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COMMUNITY COLLEGE S-STEM PROGRAMS: A SYSTEMIC LITERATURE REVIEW

DR. MARIA LUZ ESPINO
EDUCATION AND EMPLOYMENT RESEARCH CENTER
RUTGERS, STATE UNIVERSITY OF NEW JERSEY

DR. ELIZABETH MEZA
UNIVERSITY OF WASHINGTON

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Maria Luz Espino, Rutgers University

Elizabeth Meza, University of Washington

Abstract

Community colleges play a central role in expanding access to STEM education for low-income, first-generation, and racially minoritized students, yet practitioners often lack a clear synthesis of what is known about NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) programs in community college settings. This systematic literature review examines 36 peer-reviewed studies published between 2013 and 2023 that focus on S-STEM programs involving community colleges. We analyze the research landscape across five practice-relevant dimensions: publication outlets, institutional settings, methodological approaches, theoretical frameworks, and the types of student supports implemented through S-STEM funding. The findings show that most published research appears in conference proceedings and frequently centers on four-year institutions partnering with community colleges rather than on community college-led programs. Across studies, S-STEM programs most commonly emphasize faculty and peer mentoring, cohort-building, career development, and academic support activities. However, relatively few studies report student outcomes such as retention, completion, or transfer, and fewer than half explicitly link program design to established theories of student success. For practitioners, these patterns reflect structural and resource constraints rather than shortcomings in program design. This review highlights common S-STEM practices, identifies gaps in the evidence base, and points to opportunities for strengthening documentation, evaluation, and research capacity to better support continuous improvement of community college S-STEM programs.

Keywords: Community College, Systematic literature review, S-STEM Programs, Broadening Participation, Research Methods

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Community College S-STEM Programs: A Systematic Literature Review

It is a national priority to broaden the pathway to Science, Technology, Engineering, and Mathematics (STEM) credentials and careers (National Science Foundation, n.d.). Community colleges hold the potential for diversifying the pathway into STEM because they serve a large proportion of the academically talented, low-income, first-generation, and racially minoritized students traditionally underrepresented in STEM fields (Bahr et al., 2022; Van Noy & Zeidenberg, 2014).

However, low-income students are less likely to enter STEM programs in community colleges or to transfer to STEM fields than higher-income students (Zhang et al., 2021). A frustratingly large fraction of community college students who complete STEM courses leave college without any postsecondary credential (Bahr et al., 2022) and Black, Latinx, and Native American students are underrepresented in all transfer-level STEM courses in community colleges (Bahr, et al., 2017). Moreover, students who start at community colleges often encounter financial and structural challenges that make it difficult to complete STEM programs and reach their goals (Bahr et al., 2017; Wang, 2020).

S-STEM promotes the participation and success of low-income, academically talented STEM students at community colleges through scholarships, supplemented by institutional supports. S-STEM aims to improve student outcomes such as retention, graduation rates, and academic achievement in STEM fields in and outside of the classroom (National Science Foundation, 2021; Rodriguez et al., 2021). There were 651 active S-STEM awards in early 2024 (NSF, 2024). About 100 (15%) of these awards were granted primarily to community colleges. These grants range from 30,000 to five million dollars (NSF, 2024). However, single-institution grants, the types most likely to be managed by community colleges, are capped at two million

dollars (NSF, 2024). Given the significant investment in community colleges and their continued role as key pathways for underserved STEM students, a comprehensive examination of S-STEM programs is essential to better understand how these programs contribute to effectively serving and retaining community college STEM students.

Despite this substantial investment, we lack a comprehensive understanding of what research has been conducted on S-STEM programs in community colleges, how this research has been conducted, and what gaps exist in our knowledge base. Before we can assess program effectiveness or scale successful interventions, we must first understand the state of the research itself—its scope, methods, theoretical foundations, and limitations. *The research problem addressed in this paper is that there is a gap in research and knowledge about one of the largest investments in the quest for broadening STEM pathways, the National Science Foundation (NSF) Scholarships for Science, Technology, Engineering, and Mathematics Program (S-STEM), especially S-STEM programs situated in community colleges.*

Study Purpose & Research Questions

This systematic literature review aims to understand the current research landscape on S-STEM programs operating in community colleges by mapping the existing literature and examining how scholars have approached studying these programs. By analyzing publication patterns, research settings, methodological approaches, theoretical frameworks, and program activities, we provide scholars and practitioners with a comprehensive overview of the evidence base and identify critical gaps that must be addressed to strengthen future research. With this goal, the research questions are:

1. What is known about S-STEM programs and programming involving community colleges through peer-reviewed research?
2. What are the characteristics of the existing research base in terms of publication outlets, research settings, methodological approaches, and theoretical frameworks?
3. What types of programmatic activities and supports have been implemented and studied in community college S-STEM programs?
4. Where are the gaps in the research base that limit our understanding of S-STEM program effectiveness in community colleges?

This paper provides a systematic analysis of the research landscape. A companion paper examines the substantive themes that emerge from this body of research regarding student experiences and program impacts.

Methods

The systematic literature review is a rigorous method to document and synthesize the results of research (Baumeister, 2013; Baumeister & Leary, 1997) that utilizes precise methods to identify, evaluate, and synthesize studies addressing a focused topic (Newman & Gough, 2020). In this case, we searched for published peer-reviewed journal articles, book chapters, and conference proceedings regarding S-STEM scholarship programs in the community college setting.

Systematic Literature Search Strategy

The research team followed search guidelines for five databases to examine peer-reviewed literature on S-STEM programs in community colleges (Torres-Carrion et al., 2018).

The databases we searched for this study included ProQuest, Compendex, EBSCOHost, PsychInfo, and Association for the Study of Engineering Education (ASEE) Conference Repository (ASEE peer document repository). In addition to these five databases, the team searched prominent community college journals: *Community College Review* (CCR), *Community College Journal of Research and Practice* (CCJRP), *New Directions for Community Colleges* (NDCC), and the *Journal of Applied Research in the Community College* (JARCC) to ensure inclusion of all relevant material.

Inclusion and Exclusion Criteria

Through this search strategy, the research team bound the study with intentional inclusion and exclusion criteria. These criteria included:

1. The study was published between 2013 and 2023.
2. The study was peer-reviewed.
3. The study appeared in a published article, book chapter, or paper appearing in conference proceedings.
4. The study was available in full-text, written in English.
5. The study was about an awarded S-STEM scholarship program in a community college or involving a community college.

The team bound the systematic literature review with selection criteria to ensure that the current literature included relevant topical areas rather than relying on the researchers' familiarity or agreement with the available scholarship. Exclusion criteria were identified to outline how researchers eliminated studies from consideration and defined the purpose of the review. We excluded literature that did not fit our criteria, for example, studies that were published in 2012,

the year prior to the first year of publication we were pursuing, or were published on a college website or through an evaluation firm but not in a peer-reviewed setting. We also excluded published posters and PowerPoint presentation slides that were presented at conferences, focusing instead on studies, book chapters, and conference proceedings.

Study Identification

The research team began with the ASEE conference repository "*ASEE peer document repository*," which searches peer-reviewed conference papers. We used the search terms "NSF" + "community college" + "S-STEM." In this search 143 entries were returned, 68 were posters and did not meet our criteria. Out of the 75 that were left, 27 ASEE peer document repository conference proceedings met our criteria.

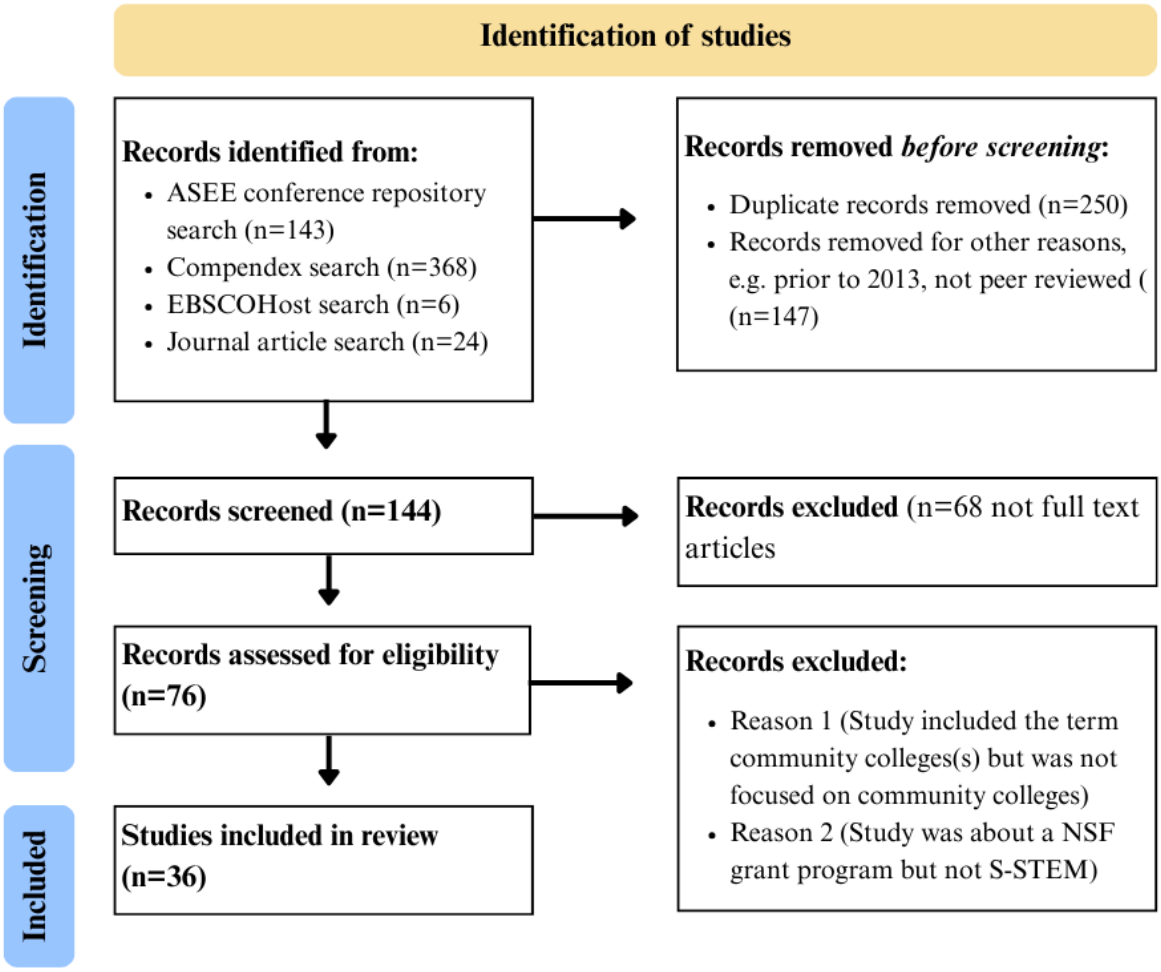
Compendex was screened for "NSF and Community Colleges" which resulted in 237 studies. The second search, "S-STEM and Community Colleges," resulted in 81 studies. To further analyze the results, "S-STEM and Community Colleges" produced 40 relevant studies, and "NSF and Community Colleges" yielded 10 more non-duplicated studies. The total number of studies yielded in Compendex searching was 368. EBSCOhost was also searched, and six studies emerged under the two search terms "S-STEM and community college" or "NSF and community colleges;" all but one was a duplicate record, meaning the piece was already identified in the other search engines. PsychInfo search yielded no new results.

Similarly, the research team searched Community College Review, Community College Journal of Research and Practice, Journal of Applied Research in the Community College (JARCC) and New Directions for Community Colleges with both "NSF and Community Colleges" and "S-STEM and Community Colleges." "S-STEM and Community Colleges"

resulted in zero results, meaning no studies found, in all three journals. For the "NSF and Community Colleges" search, Community College Journal of Research and Practice resulted in 6 studies, Community College Review in 4 studies, and New Directions for Community Colleges in 14 studies.

At the end of these searches, we compared all results from all searches for duplicates and others that did not meet our set criteria, for example, those written about another NSF program. After removing duplicates and screening studies against our inclusion and exclusion criteria, 36 studies emerged as the final number of studies, papers, conference proceedings, and book chapters that met the criteria. Figure 1 provides a brief visual of the various searches that yielded results.

Figure 1. *Literature Identification*



Data Analysis

As the research team used the systematic literature review strategy, we created a management tool to track the information. A Google form and corresponding excel sheet, "Systematic Review Article Tracker," was developed to maintain the search terms to find each document, the authors and year, full citation, theoretical framework, research method, and key findings/themes from each study. At least two researchers read the final 36 studies to develop a shared understanding from each article and analyze the data to form the findings. In order to

have inter-rater reliability, we each coded the articles and met to ensure we agreed with the findings. After the researchers completed the "Systematic Review Article Tracker," we met weekly to discuss the findings that emerged, while discussing any differences in interpretation and major findings.

We analyzed the included studies across six dimensions:

1. Publication outlet
2. Research setting
3. Methodological approach
4. Theoretical framework
5. Co and extra-curricular supports, or activities developed or enhanced with grant funds
6. Themes present in studies

This paper focuses on dimensions 1-5, which characterize the research landscape and methodological foundations of S-STEM scholarship in community colleges. The thematic analysis (dimension 6) is presented in a companion paper that examines substantive findings about student experiences and program impacts.

The reporting of this systematic review was guided by the standards of the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) Statement which guides researchers in describing methods and results of systematic reviews in sufficient detail to allow users to assess the trustworthiness and applicability of the review findings (Page et al., 2021).

Limitations

This review is not without limitations. In any review of the literature, search inclusion and exclusion criteria as well as search terms can expand and restrict the final pool of included literature and therefore plays a strong role in the content and validity of the results. For this review, we made a number of intentional decisions in regard to inclusion and exclusion criteria in order to strengthen the validity of our conclusions. First, the S-STEM program underwent significant changes to the solicitation in 2013, meaning programs before this date may have looked significantly different than those of today, we therefore bound the earliest inclusion date to 2013. Second, while posters, evaluation reports, PowerPoint presentations and other material turned up in our search, we excluded these materials because we were not confident in a systematic way to identify all such materials. In addition, their contents and usefulness to understanding STEM in community colleges varied greatly. To ensure the integrity of our systematic review and the quality of scholarship that peer review provides we limit this review to only those studies, book chapters, and conference proceedings that have been through a peer-review process. We recognize that these exclusion criteria may have eliminated some studies that are completed but not yet full-text, peer-reviewed or otherwise published in a formal venue.

Additionally, our search was limited to English-language publications, which may have excluded relevant international scholarship. The focus on peer-reviewed materials, while ensuring quality, may have missed important evaluation reports and grey literature that contain valuable insights about S-STEM program implementation and outcomes. Finally, the rapidly evolving nature of S-STEM programs means that recent innovations and approaches may not yet be reflected in the published literature due to publication lag times.

Findings

Below we present our findings from five dimensions analyzed in each of the included studies: publication outlets, research settings, methodological approaches, theoretical frameworks, and programmatic activities and supports.

Publication Outlets

The large majority of the peer-reviewed studies about S-STEM in community colleges were ASEE conference proceedings. As shown in Table 1, of the 36 papers we found, 27 (75%) of them were ASEE conference papers describing local S-STEM grant programs. Three additional papers were published at the *Special Interest Group for Computer Science Education* (SIGCSE), *the International Conference for Computer Science and Computer Intelligence* (CSCI) and the *Association of Information Technology Professional Annual Conference*. Three studies were published by the *Community College Journal of Research and Practice*, one in *Community College Review*, one in the *Journal of Biomedical Engineering*, and one in *Educational Policy Analysis Archives*.

Table 1. *Publication Outlet*

Publication Outlet	**Number of Studies**
Association for the Study of Engineering Education (ASEE) Conference Proceedings	27
Other conference proceedings	3
Community College Journal of Research and Practice	3
Community College Review	1

Research Settings

Despite searching specifically for S-STEM programs involving community colleges, fifteen (41%) of the studies identified were primarily researched at a four-year institution but were included because they had a partnership with a community college as an aspect of their grant program. Many of these studies reported conducting outreach by universities to community colleges or providing scholarships to community college students who matriculated to a university STEM program and formally supporting community college students who had already transferred to their institutions. The following most common setting was a single community college; we found nine (24%) studies where a single community college was the research setting. Five (14%) papers were set in a consortium of community colleges or multiple campuses of the same institution with different campus locations. Four (13%) papers were set at a group of community colleges with one four-year university partner. Two (5%) papers focused on the partnership between a single community college and a four-year university, and one (3%) paper included multiple community colleges and multiple four-year receiving institutions in their research.

Table 2. *Research Settings*

Research Setting	**Frequency**	**Percentage**
A single four-year college or university	15	41%
A single community college	9	24%
A community college consortium	5	14%
1 four-year institution and a group of community colleges	4	13%
1 community college and 1 four-year partnership	2	5%
Multiple community colleges and four-year institutions	1	3%

Methodological Approaches

The studies included in this review represent a variety of different methodological approaches, though with notable patterns and limitations. Twelve (33%) were descriptive in nature, detailing the program's activities without formal data collection or analysis beyond program participation numbers. These studies typically described the structure of the S-STEM program, the types of activities offered, and sometimes provided enrollment or completion data. The next eight (22%) were quantitative student surveys that provided insight into the program's purpose, activities, and student perceptions of the program. Descriptive statistics and correlation analysis were frequently employed to examine relationships between program participation and perceived outcomes. However, most of these studies relied on convenience samples, lacked comparison groups, and did not employ more sophisticated statistical techniques that could help establish causal relationships or control for confounding variables. Six (16.6%) studies were qualitative in nature. These six studies focused on understanding the programs, the student population served and their needs and provided student interview or focus group data. The six

qualitative studies utilized semi-structured interviews and focus groups, analyzing themes related to student engagement, perceptions of support systems, and barriers to success. While these studies provided rich, detailed information about student experiences, most were limited to single institutions and small sample sizes, limiting transferability. Moreover, there were five (13.8%) that were mixed methods. In general, the mixed methods studies presented a theoretical underpinning to explore defined research questions characterized by semi-structured interviews and descriptive data analysis. These studies typically combined quantitative survey data with qualitative interviews to provide both breadth and depth of understanding. Lastly, there were four (11.1%) that we could not categorize due to the lack of information provided in the studies. These four articles did not have methods sections or described how the study was conducted, hence were not included in other method areas.

Theoretical Frameworks

The majority of the scholarship included came from the ASEE conference papers, most of which did not mention theoretical or conceptual foundations for the study or a theory of change for their program supports or activities. However, most of these studies did include a discussion of the S-STEM grant mission and principles of broadening participation and access for low-income students. For example, in an article titled "Fostering Technology Student Success through Community Building and Financial Support," LeMire (2015) discusses the importance of faculty mentors and required workshops on academic and career topics on student retention and career readiness for students at a single community college.

The 13 studies that did use theoretical or conceptual frameworks employed a range of frameworks including cultural and social capital (Bourdieu, 1986), self-efficacy (Bandura, 1986), situated learning (Lave & Wenger, 1991), transformative learning (Meizrow, 1991), to name a

few (reference Table 3). As an example, in the conference paper Supporting STEM Transfer Students, Duis et al., (2016) describe a semi-residential learning community comprising peer mentors, faculty/staff mentors, and academic coaching. The model is based on student development theories as described by Tinto (1993) and also references social capital as theorized by Bourdieu (1986). We provide a detailed crosswalk between articles that included a theoretical framework and the framework used in Table 4.

Table 3. *Theoretical Frameworks that Emerged*

Communities of Practice (Wenger, 1998)	Cultural and Social Capital (Bourdieu, 1986)
Departure (Tinto, 1993)	Role Identity Theory (Stryker & Burke, 2000)
Identity Theory (Burke & Stets, 2009)	Sense of Community (McMillian & Chavis, 1986)
Self-Efficacy (Bandura, 1986)	Social Cognitive Theory (Lent et al., 1994)
Situated Learning (Lave, 1990)	Critical Race Theory (Solorzano, 1997, 1998)
Student Integration Model (Nora, 2002)	Transition Theory (Schlossberg, 1981)
Transformative Learning (Meizrow, 1991)	Person-In-Environment (Hutchinson, 2016)

The theoretical frameworks that were employed cluster around several key areas. Many emphasize the importance of STEM identity, and social and academic integration and community within S-STEM programs (e.g., Departure, Role Identity, Identity, Sense of Community, Communities of Practice). Cultural and social capital theories were used to understand how students' social networks and cultural backgrounds influence their educational success, particularly for underrepresented students. Self-efficacy and social cognitive theories focused on students' beliefs about their capabilities and how these beliefs, along with environmental support, shape educational and career decisions.

A few studies employed critical perspectives, particularly Critical Race Theory (CRT), to examine how race and power dynamics affect educational outcomes and to design interventions that address systemic inequalities. Others used transition and integration theories to understand the challenges students face when entering STEM programs or transferring to four-year institutions.

Grant Co-Curricular and Extra-Curricular Supports and Activities

Each campus or consortium of campuses awarded an S-STEM grant creates their own program and, therefore, emphasizes different approaches to activities and curricular and co-curricular support. The breadth and depth of different program supports reflect the unique needs of the campus where the S-STEM grant was set. Each of these types of activities are intended to contribute to community college student success as they navigate STEM pathways through the community college and on to future goals.

We identified 26 different approaches that colleges took in their development of S-STEM programming in the studies we reviewed. These activities can be organized into four main categories:

1. Advising and Mentoring Activities (most common).

The most prevalent programmatic activities were related to advising, college student success and transfer preparedness. Faculty mentoring was the most frequently reported activity (appearing in 16 of 36 studies), followed by peer mentoring (14 studies). Other advising-related activities included STEM-focused advising/academic counseling (4 studies), college transition courses (1 study), and personal financial aid advising (1 study).

2. Career Development Activities.

Career exploration or development activities such as workshops were reported in 13 studies and often included information on transfer or even graduate school. Undergraduate research opportunities appeared in 9 studies, internship opportunities in 9 studies, industry mentors in 2 studies, and research mentors in 1 study. Conference travel opportunities were mentioned in 6 studies, and after-transfer workshops in 1 study.

3. Academic Support Activities.

Activities meant to bolster the academic performance of students included tutoring (5 studies), academic success and professional development courses or required workshop series (2 studies), summer bridge programs (2 studies), supplemental instruction courses (1 study), and curriculum redesign (1 study).

4. Community-Building Activities.

Social and community-building activities were also emphasized. Intentional cohort building was mentioned in 12 studies, social events in 4 studies, living learning communities in 3 studies, networking opportunities in 3 studies, field trips in 2 studies, Discord or WhatsApp channels in 2 studies, guest speakers in 1 study, and faculty research presentations in 1 study.

Table 4. *S-STEM Supported Activities*

S-STEM Activity	Number of studies (of 36)	S-STEM Activity	Number of studies
Faculty mentoring/advising	16	Academic Success and Professional Development Course or required workshop series	2
Peer mentors	14	Discord or WhatsApp Channel	2
Career exploration or preparation workshops	13	Industry Mentors	2
Intentional cohort building	12	Summer Bridge program	2
Research opportunities	9	Field trips	2
Internship opportunities	9	Research mentors	1
Conference travel	6	Guest speakers	1
Tutoring	5	Faculty research presentations	1
STEM focused Advising/academic counseling	4	College transition course	1
Social events	4	Supplemental instruction courses	1
Living Learning Community	3	Personal financial aid advising	1
Networking opportunities	3	After-transfer workshops	1
Transfer preparation workshops	2	Curriculum redesign	1

The dominance of mentoring and advising activities (faculty mentoring in 16 studies, peer mentoring in 14 studies) suggests a strong practitioner belief in the importance of personal

relationships and guidance. Similarly, the prevalence of cohort-building activities (12 studies) and career development workshops (13 studies) indicates common programmatic priorities. However, the research base provides limited evidence about **how** these activities should be structured, what intensity or duration is optimal, or how they interact with other program components.

Implications & Discussion

Practice

Researchers have long suggested that the research-to-practice exchange of information needs to be tightened. Our results suggest this is still an issue and that theories developed by scholars based on existing research may not be making their way to the field as an underpinning of programs that serve students and aim to broaden participation. If these studies used intentional frameworks to develop curricular and co-curricular programming, this could enhance and demonstrate how to understand student experiences and implementation of programs in community college S-STEM programs in relation to theory to continue to build understanding and scale of successful programmatic activities. For example, we found that sense of belonging and STEM identity theories emerged as two theoretical underpinnings with particular significance to informing practice and building interventions that appeared significant for student success. Sense of Belonging emphasizes that students are more likely to succeed when they feel accepted and supported within their academic community.

Research

There is a need to expand research that focuses on NSF S-STEM programs in community colleges, the various implementation methods, and particularly how this unique grant funding operates and supports students in community colleges, including integrating CTE students as opposed to STEM transfer pathways. With the increasing focus and recognition of community colleges as a critical pathway into STEM careers, there is little research that has incorporated S-STEM programs and community colleges. Given that these programs focus on financially needy students, the lack of research on this critical group of students, low-income STEM students in community college is disappointing. The overall dearth of a robust grouping of studies connecting these topics emphasizes the need to more fully understand and explore S-STEM community college recipients and the tools and resources that they provide their students.

Unfortunately, we were largely unable to answer research question three regarding the influence of S-STEM programs on student outcomes such as retention because very few of the studies we reviewed included outcomes information. The lack of outcomes data in many studies may be due to the early stages of many S-STEM programs, which do not yet have longitudinal data on retention or graduation. Additionally, institutional barriers to data sharing or the complexity and different metrics used to measure "success" in community colleges may have contributed to this gap. Furthermore, it is important to note that research conducted within community colleges is often underreported in peer-reviewed journals. The challenges faced by community college scholars, such as limited resources, competing institutional priorities, and a lack of research infrastructure, can lead to their work being overlooked or underrepresented in the broader academic conversation. It's important to note that NSF funds a wide variety of educational and research projects, and many of these might produce valuable resources such as

evaluation reports. However, these are not necessarily all gathered into one central, easily searchable repository, such as the Department of Labor's Skills Commons. This underreporting limits the extent to which community colleges are able to contribute their valuable perspectives and findings on S-STEM programs.

While we set out to learn as much as we could about S-STEM in community colleges, the majority of the studies we found were set in four-year institutions that were aiming to recruit community college students or in collaboration with a community college. These topics are undoubtedly important, but there is a need to bolster research that occurs on community college campuses and is conducted primarily by and about community college students. Previous literature has provided insight into the successes and challenges that community colleges have with college success of STEM students (Bahr et al., 2023; Cohen & Kelly, 2020; Harper & Thirry, 2023). While there may be many reasons community college practitioners and scholars are not well-represented in this research, resource constraints may be one. With the majority of the research involving a four-year institution, community colleges also need to be supported and guided to conduct research at their own institution to bolster what we know about how to support community college STEM students. Additionally, there is a lack of detailed and robust research that includes sound theoretical and methodological underpinnings, hindering our ability to know how common theories in play in STEM research might apply to community college students.

Policy

To enhance the impact of S-STEM programs, policymakers should invest in data collection and evaluation efforts that assess both the qualitative and quantitative outcomes of these programs. Regularly evaluating the effectiveness of S-STEM initiatives will provide evidence-based insights for improving program design and supporting the future expansion of

these programs. The grant criteria requires nearly 60% of the total award to be allocated for scholarships. Thus S-STEM grants operate on a tight-budget that not every community college can afford to implement without additional resources and support structures in place. NSF should consider allowing community colleges, at least in some cases such as where large groups of consortia are involved or where the college has been awarded a second S-STEM grant, the funding ability to conduct multi-year research studies with theoretical underpinnings. Such additional research could bring the benefits of what community colleges learn to bear on future S-STEM programs. This would help bridge the gap between program implementation and knowledge generation, providing valuable insights that could inform future S-STEM initiatives and strengthen the overall effectiveness of STEM programs across community colleges.

Conclusion

This systematic literature review sheds some light on the role and influence of NSF S-STEM programs in broadening access to and success in STEM fields among community college students. The 36 papers reviewed offered important lessons, but strong conclusions were hindered by an absence of a theoretical or conceptual framework in some papers and a lack of quantitative outcomes data. Despite these challenges the research emphasizes the importance of intentional programmatic supports, such as faculty mentoring, career development workshops, and cohort-building activities, in fostering STEM identity and sense of belonging. These factors emerged as pivotal for student retention and success in STEM pathways.

While S-STEM programs aim to address inequities in STEM education, the review reveals gaps in the literature, particularly regarding community college-specific outcomes and robust theoretical foundations. Much of the research focuses on four-year institutions or

partnerships, leaving the role and potential of community colleges underexplored. Additionally, the lack of longitudinal data on retention, transfer success, and career outcomes limits the ability to assess the full impact of these programs. This review underscores the need for a more cohesive integration of research, practice, and policy to strengthen S-STEM initiatives. Enhancing program design with evidence-based practices, informed by theories, can help address systemic barriers.

Furthermore, expanding funding flexibility and supporting community colleges in conducting or partnering to conduct research can amplify the reach and effectiveness of S-STEM programs. Moving forward, stakeholders should prioritize scaling successful program elements, fostering cross-institutional collaborations, and ensuring that research findings inform program design and policy decisions. By doing so, S-STEM programs in community colleges can not only improve educational and career outcomes for individual students but also contribute to the diversification and expansion of the nation's STEM workforce, addressing pressing societal and economic needs.

The companion paper to this review examines the substantive themes that emerge from this body of research regarding student experiences and program impacts. Together, these reviews provide a comprehensive understanding of both what we know and what we need to know about S-STEM programs in community colleges.

By addressing the gaps identified in this review, we can build a stronger evidence base that supports continuous improvement of S-STEM programs, informs policy decisions, contributes to theoretical understanding, and ultimately helps community colleges fulfill their critical role in diversifying and expanding the STEM workforce.

Appendix A: Articles included in systemic literature review

Authors	**Title**	**Link**
Espino et al.	A Systematic Review of Literature: Engineering Identity and Students with Financial Need in Community Colleges	https://doi.org/10.1080/10668926.2020.1856218
Washburn & Bragg	How NSF S-STEM Scholarship Students Experience College during COVID-19: Lessons to Improve STEM Education	https://par.nsf.gov/servlets/purl/10337824
Wickersham & Wang	What's Life Got to Do With It? The Role of Life Experiences in Shaping Female Community College Students' Transfer Intent in STEM Fields of Study	https://doi.org/10.1080/10668926.2016.1211039
Zhu et al.	Establishing the Need to Broaden Bioengineering Research Exposure and Research Participation in Mechanical Engineering and Its Positive Impacts on Student Recruitment, Diversification, Retention and Graduation: Findings from the UMBC ME S-STEM Scholarship Program	https://doi.org/10.1115/1.4047839
Dancz	Implementation of a Guided Mentorship Program in a STEM Community of Practice at a Two-Year College	https://par.nsf.gov/servlets/purl/10316906
Dal Bello	What's shaking with SESMC? An update on an NSF S-STEM Project	https://peer.asee.org/27827
Baltaci	NSF S-STEM scholarship grant for engineering and applied technology majors to increase enrollment and retention	https://strategy.asee.org/22872
Anderson-Rowland et al.	S-STEM programs for transfer and non-transfer upper division and graduate engineering and computer science students	https://peer.asee.org/s-stem-programs-for-transfer-and-non-transfer-upper-division-and-graduate-engineering-and-computer-science-students.pdf
Castles et al.	Managing the Challenges of Recruiting and Supporting SSTEM Scholars at Three Partnering Community Colleges During a Pandemic	https://par.nsf.gov/servlets/purl/10388917
Gwinn & Gary	The Path from Community College to Engineering Bachelor's Degree Through Partnerships and NSF S-STEM Funded Scholarships	https://strategy.asee.org/37880

Hug	Developing communities of practice to serve Hispanic students: Supporting identity, community, and professional networks	https://strategy.asee.org/developing-communities-of-practice-to-serve-hispanic-students-supporting-identity-community-and-professional-networks.pdf
Maher et al.	Understanding Undergraduate Engineering Students' Pandemic Experiences	https://strategy.asee.org/understanding-undergraduate-engineering-students-pandemic-experiences.pdf
Rodriguez et al.	“It's not about making money, but it kind of is about making money”: How Socio-economic Status Influences Science and Engineering Identity for Community College Students in an S-STEM Program	https://peer.asee.org/33970
Castles et al.	Recruiting and Retaining Low-Income Engineering Students Across Four Institutions During a Pandemic: Progress and Lessons Learned from a Track 3 S-STEM Grant	https://peer.asee.org/42060
Camp et al.,	CS@Mines Successful S-STEM Scholarship Ecosystem for Low-Income and Underrepresented Students	https://peer.asee.org/36884
Zhu et al.,	Outcomes of the S-STEM Scholarship Program in Our Institution in the Past Three Years	https://strategy.asee.org/37552
Ford et al.	The Impact of Federally Funded Scholarship Programs on the Success of Transfer Students at a Public Engineering College	https://strategy.asee.org/24880
Kar et al.	Supporting Undergraduates for Careers in Computing and Engineering with Scholarships and Supervision	https://nemo.asee.org/public/conferences/327/papers/37290/download
Duggan et al.	Mitigating transfer shock for undergraduates in engineering to increase diversity (work in progress)	https://peer.asee.org/35561
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