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Science Identity Development Among Community College Students: A Thematic Analysis of Reflective Blog Posts During a Summer REU

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Introduction

Community colleges serve as a vital entry point to higher education for more than half of undergraduate students in the United States, including a substantial proportion who aspire to pursue degrees in science, technology, engineering, and mathematics (STEM) (Leoni et al., 2023). While many students enroll in community colleges for vocational training, a significant subset enters with the intention of transferring to four-year institutions to earn bachelor's degrees (Hagerdon et al., 2010; Leoni et al., 2023). Among these students, those pursuing STEM pathways are of particular interest due to ongoing national efforts to diversify and expand participation in the STEM workforce (Jelks & Crain, 2020).

Despite the community college's role as a more accessible and affordable gateway to higher education, transfer students' long-term success rates remain low. According to data from the U.S. Department of Education, only 13% of community college students complete a degree at a four-year institution within eight years (McCoy, 2024). These numbers are especially concerning in STEM, a field that often requires advanced degrees and research experience to enter and succeed.

Prior research demonstrates that early undergraduate exposure to research has been shown to significantly influence student success and persistence in STEM, yet community colleges often have limited access to such opportunities (Martin et al., 2020). To address this gap, Rice University developed a Research Experience for Undergraduates (REU) program specifically for community college students in STEM majors. Since its inception in 2009, the program has served 161 participants. Of these, 88% transferred to four-year institutions, 77% earned bachelor's degrees in STEM, and 58% are currently employed in STEM occupations. These outcomes highlight both the program's impact on student success and the ongoing need for such programs to support STEM community college students. Longitudinal follow-up data were obtained through a combination of self-reported updates and publicly available sources, such as LinkedIn, to track participants' educational outcomes and career trajectories.

Building on this context, this study examines how participation in this REU influenced students' science identity formation and is guided by the following question: How do community college students construct and express their science identities during a summer undergraduate research experience?

Theoretical Framework
STEM identity has emerged as a critical construct for understanding student persistence and success in science, technology, engineering, and mathematics fields. Carlone and Johnson, two prominent scholars in STEM identity research, define STEM identity as the ways individuals see themselves, and are seen by others, as fitting in within STEM disciplines. Specifically, STEM identity reflects the ways individuals "make meaning of science experiences and how society structures possible meanings" (Carlone & Johnson, 2007). STEM identity has been shown to have a significant role in individuals' engagement, persistence in educational environments, and long-term career trajectories (Chen & Wei, 2022). Moreover, individuals who develop strong STEM identities are more likely to persist through academic challenges, actively engage in learning, and pursue STEM careers (Chemers et al., 2011). However, STEM identity formation for underrepresented students has been historically hampered by the lack of representation in STEM fields. Without visible role models who share their identity, underrepresented and minority students may struggle to see themselves succeeding in STEM careers, which may negatively impact their persistence and career aspirations.

This study is grounded in Carlone and Johnson's (2007) Science Identity Framework, which posits that science identity develops along three dimensions: competence, performance, and recognition. This framework highlights that becoming a scientist requires both skill and a sense of belonging in the scientific community. Within this framework, performance refers to the enactment of socially recognized scientific practices, such as participating in research-related tasks or communicating about science. Competence is defined as the knowledge or understanding of STEM content in a way that is less publicly visible than performance. Recognition involves both self-recognition and recognition by others as a "STEM person," or a legitimate member of the scientific community. According to the model, individuals with strong STEM identities are more likely to perceive themselves as competent and be recognized by others as competent. Importantly, Carlone and Johnson's framework also acknowledges that personal identities, such as race, ethnicity, and gender, shape how students navigate scientific spaces, thereby affecting STEM identity development. While examining the intersection of personal identities and STEM identity is beyond the scope of this paper, it is important to acknowledge that these intersections play a critical role in how students develop their STEM identities.

Methods

Research Design

This study employed a qualitative, longitudinal research design to examine how community college students developed and expressed their science identities over the course of a ten-week Research Experience for Undergraduates (REU) program. The analysis was informed by Carlone and Johnson's Science Identity Framework, which conceptualizes identity development through the dimensions of competence, performance, and recognition.

Program Overview

The data for this study were drawn from a Research Experience for Undergraduates (REU) program hosted annually by a major research university in Texas. The program centers on research in nanotechnology and electrochemical devices to address challenges related to climate change, energy production, and environmental sustainability. Each summer, the program selects, on average, 8 to 12 students from local community colleges to participate in a 10-week, full-time research internship. Each student is placed in a research lab and matched with a graduate mentor and faculty advisor who guide their work throughout the program. In addition to engaging in hands-on laboratory research, participants receive sustained mentorship, attend professional development workshops, and present their findings at a formal research symposium.

Data Collection

Data for this study consisted of weekly blog posts written by seven student participants over the ten-week program, totaling 70 posts collected between May 2025 and August 2025. Blog posts were submitted at the end of each work week and ranged in length from a short paragraph to approximately half a page of freely written text. It is important to note that no prompts or guiding questions were provided. Students were encouraged only to reflect broadly on their experiences during the program. This open-ended format allowed participants to highlight the aspects of their experiences that they found most relevant, providing insight into how they made meaning of their research participation and identity development over time. Considering the use of these digital tools, technology provides many advantages in supporting URE reflection and career readiness. Technology provides the scalability needed to reach many students (Ma et al., 2024). With asynchronous and multimodal options, technology can be accessible to more individuals. Additionally, technology has the potential to be personalized to an individual with tailored prompts, adaptive content, and customization of how information is shared. Finally, as mentors' training, expectations, and availability vary, technology used for URE reflection could support students who do not have readily available access to mentors to discuss career readiness competencies (Limeri et al., 2019). With an available technology that could support all undergraduate researchers, those with absent mentors or those with dissimilar personalities or communication preferences can receive some guidance on the value of their UREs.

Data Analysis

First, all blog posts were organized by week and participant, and student identities were anonymized using participant labels S1 through S7. The full dataset was then read in its entirety to gain familiarity with the content and with each student's narrative voice. Following this initial familiarization, a more detailed and critical re-reading of each blog post was conducted. Blog entries were analyzed line by line, with particular attention to instances in which students described experiences related to competence, performance, and recognition. During this phase, segments of text with similar meanings were grouped to develop provisional codes and themes. Next, these codes were iteratively refined through repeated readings of the data. Throughout this process, Carlone and Johnson's framework was used to deductively guide the analysis, and modifications were made until additional revisions no longer contributed meaningfully to the analysis.

Results

Overview of Coding and Themes

This study employs Carlone and Johnson's STEM identity framework to examine how participation in a 10-week REU shapes students' developing identities as STEM researchers. Weekly reflective blog posts provide longitudinal insight into students' perceptions of competence, performance, and recognition as they engage in authentic research practices. Themes were organized deductively according to the three dimensions of STEM identity proposed by Carlone and Johnson. Table 1 lists the codes used to operationalize each identity dimension, along with examples drawn from the blog posts.

Table 1. *STEM Identity Dimension Definitions and Sample Codes Themes*

Identity Dimension	*Definition*	*Codes*	*Examples in the context of blog posts*
Competence	Knowledge and understanding of science content	Skill acquisition, problem-solving Conceptual understanding	Student describing learning concepts, methods, or how to use tools

Performance	Social performances of relevant scientific practices (ex: ways of speaking and using tools)	Research practices Communication of science Project ownership Professional behaviors	Student discusses doing research tasks Student explains or presents work
Recognition	Recognizing oneself and getting recognized by others as a “science person.”	Mentor recognition Peer recognition Self-recognition Institutional recognitions (encouragement from program administrators)	Mentors praise or acknowledge students Peers acknowledge students Students explicitly identify as a scientist or researcher

Longitudinal Patterns of STEM Identity Development

Over the ten-week program, most students’ blog post narratives shifted from describing themselves as observers to active and confident participants in scientific work. As shown in Table 2, the themes related to students’ transitions aligned with the three dimensions of the science identity framework: competence, performance, and recognition. In competence, students progressed from gaining basic laboratory skills to expressing confidence in scientific abilities. In performance, early posts focused on following instructions, while later entries reflected greater initiative and ownership of research projects. Within recognition, students moved from feeling like outside observers to seeing themselves as capable contributors, especially after receiving acknowledgment from their mentors. The interaction of these dimensions strengthened students’ sense of belonging and inspired enthusiasm for future careers in STEM.

Table 2. *Longitudinal Progression of STEM Identity Dimensions*

Time	*Competence*	*Performance*	*Recognition*
Week 1-3	• Learning disciplinary vocabulary • Understanding the theory behind experiments • Productive struggle with new concepts	• Hands-on lab exposure • Asking research questions • Observing experiments	• Mentor encouragement • Feeling welcomed in the lab • Peer assurance
Week 4-7	• Interpreting data trends • Explaining experimental constraints • Understanding research limitations	• Running experiments independently • Data analysis	• Contributing to lab decisions • Publication opportunities • Sense of belonging in the lab
Week 8-10	• Reflection on personal growth • Articulating skill development	• Presenting research at a research symposium • Professional lab practices	• Belonging in scientific communities • Self-recognition of scientific work

Early Program, Weeks 1-3

During the first three weeks of the REU program, students primarily constructed their STEM identities through recognition and belonging, rather than through demonstrated mastery of STEM content.

Across the dataset, mentors, lab members, and program administrators played a critical role in legitimizing students as emerging researchers. Weekly cohort meetings with program administrators also provided a supportive space for students to reflect on their experiences outside the laboratory, allowing them to hear peers discuss similar struggles and uncertainties. This normalization of difficulty reassured students that challenges were an expected part of the research process.

At this stage, competence was largely characterized by observation and guided participation. Students focused on understanding theoretical concepts and developing familiarity with disciplinary language. For example, S1 wrote, *"I spent a lot of time in meetings and got to see some of the people who have already been doing research for months present their work."* Similarly, S7 noted, *"To integrate me into the group, they have guided me through their personal research experiments while going into detail about what they are doing."*

Performance during this phase was limited to early engagement behaviors such as observing experiments, asking questions, and participating in discussions. Meanwhile, recognition came primarily from mentors and peers who affirmed students' roles within the research environment. These findings highlight the importance of early recognition in building students' confidence and helping them envision themselves as capable contributors before engaging independently in research.

Mid-Program, Weeks 4-7

By the midpoint of the REU, students no longer relied solely on recognition to feel confident within STEM spaces. Instead, recognition increasingly emerged through demonstrated competence and performance.

Competence evolved from basic understanding to deeper conceptual knowledge, including interpreting data and understanding experimental design. Students demonstrated increased ownership of their projects and greater confidence in their abilities. For example, S5 reflected, *"I was really proud to have some in-depth discussions regarding my project with my mentor. I realized I was understanding the concepts very well."*

At the same time, performance shifted significantly. Students moved from observing experiments to conducting them independently and contributing meaningfully to lab work. S7 described this transition: *"I am operating almost fully independently in the lab, which grants me the luxury of working at my own rhythm."*

As a result of these developments, recognition became more internalized and performance-based, as students began to be acknowledged for their active participation and growing expertise. This period marked a clear transition from observers to active engagement in scientific work.

End of Program, Weeks 8-10

By the final weeks of the program, students expressed STEM identities that were characterized by confidence, autonomy, and a future path in STEM education and careers. Participants reflected on their growth as researchers. As S1 wrote, *"I have not only grown a lot compared to how I was at the beginning, but now I know more about what I need to work on."*

At this stage, competence was reflected in students' ability to articulate their learning, evaluate their progress, and identify areas for continued development.

Performance culminated in students' ability to communicate their research findings, particularly through the final poster presentation. Presenting their work at a research symposium attended by peers and faculty served as a key milestone in their development.

Recognition became more internalized and community-oriented. Students increasingly saw themselves as legitimate members of the scientific community. For many, the final poster session was a pivotal experience in solidifying this identity. As S3 shared, *"This REU has definitely made an impact on me, and I'll carry everything I've learned into whatever comes next."*

Overall, students began to view research as approachable and attainable, reflecting a shift from uncertainty to confidence in their ability to participate in STEM.

Discussion

The results suggest that the REU program effectively supported students' development as scientists by fostering confidence, a sense of belonging, and engagement in research. In particular, mentor recognition and opportunities for authentic research experiences were influential in students' growing confidence and sense of belonging in science. Community college students bring strong potential to STEM, and programs like this provide formative research experiences that nurture their science identities and support continued persistence in the field.

The findings in this study were important in showing that the dimensions of competence, performance, and recognition did not necessarily develop at the same time. Rather, during the early stages of the REU, recognition emerged as the primary driver of students' willingness and confidence to enter STEM spaces. Welcoming mentors who actively integrated students into their laboratories, along with program administrators who provided safe spaces for reflection and discussion, were instrumental in validating students as legitimate participants in research. This early recognition functioned as a gateway, enabling students to begin engaging meaningfully in scientific work. These findings suggest that recognition is not merely an outcome of competence and performance, but a foundational condition that allows those dimensions to emerge over time.

As students progressed into the middle stage of the program, competence and performance became more visible and mutually reinforcing. Students described gaining technical skills, interpreting data, and taking increasing ownership of their projects. Notably, this independence did not occur abruptly but developed gradually through sustained mentor support. These findings underscore the importance of mentorship models that emphasize progressive autonomy, rather than expecting students, particularly those with limited prior research exposure, to operate independently early in the experience.

In the final stage of the REU, the poster presentation served as more than a culminating academic requirement. For many students, it represented a critical milestone in the formation of STEM identity. Publicly presenting their work allowed students to experience formal recognition from a broader scientific audience and to internalize their identities as capable researchers. Students' reflections emphasized both confidence in their technical mastery and pride in their ability to communicate scientific ideas. These findings highlight that REU programs are not solely for introducing research methods but can also serve as powerful identity-building experiences.

Across blog posts, students consistently emphasized the importance of lab culture, relationships, and mentorship as much as they mentioned technical skill development. This aligns closely with Carlone and Johnson's framework, which conceptualizes STEM identity as rooted not only in competence, but also in cultural belonging. Such experiences may be especially impactful for students who have been historically excluded from STEM spaces, who often enter research environments without prior access to scientific capital or role models.

Conclusion

The REU program, designed exclusively for community college students, had a clear impact on students' development of their science identity. Hands-on research experiences and supportive mentorship helped students grow more confident in science, develop a sense of belonging in research, and become excited about future careers in STEM. Continued support for programs like this is vital to expanding access to STEM pathways for community college students. Future research should further explore how students' personal identities, including race, gender, and first-generation status, interact with research experiences to shape STEM identity development. Understanding these intersections will be critical for designing research programs that are not only effective but also equitable and inclusive.

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