; Sto Domingo et al., 2019).

For many of us, one of the most meaningful aspects of CSTEP was the sense of community it fostered. STEM coursework can be demanding, and students from historically underrepresented and economically disadvantaged backgrounds often encounter challenges that extend beyond the classroom. Through regular meetings, workshops, mentoring activities, and interactions with fellow scholars, CSTEP created an environment where students could share experiences, seek advice, and support one another. These connections helped reduce feelings of isolation and reinforced the idea that we were part of a larger community working toward similar goals. Previous studies have similarly identified belonging and peer support as important contributors to student persistence and engagement in STEM fields (Eagan et al., 2013; Chang et al., 2014).

Participation in CSTEP also provided access to mentors, peers, and professionals who offered guidance at different stages of our academic journeys. Through conversations with faculty mentors, alumni, guest speakers, and fellow students, many of us gained perspectives that extended beyond coursework and helped us better understand potential educational and career pathways. Exposure to individuals who had successfully navigated STEM careers reinforced our confidence and encouraged us to pursue opportunities that we may not have otherwise considered. The importance of mentoring relationships in supporting student development and persistence has been well documented, particularly among students from underrepresented groups in STEM (Chang et al., 2014; Sto Domingo et al., 2019).

The program further contributed to our development by providing structured opportunities for professional growth. Workshops on graduate school preparation, career exploration, scientific communication, and professional skills encouraged us to think more intentionally about our futures. These experiences helped many of us develop a stronger sense of direction and increased our awareness of the diverse pathways available within STEM disciplines. Such opportunities align with broader findings that support programs can enhance students' educational aspirations, career readiness, and professional identity development (Bancroft et al., 2016).

For several students, CSTEP also served as an important source of encouragement during periods of academic uncertainty. Balancing demanding coursework with employment, family responsibilities, commuting, and other obligations often created challenges that tested our persistence. The support provided through CSTEP, both formally through program activities and informally through peer and mentor relationships, helped us navigate these competing demands and remain focused on our long-term goals. Prior studies have similarly highlighted the importance of comprehensive support systems in helping students overcome barriers and remain engaged in STEM pathways (Eagan et al., 2013; Ghee et al., 2016).

Collectively, our reflections suggest that the value of CSTEP extended beyond any single activity or opportunity. The program created a supportive environment that fostered belonging, confidence, and personal growth while helping students build the relationships and skills necessary to succeed in STEM. This foundation often became the starting point from which students pursued additional opportunities, including internships, leadership experiences, conference participation, and undergraduate research.

Accessing Opportunities Through CSTEP

A recurring theme in our reflections was the role CSTEP played in expanding access to opportunities that many of us had not previously considered. Prior to joining the program, several students had limited awareness of the range of academic, professional, and experiential opportunities available within STEM. Through workshops, faculty interactions, guest speakers, and peer discussions, we were introduced to internships, research experiences, graduate and professional school pathways, scientific conferences, and career options across a variety of STEM disciplines.

For many students, these experiences helped transform STEM from a collection of academic courses into a broader professional landscape. Learning about the experiences of faculty members, alumni, and STEM professionals provided valuable insight into the educational and career trajectories available after graduation. Exposure to these pathways encouraged students to think more intentionally about long-term goals and identify opportunities that aligned with their interests and aspirations. Previous studies have shown that structured support programs can enhance students' awareness of educational and career opportunities while strengthening motivation and persistence in STEM (Bancroft et al., 2016; Sto Domingo et al., 2019).

CSTEP also created opportunities for students to engage with the broader scientific community. Through conference attendance, professional development activities, and interactions with visiting speakers, students were able to observe how scientific knowledge is communicated and applied beyond the classroom. These experiences increased our understanding of the collaborative nature of STEM fields and helped us envision ourselves as future participants in these professional communities.

Importantly, exposure to opportunities often reduced the uncertainty and intimidation that can accompany unfamiliar experiences. Activities that initially seemed inaccessible, such as attending a scientific conference, participating in research, or considering graduate school, became more

attainable when students could learn from peers and mentors who had already navigated these pathways. The presence of supportive mentors and role models helped demystify these opportunities and encouraged students to pursue experiences that contributed to their academic and professional growth (Chang et al., 2014).

For many of us, undergraduate research emerged as one of the opportunities made more accessible through CSTEP. Faculty presentations, mentoring relationships, and conversations with fellow scholars helped students better understand the purpose and value of research while reducing apprehension about becoming involved. As a result, undergraduate research became not simply an academic activity, but a pathway through which students could further develop technical skills, professional confidence, and engagement with STEM.

Engaging in Undergraduate Research

Among the opportunities that became available through CSTEP, undergraduate research was one of the most transformative experiences for many students. While some students entered college with a general interest in science, few had prior exposure to authentic scientific research. Participation in undergraduate research provided an opportunity to move beyond structured laboratory exercises and engage directly with the process of scientific inquiry. Through hands-on experiences, students were able to apply concepts learned in coursework to real-world questions, transforming abstract theories into practical understanding.

Research participation exposed students to experimental design, data collection, analytical instrumentation, and data interpretation. Through repeated engagement with these activities, we developed technical competencies while also strengthening critical thinking, problem-solving, creativity, and independence. These experiences align with prior studies demonstrating that undergraduate research contributes to both cognitive and personal development by allowing students to actively participate in the creation of knowledge rather than simply learning established concepts (Hathaway et al., 2002; Hunter et al., 2007).

For many of us, research also provided opportunities to experience the iterative nature of scientific work. Experiments did not always proceed as planned, unexpected results often required reevaluation, and progress frequently depended on persistence and adaptability. While these challenges could be frustrating, they ultimately became valuable learning experiences that taught patience, resilience, and flexibility. Such experiences have been identified as important components of research-based learning and contribute to students' long-term academic and professional growth (Petrella & Jung, 2008; Ghee et al., 2016).

Research participation further strengthened our ability to think independently and approach problems with greater confidence. As students became more involved in their projects, many transitioned from following established procedures to contributing ideas, troubleshooting experiments, and making decisions about data interpretation. This gradual increase in responsibility fostered a sense of ownership and engagement that extended beyond the laboratory. Previous work has shown that undergraduate research can promote the development of scientific identity and self-confidence by allowing students to see themselves as active contributors to scientific inquiry (Hunter et al., 2007; Lopatto, 2010).

An equally important aspect of undergraduate research was the opportunity to work closely with faculty mentors and fellow students. Research environments encouraged collaboration, discussion, and shared problem-solving, reinforcing the understanding that science is a collective endeavor rather than an individual pursuit. These interactions not only supported technical learning but also provided encouragement and guidance during moments of uncertainty. The importance of mentoring

relationships in undergraduate research has been widely documented, particularly for students from historically underrepresented backgrounds in STEM (Shanahan et al., 2015).

Although our projects differed in scope, discipline, and duration, we shared a common recognition that undergraduate research expanded our understanding of science and our place within it. Through research, we gained practical skills, developed confidence in our abilities, and acquired experiences that complemented the academic, professional, and personal support provided through CSTEP. Rather than functioning as an isolated activity, undergraduate research became part of a broader developmental process that helped prepare us for future educational and career opportunities.

Professional Growth and Future Pathways

Beyond the technical skills developed through coursework and research, participation in CSTEP contributed significantly to our professional growth. Through workshops, mentoring relationships, conference participation, and interactions with STEM professionals, we gained experiences that helped prepare us for future academic and career opportunities. These activities encouraged us to think more intentionally about our long-term goals and provided practical tools for pursuing them.

One of the most impactful experiences for many students was the opportunity to present research at institutional, regional, and national conferences. Presenting our work challenged us to communicate complex ideas clearly, respond to questions from diverse audiences, and engage in professional discussions about our research. Although many of us initially approached these presentations with apprehension, repeated opportunities to share our work helped strengthen our confidence and communication skills. Prior research has similarly shown that undergraduate research experiences contribute to students' ability to communicate scientific ideas effectively and develop professional competencies valued across STEM careers (Lopatto, 2010; Petrella & Jung, 2008).

Conference participation also provided exposure to the broader scientific community. Interacting with researchers, students, and professionals from other institutions allowed us to gain a greater appreciation for the diversity of research interests, career pathways, and opportunities available within STEM. For many students, these experiences expanded their professional networks and reinforced aspirations to pursue graduate education, healthcare professions, industry careers, or other STEM-related pathways.

Professional development activities offered through CSTEP further contributed to our growth. Workshops focused on topics such as graduate school preparation, resume development, interviewing skills, and career exploration provided practical knowledge that many students had not previously encountered. These experiences helped bridge the gap between academic preparation and career planning while increasing our confidence in navigating future opportunities. Similar benefits have been reported in studies examining structured support programs designed to promote student success in STEM (Bancroft et al., 2016; Sto Domingo et al., 2019).

Participation in CSTEP also encouraged many of us to view our educational experiences within a broader context. Exposure to faculty mentors, alumni, and STEM professionals demonstrated that career pathways are rarely linear and that success can take many forms. Learning about the diverse experiences of others helped us approach our own futures with greater flexibility and confidence while broadening our understanding of what was possible after graduation.

Collectively, these experiences contributed to a stronger sense of preparedness for the next stages of our academic and professional journeys. Whether pursuing graduate study, professional school, industry positions, or other STEM-related careers, many of us viewed CSTEP as an important source

of support that helped us develop the skills, confidence, and perspectives necessary to navigate future opportunities and challenges.

Collective Reflection and Implications

Reflecting together as CSTEP scholars and faculty mentor, we recognize that our experiences cannot be attributed to any single activity or intervention. While undergraduate research played an important role in our development, its impact was strengthened by the broader network of support provided through CSTEP. Across our collective experiences, mentoring, community-building, professional development, financial assistance, and research opportunities worked together to create an environment that supported student growth and persistence in STEM. Similar findings have been reported in studies demonstrating that multifaceted support programs are particularly effective in promoting success among students from historically underrepresented backgrounds (Eagan et al., 2013; Sto Domingo et al., 2019).

One of the most significant insights emerging from our reflections is the importance of access. Many students enter college with limited awareness of research opportunities, graduate education pathways, professional networks, or STEM careers beyond those immediately visible to them. Programs such as CSTEP can help address these gaps by intentionally connecting students with information, resources, mentors, and experiences that expand their understanding of available opportunities. Our reflections suggest that access involves more than simply making opportunities available; it also requires creating supportive environments that encourage students to participate in them. This observation is consistent with prior research highlighting the importance of structured interventions in broadening participation in STEM (Bancroft et al., 2016; Sto Domingo et al., 2019).

A second theme that emerged from our experiences is the importance of community. Throughout our academic journeys, interactions with peers, faculty mentors, alumni, and STEM professionals provided encouragement, guidance, and reassurance during periods of uncertainty. For many students, participation in a supportive community helped normalize challenges commonly encountered in STEM and reinforced the belief that success was attainable. Previous studies have similarly identified belonging, representation, and peer support as important contributors to persistence and engagement among students from underrepresented groups in STEM (Chang et al., 2014; Eagan et al., 2013).

Our reflections also highlight the value of approaching student development holistically. Academic success is influenced not only by intellectual ability and coursework, but also by financial circumstances, personal responsibilities, access to mentoring, and opportunities for professional growth. CSTEP addressed many of these dimensions simultaneously through academic support, professional development activities, mentoring relationships, and financial assistance. The combined effect of these supports often enabled students to engage more fully in opportunities such as undergraduate research, internships, conference participation, and leadership experiences. Research examining successful STEM support initiatives similarly emphasizes the importance of integrating academic, financial, and social supports to promote student success (Bancroft et al., 2016; Sto Domingo et al., 2019).

Another important observation is that student development often occurs through the interaction of multiple experiences rather than through a single transformative event. Undergraduate research contributed significantly to our growth, but so did mentoring conversations, professional development workshops, peer relationships, and exposure to STEM professionals. These experiences collectively shaped our confidence, aspirations, and understanding of future possibilities. This perspective aligns with studies suggesting that student success is strengthened

when high-impact educational practices are embedded within broader support structures rather than experienced in isolation (Eagan et al., 2013; Ghee et al., 2016).

From an institutional perspective, our reflections point to several considerations for programs designed to support underrepresented and economically disadvantaged students in STEM. First, opportunities should be intentionally communicated and made accessible to students who may be unfamiliar with pathways such as research, graduate school, or professional careers. Second, mentoring should be recognized as a sustained and relational process that extends beyond academic advising (Chang et al., 2014). Third, support structures should acknowledge the realities many students face, including employment obligations, commuting, financial constraints, and family responsibilities. Finally, institutions should create opportunities for students to build meaningful connections with peers, mentors, alumni, and professionals who can provide guidance and encouragement throughout their academic journeys.

Collectively, our experiences suggest that undergraduate research is most impactful when situated within a broader ecosystem of support. Programs such as CSTEP demonstrate how mentoring, community, professional development, financial assistance, and experiential learning can work together to promote student success. Rather than viewing undergraduate research as a stand-alone activity, our reflections highlight the value of embedding research within a comprehensive support structure that helps students access opportunities, navigate challenges, and envision themselves within STEM pathways.

Conclusions

This Dialogue brings together the perspectives of CSTEP scholars and their faculty mentor to reflect on the role of a structured support program in fostering student development, persistence, and engagement in STEM. Across our collective experiences, participation in CSTEP provided access to mentoring, professional development, community, financial support, and experiential learning opportunities that contributed to our academic and personal growth.

As student authors, we recognize that our experiences within CSTEP extended beyond any single activity. While undergraduate research was among the most influential opportunities available to many of us, its impact was strengthened by the broader network of support that surrounded it. Through interactions with mentors, peers, alumni, and STEM professionals, we gained confidence, developed professional skills, expanded our awareness of future pathways, and strengthened our commitment to our educational goals.

Our reflections suggest that support programs can play an important role in helping students navigate the academic, social, and structural challenges that often accompany STEM education. Access to mentoring relationships, professional development activities, financial resources, and supportive peer communities helped many students remain engaged during periods of uncertainty while encouraging participation in opportunities that contributed to long-term growth. These observations are consistent with prior research demonstrating the importance of comprehensive support structures in promoting persistence and success among students from historically underrepresented backgrounds in STEM.

From the faculty mentor's perspective, these reflections reinforce the value of creating educational environments that recognize students as whole individuals whose success is shaped by multiple interconnected factors. Effective support extends beyond academic instruction and includes fostering community, providing encouragement, creating access to opportunities, and helping students envision future possibilities.

Rather than serving as an evaluation of CSTEP, this Dialogue offers student-centered reflections on how participation in a support program shaped educational experiences and opportunities in STEM. By foregrounding the voices of students alongside their faculty mentor, the manuscript highlights the ways in which mentoring, community, professional development, and undergraduate research can work together to support student success.

Collectively, our experiences suggest that undergraduate research is most effective when embedded within a broader ecosystem of support. Programs such as CSTEP demonstrate how intentional investments in mentoring, access, community-building, and student development can help broaden participation in STEM while fostering confidence, resilience, and preparedness for future academic and professional pathways.

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