NSF S-STEM Principal Investigators on the Effectiveness of Advising, Academic Support, and Other Program Elements

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NSF S-STEM Principal Investigators on the Effectiveness of Advising, Academic Support, and Other Program Elements Toward Promoting STEM Pathways for Two-Year College Students and Transfers

INTRODUCTION

Community colleges play a central role in broadening participation in STEM by enrolling large shares of first-generation, low-income, post-traditional, historically underrepresented students. These students often encounter structural barriers, including limited financial resources, limited time due to work or family responsibilities, confusing transfer and advising processes, and inconsistent access to mentoring and academic support. The National Science Foundation (NSF) Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) program attempts to address these barriers by funding student scholarships and by enabling locally designed program strategies to strengthen academic success, persistence, transfer, and early-career outcomes.

This paper presents results from a national survey of S-STEM Principal Investigators (PIs), Co-PIs, and program staff whose awards between 2018 and 2023 included community college students. We focus on five program domains—advising, career preparation, social support, academic support, and transfer support—and describe project leaders' reports of (1) prevalence, (2) frequency of student use among implementers, and (3) perceived effectiveness for four outcomes: GPA, persistence toward degree, transfer to a four-year university, and job placement. This study offers a system-level view of the most actionable and impactful S-STEM practices to promote STEM pathways among two-year college students and transfers into four-year universities.

NSF Scholarships in STEM (S-STEM)

S-STEM awards operate at the intersection of financial support and educational practice, pairing scholarships with structured activities intended to improve academic and career outcomes. S-STEM scholarships provide significant financial support to academically talented low-income students, typically covering a substantial portion of tuition and related educational expenses. Under current NSF guidelines, undergraduate S-STEM scholarships may award up to $15,000 per student per year (increased from $10,000 in the FY2023 cycle), with amounts determined by each scholar's unmet financial need as part of this last-dollar aid model. The programmatic supports (mentoring, tutoring, research, internships, cohorting, transfer advising) are locally designed and not uniformly mandated by NSF—hence the variation in prevalence, student use, and perceived effectiveness observed across projects and presented in this study [1]:

- Mentoring provides academic guidance, socialization into disciplinary norms, and timely problem-solving, both through faculty mentoring and peer mentoring.
- Cohort strategies are frequently used to foster peer networks, strengthen a sense of belonging, and normalize help-seeking.
- Academic support (tutoring, skills workshops, early alerts, cohort classes, and first-year STEM seminars) is designed to address coursework demands directly.

- Career preparation typically emphasizes exposure and exploration (e.g., research opportunities, speaker series, field trips/visits, networking), with internships and job placement supports implemented where institutional and employer partnerships permit.
- Transfer support is particularly key for community college students to clarify requirements and reduce friction at the two-to-four-year interface.

Despite the prominence of these strategies in S-STEM narratives, there is limited comparative evidence about which elements are most widely implemented, which reach students most consistently, and which are perceived as most effective for GPA, persistence, transfer, and job placement when offered. The present study addresses this gap with descriptive evidence from S-STEM projects serving community college students nationwide.

Literature Review

Community colleges are a primary on-ramp to STEM and engineering for first-generation, lower-income, working, and racially/ethnically underrepresented students, yet many encounter persistent barriers across finance, time, and navigation. Recent syntheses emphasize that transfer outcomes have not improved as quickly as hoped, with the complexity of policy environments and inconsistent information to students identified as key drivers [2, 3]. Practitioner guidance for transfer now centers on institutional partnerships, coherent pathway alignment, and proactive, dedicated advising—recommendations that align well with engineering's prerequisite chains and sequenced curricula [4].

Within this landscape, S-STEM scholarships are required, but projects develop and evolve their own mentoring, academic, career, and transfer activities to fit institutional context and student needs [1], thus the need for project-level descriptors of what program elements are offered, used, and perceived to be most effective [5].

Mentoring and cohort-based community feature prominently in S-STEM designs and in engineering education research focused on persistence. Studies point to faculty and peer mentoring as practical remedies for transfer shock and as mechanisms that strengthen students' social integration during the transition to engineering programs at receiving universities [6]. Structured mentoring that provides consistent, face-to-face engagement is associated with higher connectedness, satisfaction, and social capital among undergraduate engineers—evidence that mentoring functions as a relational program element rather than a one-off activity [3, 7].

Academic supports are central to the goal of improved course performance and on-sequence progression in engineering. At two-year colleges, initiatives that combine tutoring with accessible study spaces, faculty advising, and transfer assistance have been associated with higher GPAs in high-enrollment STEM courses, stronger term-to-term persistence, and better continuation in gateway mathematics and chemistry courses, even for students who struggled in early courses [8]. These findings complement engineering-education research showing that relationship-rich supports and structured learning communities are associated with persistence through belonging, motivation, and identity development [7].

Advisory quality and pathway transparency are critical to engineering transfer.   Community college transfers face advising workload pressures, weak cross-institution communication, and restrictions arising from program requirements, resulting into lost credits and slower time-to-degree [9]. Longitudinal work on community-college STEM students' decision processes shows that major and destination choices are iterative and information-intensive, underscoring that pathway clarity and access to advising are design problems as much as individual preferences [10].

Career preparation in S-STEM commonly blends exposure (talks, field visits, networking) with experience (undergraduate research and internships). Evidence indicates that internships are associated with greater perceived preparedness and expectancy of success in obtaining preferred first positions, with diminishing returns only after several repeats. Large-scale case studies similarly report high satisfaction and gains in practical, technical, and soft-skill development with structured internship models [11, 12]. These results align with engineering programs' employability objectives and suggest that, when job placement is the primary outcome, work-based learning warrants prioritization.

The literature suggests a set of purpose-built alignments: mentoring and cohorts for persistence; tutoring, learning communities, and first-year seminars for GPA; pre-transfer advising and pathway alignment for transfer; and internships (with undergraduate research and networking) for employment. The present study contributes by providing these descriptors for community-college-inclusive S-STEM projects, enabling engineering educators to match elements to objectives and to plan capacity-sensitive sequencing across two-year pathways through transfer to bachelor's degree attainment.

METHODS

Study Design and Objective

Study data is from a cross-sectional survey of PIs, Co-PIs, and staff from active NSF S-STEM awards involving community colleges. The objective was to describe the prevalence, student frequency of use (among implementers), and perceived effectiveness of program elements within five domains (advising, career preparation, social support, academic support, transfer support) toward four outcomes (GPA, persistence, transfer, job placement).

Sampling Frame and Respondents

I used the NSF Advanced Search to identify all S-STEM awards from 2018 onward. I used the Organization and Abstract fields to narrow down to granted awarded to community colleges or awarded to four-year universities in which community colleges were named. For each grant, the NSF Advanced Search includes the Principal Investigator's (PI) name and email and the names of Co-Principal Investigators (Co-PI). I found the Co-Principal Investigator's emails online. I sent a survey invitation to the PI and Co-PIs. In total, 102 investigators from 79 projects responded. The sampling frame S-STEM projects that included community college and were categorized as:

- Community college–led grants (79 invited; 39 responded; 49%),
- Collaborative grants with community colleges (35 invited; 10 responded; 29%),
- Led by four-year university(ies) with named community college partners (58 invited; 24 responded; 41%),

- Led by four-year universit(ies) with unnamed community college partners (16 invited; 6 responded; 38%).

These response rates yielded sufficient variation across institutional roles to summarize practices relevant to two-year colleges. For S-STEM awards with multiple respondents, the Principal Investigator's response was used (n=79).

Instrument Development

Survey respondents were asked to select elements used in their S-STEM program from a list of core program elements used by some S-STEM programs derived from a systematic literature review of S-STEM programs [5]. Elements are the named practices (e.g., faculty mentoring, tutoring, research opportunities, regular cohort meetings, pre-transfer advising) organized into five domains: Advising, Career Preparation, Social Support, Academic Support, and Transfer Support.

From the selected elements, respondents selected the program elements that were most frequently used/highly effective. Then, from the remaining program elements, they selected the program elements used less frequently than expected/less effective. This created three sets of responses:

- Prevalence (Used vs. not used in their project),
- Frequency of Use by Students among implementers (Most Frequently, Less Frequently, or neither),
- Perceived Effectiveness for each outcome among implementers (Most Effective, Less Effective, or neither).

The four outcomes were improving student academic performance (GPA), improving persistence toward degree, improving transfer to a four-year university, and improving student job placement.

FINDINGS

Prevalence of Program Elements

This section describes how frequently S-STEM projects report offering each of the advising, career preparation, social support, academic support, and transfer support elements. *Prevalence* figures are computed at the project level (n = 79, PI record); *Use* and *Effectiveness* are computed only among implementers of each element (denominators vary by element).

[Insert Figure 1 here]

Advising. Advising elements are widely implemented across S-STEM projects. The most prevalent component is faculty mentoring, reported by 81.9% of grantees, making it the single most common element across all categories. The next most common advising practices are individualized education or career plans (56.6%) and advising and transfer workshops (54.2%), both of which appear in more than half of projects. Mid-range advising elements include peer mentoring (47.0%) and intrusive/enhanced advising (44.6%), each implemented by roughly four in ten grantees. The least prevalent form of advising support is a dedicated student success coach or coordinator (30.1%), suggesting that resource-dependent advising models are less common than faculty- or advisor-driven activities.

Career Preparation. Career preparation and STEM identity development elements show a wide range in prevalence. The most common supports—research opportunities and field trips or visits to industry/colleges (both 66.3%)—appear in two-thirds of programs. Networking events (63.9%) and career exploration/counseling (56.6%) also have a broad reach, with more than half of projects offering them. Internships (55.4%) are nearly as common. Mid-prevalence elements include STEM speaker series (45.8%) and professional mentoring (38.6%), while more targeted employment supports, such as job placement support (16.9%) and job shadowing (6.0%), are considerably less common. The overall pattern suggests that S-STEM projects prioritize exposure and exploration experiences over structured employment pipelines.

Social Support. Social support elements show the greatest disparity in prevalence across categories. Regular cohort meetings are widely implemented (78.3%) and are the second most common element across all domains, reflecting the centrality of cohort-based models within -STEM. Conferences (50.6%) are also offered by half of the projects, whereas clubs (30.1%) and equity-focused STEM identity workshops (26.5%) are offered less consistently. Several community engagement activities—including community service (9.6%), competitions (6.0%), service learning (6.0%), and civic engagement (4.8%)—are rare, suggesting few S-STEM programs incorporate structured outreach or external engagement as part of their core model.

Academic Support. Academic supports fall within the moderate-prevalence range, with one clear leader: tutoring, offered by 61.4% of projects. Additional academic supports show lower but still meaningful uptake, including soft skills workshops (43.4%), academic skills workshops (38.6%), early alert systems (38.6%), learning communities (31.3%), and first-year STEM seminars or success courses (28.9%). Less common academic supports include cohort classes (27.7%), summer bridge or bootcamp programs (18.1%), and Supplemental Instruction (15.7%). These patterns suggest that, although most -STEM programs integrate at least one academic enhancement strategy, more resource-intensive or logistically complex models are less common.

Transfer Support. Transfer support elements exhibit a consistently moderate-to-high prevalence. Pre-transfer advising (71.1%) is the dominant element, appearing in more than seven in ten programs—making it one of the most common program components overall. About half of the projects report pathways alignment with universities (48.2%), while post-transfer advising (39.8%) and formal community college–university STEM collaborations (38.6%) are somewhat less prevalent but still broadly represented. These results signal that many S-STEM programs explicitly support transfer planning, but fewer maintain structured partnerships or coordinated advising after students arrive at the four-year institution.

Across all program elements, several patterns stand out. Mentoring (faculty and peer) and cohort-based approaches represent the backbone of S-STEM programming, with the highest overall prevalence. Career exposure activities, such as research experiences, networking, and field trips, appear far more commonly than job-placement structures. Academic support strategies vary widely, but tutoring remains the most universal approach. Transfer-focused advising ranks among the most consistently implemented supports across all categories.

Elements requiring cross-institutional coordination, staffing, or extensive logistics (e.g., job shadowing, community engagement, supplemental instruction) are least prevalent.

Frequency of Use by Students

The survey asked respondents to choose the elements used "Most Frequently" and "Less Frequently" by students among the program elements they reported using (as shown above). It is important to note that this frequency of use is reported by project PIs, not by students, and thus reflects the S-STEM project leaders' perception of student use based on their own observations. Percentages below refer to the share of implementers of each program element that selected Most Frequently or Less Frequently. *Most minus Less* refers to the percentage of implementers who selected Most Frequently minus the percentage of implementers who selected Less Frequently. For example, Peer mentoring under Frequency of Use by Students is -2.6 because 33.3% of implementers selected Most Frequently and 35.9% of implementers selected Less Frequently (33.3 - 35.9 = -2.6).

[Insert Figure 2 here]

Advising. Advising elements show notable variation in day-to-day student engagement among projects that offer them. Respondents most often reported high student use of Faculty mentoring (88.2%), Advising & transfer workshops (48.9%), and Dedicated student success coach/specialist/coordinator, etc. (48.0%). Elements most often marked as less frequently used include Peer mentoring (35.9%) and Advising & transfer workshops (26.7%). Considering the balance of use (Most minus Less), leading practices are Faculty mentoring (+80.9), Dedicated student success coach/specialist/coordinator, etc. (+32.0), and Individualized education/career plan (+23.4). The only net negative Advising element was Peer mentoring (-2.6), possibly because faculty have less knowledge of informal or even formal peer mentoring practices in their programs.

Career Preparation. Career Preparation elements show notable variation in day-to-day student engagement among projects that offer them. Project leaders indicated that students most commonly used Internship opportunities (52.2%), Research opportunities (47.3%), and STEM professional speaker series (44.7%). The most frequently marked as less frequently used are job shadowing (40.0%) and Research opportunities (27.3%). Considering the balance of use (Most minus Less), leading practices are STEM professional speaker series (+34.2), Internship opportunities (+30.4), and Professional mentoring (+28.1). Elements with comparatively lower net use include Job shadowing (-20.0) and Job placement supports (+7.1).

Social Support. Social Support elements show notable variation in day-to-day student engagement among projects that offer them. According to respondents, the most frequently used elements are Regular cohort meetings (56.9%), Civic engagement (50.0%), and Clubs (40.0%). Elements most often marked as less frequently used include Service learning (60.0%) and Community service (37.5%). Considering the balance of use (Most minus Less), leading practices are Regular cohort meetings (+49.2), Civic engagement (+25.0), and Competitions

(+20.0). Elements with comparatively lower net use include Service learning (-60.0) and Community service (0.0).

Academic Support. Academic Support elements show notable variation in day-to-day student engagement among projects that offer them. Among implementers, the elements perceived as most frequently used were first-year seminar/STEM success course (58.3%), Tutoring (56.9%), and Cohort classes (52.2%). The most frequently marked as less frequently used are Supplemental Instruction (30.8%) and Cohort classes (26.1%). Considering the balance of use (Most minus Less), leading practices are the first-year seminar/STEM success course (+54.2), Tutoring (+45.1), and "Soft skills" (e.g., communication, growth mindset) workshops (+33.3). Elements with comparatively lower net use include Supplemental Instruction (-7.7) and the Early Alert System (+9.4).

Transfer Support. Transfer Support elements show notable variation in day-to-day student engagement among projects that offer them. Respondents attributed the greatest student uptake to Pre-transfer advising (69.5%), Pathways alignment with university (55.0%), and Formal CC & University STEM collaboration (50.0%). Elements most often marked as less frequently used include Formal CC & University STEM collaboration (25.0%) and Post-transfer advising (18.2%). Considering the balance of use (Most minus Less), leading practices are Pre-transfer advising (+69.5), Pathways alignment with the university (+40.0), and Post-transfer advising (+27.3). Elements with comparatively lower net use include Formal CC & University STEM collaboration (+25.0) and Post-transfer advising (+27.3), but these were overall still high indicating the perceived popularity of transfer support elements.

Respondents report that certain program elements consistently engage participants more than others. Mentoring—particularly faculty and professional mentoring—along with internships, networking events, tutoring, cohort meetings, and pre-transfer advising —emerges as the most frequently used support within the projects that offer it. At the same time, several elements show comparatively lower student uptake, including job shadowing, community engagement activities, supplemental instruction, and some transfer-related workshops. Overall, the frequency-of-use data suggest that, according to project leaders, students gravitate toward relationship-based supports, structured academic and career development activities, and clear transfer-advising pathways, whereas more specialized or resource-intensive offerings reach a smaller share of participants.

Effectiveness for Improving Student Academic Performance (GPA)

The next four sections summarize which program elements project leaders perceived as most effective in improving students' academic performance (GPA), persistence toward a bachelor's degree, transfer to a four-year university, and job placement. These sections summarize which respondents chose the elements that were "Highly Effective" or "Less Effective" as reported by project PIs. Again, effectiveness is reported by project PIs, not by students, and thus reflects the S-STEM project leaders' own perception of what works in improving student performance in these areas.

Percentages below refer to the share of implementers of each program element that selected Highly Effective or Less Effective. Net effectiveness refers to the percentage of implementers who selected Highly Effective minus the percentage of implementers who selected Less Effective, similar to More minus Less used above.

[Insert Figure 3 here]

Advising. Advising elements vary considerably in their perceived effectiveness for improving student academic performance (GPA). The elements most frequently rated as highly effective are Faculty mentoring (73.5%), Intrusive or enhanced advising (43.2%), and Dedicated student success coach/specialist/coordinator, etc. (40.0%). Elements most commonly rated as less effective include Individualized education/career plan (27.7%) and Peer mentoring (17.9%). Considering the balance between high and low effectiveness ratings, leading practices include Faculty mentoring (+69.1), Intrusive or enhanced advising (+29.7), Dedicated student success coach/specialist/coordinator, etc. (+24.0). Elements with comparatively lower net effectiveness include Individualized education/career plan (-2.1) and Peer mentoring (+10.3). Faculty would likely have less direct knowledge of individualized plans and peer-to-peer interactions.

Career Preparation. Career Preparation elements vary considerably in their perceived effectiveness for improving student academic performance (GPA). The elements most frequently rated as highly effective are Research opportunities (47.3%), Internship opportunities (30.4%), and STEM professional speaker series (28.9%). The most commonly rated as less effective are professional mentoring (18.8%) and Networking opportunities and events (15.1%). Considering the balance between high and low effectiveness ratings, leading practices include Research opportunities (+36.4), Internship opportunities (+19.6), and STEM professional speaker series (+18.4). Elements with comparatively lower net effectiveness include Networking opportunities and events (-9.4) and Professional mentoring (-3.1). Interestingly, no respondents rated Job shadowing highly effective or less effective.

Social Support. Social Support elements vary considerably in their perceived effectiveness for improving student academic performance (GPA). The elements most frequently rated as highly effective are Regular cohort meetings (47.7%), Competitions (40.0%), and Conferences (28.6%). Elements most commonly rated as less effective include Service learning (60.0%) and Competitions (40.0%). Considering the balance between high and low effectiveness ratings, leading practices include Regular cohort meetings (+35.4) and Conferences (+21.4). Elements with comparatively lower net effectiveness include Service learning (-60.0) and Civic engagement (-25.0).

Academic Support. Academic Support elements vary considerably in their perceived effectiveness for improving student academic performance (GPA). The elements most frequently rated as highly effective are Tutoring (49.0%), Cohort classes (43.5%), and first-year seminar/STEM success course (37.5%). Elements most commonly rated as less effective include first-year seminar/STEM success course (8.3%) and Summer bridge program/bootcamp/workshop (6.7%). Considering the balance between high and low effectiveness ratings, leading practices include Tutoring (+47.1), Cohort classes (+43.5), Learning community (+30.8). All elements were rated high effective more than less effective.

Elements with comparatively lower net effectiveness include Summer bridge program/bootcamp/workshop (+6.7) and Early alert system (+12.5).

Transfer Support. Transfer Support elements vary considerably in their perceived effectiveness for improving student academic performance (GPA). The elements most frequently rated as highly effective are Post-transfer advising (33.3%), Pathways alignment with university (30.0%), and Pre-transfer advising (28.8%). Elements most commonly rated as less effective include Post-transfer advising (33.3%) and Pre-transfer advising (15.3%). Considering the balance between high and low effectiveness ratings, leading practices include Pathways alignment with university (+22.5), Formal CC & University STEM collaboration (+18.8), Pre-transfer advising (+13.6). Elements with comparatively lower net effectiveness include Post-transfer advising (0.0) and Pre-transfer advising (+13.6).

Taken together, the effectiveness ratings indicate that only a subset of program elements are viewed as meaningfully improving student academic performance. Across program types, mentoring—particularly faculty mentoring—emerges as one of the most consistently valued supports for strengthening GPA. Academic supports such as tutoring, cohort-based classes, and first-year STEM seminars also stand out for their perceived impact, whereas many career-preparation, social-support, and transfer-focused activities receive more modest ratings in relation to academic performance. These patterns suggest that direct academic engagement, structured guidance, and relationship-centered supports are viewed as the most powerful levers for improving GPA within S-STEM programs, whereas elements designed primarily for career readiness, community building, or transfer navigation tend to play more complementary roles in academic achievement.

Effectiveness for Improving Persistence Toward a Bachelor's Degree

This section summarizes which advising, career preparation, social support, academic support, and transfer support elements were perceived by project leaders as most effective in improving student persistence toward bachelor's degree.

[Insert Figure 4 here]

Advising. Advising elements vary in their perceived effectiveness for improving student persistence toward a degree. The elements most frequently rated as highly effective are Faculty mentoring (77.9%), Intrusive or enhanced advising (59.5%), and Dedicated student success coach/specialist/coordinator etc. (56.0%). Elements most commonly rated as less effective include Peer mentoring (17.9%) and Advising & transfer workshops (17.8%). Considering the balance between high and low effectiveness ratings, leading practices include Faculty mentoring (+75.0), Intrusive or enhanced advising (+59.5), Dedicated student success coach/specialist/coordinator etc. (+44.0). Elements with comparatively lower net effectiveness include Advising & transfer workshops (-2.2) and Peer mentoring (+17.9).

Career Preparation. Career Preparation elements vary in their perceived effectiveness for improving student persistence toward a degree. The elements most frequently rated as highly effective are Research opportunities (50.9%), Internship opportunities (41.3%), and Field trips/tours/visits to industry or colleges (38.2%). Elements most commonly rated as less effective include Networking opportunities and events (26.4%) and Job shadowing (20.0%). Based on net effectiveness ratings, leading practices include Research opportunities (+40.0), Field trips/tours/visits to industry or colleges (+32.7), and Internship opportunities (+32.6). Elements with comparatively lower net effectiveness include Job shadowing (-20.0) and Networking opportunities and events (-15.1).

Social Support. Social Support elements vary greatly in their perceived effectiveness for improving student persistence toward a degree. The elements most frequently rated as highly effective are Regular cohort meetings (52.3%), Clubs (32.0%), and Conferences (31.0%). Elements most commonly rated as less effective include Civic engagement (50.0%) and Competitions (40.0%). Considering the balance between high and low effectiveness ratings, leading practices include Regular cohort meetings (+41.5), Conferences (+23.8), Clubs (+16.0). Elements with comparatively lower net effectiveness include Civic engagement (-50.0) and Service learning (-40.0). Overall, five elements had a negative net effectiveness.

Academic Support. Academic Support elements vary in perceived effectiveness in improving students' persistence toward a degree. The elements most frequently rated as highly effective are Academic skills workshops (43.8%), Tutoring (39.2%), and Cohort classes (39.1%). Elements most commonly rated as less effective include Cohort classes (21.7%) and Academic skills workshops (15.6%). Based on net effectiveness ratings, leading practices include first-year seminar/STEM success course (+33.3), Tutoring (+31.4), Learning community (+30.8). Elements with comparatively lower net effectiveness include the Summer Bridge Program/Bootcamp/Workshop (+13.3), Supplemental Instruction (+15.4), "Soft Skills" workshops (+16.7%), and Cohort class (17.4%).

Transfer Support. Transfer Support elements vary in their perceived effectiveness for improving student persistence toward a degree. The elements most frequently rated as highly effective are Post-transfer advising (36.4%), Pre-transfer advising (35.6%), and Pathways alignment with university (35.0%). Elements most commonly rated as less effective include Post-transfer advising (30.3%) and Pathways alignment with university (12.5%). Considering the balance between high and low effectiveness ratings, leading practices include Pre-transfer advising (+33.9), Formal CC & University STEM collaboration (+25.0), Pathways alignment with university (+22.5). Post-transfer advising had the lowest net effectiveness among the four elements (+6.1).

Across program types, persistence effectiveness concentrates on relationship-centered advising and structured program designs. Faculty mentoring and individualized advising-related practices frequently rank among the highest-rated elements in advising; in social support, regular cohort activities tend to lead; in academic support, tutoring and core academic scaffolds stand out; and within career preparation and transfer support, research or field-based experiences and pre-transfer advising, respectively, show strong signals. Overall, elements that combine consistent contact, clear expectations, and embedded academic guidance are most often perceived as improving persistence, whereas more episodic outreach or activities with limited experiences tend to receive lower effectiveness marks among implementers.

Effectiveness for Improving Transfer to a Four-Year University

This section summarizes which program elements were perceived as most effective in supporting students' transfer to a four-year institution.

[Insert Figure 5 here]

Advising. Advising elements vary in their perceived effectiveness for improving transfer outcomes. The elements most frequently rated as highly effective are Faculty mentoring (55.9%), Dedicated student success coach/specialist/coordinator etc. (52.0%), and Individualized education/career plan (48.9%). Elements most commonly rated as less effective include Peer mentoring (17.9%) and Advising & transfer workshops (17.8%). Considering the balance between high and low effectiveness ratings, leading practices include Faculty mentoring (+52.9), Intrusive or enhanced advising (+40.5), Dedicated student success coach/specialist/coordinator etc. (+40.0). Elements with comparatively lower net effectiveness include Peer mentoring (+2.6) and Advising & transfer workshops (+15.6).

Career Preparation. Career Preparation elements vary in their perceived effectiveness for improving transfer outcomes. The elements most frequently rated as highly effective are Research opportunities (32.7%), Field trips/tours/visits to industry or colleges (30.9%), and Professional mentoring (25.0%). Elements most commonly rated as less effective include Networking opportunities and events (26.4%) and Job shadowing (20.0%). Practices with a high net effectiveness include Field trips/tours/visits to industry or colleges (+25.5), Research opportunities (+21.8), and Internship opportunities (+13.0). Elements with comparatively lower net effectiveness include Job shadowing (-20.0) and Job placement supports (-14.3).

Social Support. Social Support elements vary in their perceived effectiveness for improving transfer outcomes. The elements most frequently rated as highly effective are Regular cohort meetings (29.2%), Competitions (20.0%), and Conferences (16.7%). Elements most commonly rated as less effective include Civic engagement (50.0%) and Competitions (40.0%). Considering the balance between high and low effectiveness ratings, leading practices include Regular cohort meetings (+18.5), Conferences (+9.5), Clubs (+0.0). Elements with comparatively lower net effectiveness include Civic engagement (-50.0) and Service learning (-40.0).

Academic Support. Academic Support elements vary in their perceived effectiveness for improving transfer outcomes. The elements most frequently rated as highly effective are first-year seminar/STEM success course (33.3%), Cohort classes (30.4%), and Summer bridge program/bootcamp/workshop (26.7%). Elements most commonly rated as less effective include Cohort classes (21.7%) and Academic skills workshops (15.6%). Leading elements based on net effectiveness include first-year seminar/STEM success course (+33.3), Tutoring (+17.6), and Learning community (+15.4). Elements with comparatively lower net effectiveness include an Early alert system (-9.4) and "Soft skills" (e.g. communication, growth-mindset) workshops (0.0).

Transfer Support. Transfer Support elements vary in their perceived effectiveness for improving transfer outcomes. The elements most frequently rated as highly effective are Pre-transfer advising (67.8%), Formal CC & University STEM collaboration (56.2%), and Pathways alignment with university (52.5%). Elements most commonly rated as less effective include

Post-transfer advising (30.3%) and Pathways alignment with the university (12.5%). Considering the balance between high and low effectiveness ratings, leading practices include Pre-transfer advising (+66.1), Formal CC & University STEM collaboration (+46.9), Pathways alignment with university (+40.0). The lowest net effectiveness element was Post-transfer advising (-9.1).

Across categories, the strongest transfer-related effectiveness signals emerge from advising and structured pathway supports. As expected, pre-transfer advising and pathways alignment frequently appear among the highest-rated practices. By contrast, certain career-preparation and social-support activities show more limited perceived impact on transfer. Overall, elements that provide clear guidance, planning structures, and coordinated cross-institutional navigation are viewed as most effective for improving transfer outcomes.

Effectiveness for Improving Job Placement

This section summarizes which program elements were perceived as most effective in improving job placement outcomes.

[Insert Figure 6 here]

Advising. Advising elements vary in their perceived effectiveness for improving job placement outcomes. The elements most frequently rated as highly effective are Faculty mentoring (39.7%), Individualized education/career plan (29.8%), and Dedicated student success coach/specialist/coordinator etc. (20.0%). Elements most commonly rated as less effective include Advising & transfer workshops (22.2%) and Peer mentoring (17.9%). Considering the balance between high and low effectiveness ratings, leading practices include Faculty mentoring (+38.2), Individualized education/career plan (+23.4), Dedicated student success coach/specialist/coordinator etc. (+16.0). Elements with comparatively lower net effectiveness include Advising & transfer workshops (-8.9) and Peer mentoring (-5.1).

Career Preparation. Career Preparation elements vary in their perceived effectiveness for improving job placement outcomes. The elements most frequently rated as highly effective are Internship opportunities (63.0%), Job placement supports (57.1%), and Research opportunities (43.6%). Elements most commonly rated as less effective include STEM professional speaker series (26.3%) and Job shadowing (20.0%). Considering the balance between high and low effectiveness ratings, leading practices include Internship opportunities (+58.7), Job placement supports (+57.1), and Research opportunities (+36.4). Elements with comparatively lower net effectiveness include Job shadowing (0.0) and STEM professional speaker series (5.3).

Social Support. Social Support elements vary in their perceived effectiveness for improving job placement outcomes. The elements most frequently rated as highly effective are Conferences (42.9%), Competitions (20.0%), and Service learning (20.0%). Elements most commonly rated as less effective include Civic engagement (25.0%) and Clubs (24.0%). Considering the balance between high and low effectiveness ratings, leading practices include Conferences (+31.0), Equity-focused STEM identity development workshops (+9.1), and Regular cohort meetings (+4.6). Elements with comparatively lower net effectiveness include Civic engagement (-25.0) and Clubs (-20.0).

Academic Support. Academic Support elements vary in their perceived effectiveness for improving job placement outcomes. The elements most frequently rated as highly effective are Cohort classes (34.8%), first-year seminar/STEM success course (29.2%), and “Soft skills” (e.g. communication, growth-mindset) workshops (25.0%). Elements most commonly rated as less effective include Learning community (23.1%) and Supplemental Instruction (23.1%). Considering the balance between high and low effectiveness ratings, leading practices include Cohort classes (+21.7), first-year seminar/STEM success course (+16.7), “Soft skills” workshops (+11.1). Elements with comparatively lower net effectiveness include Supplemental Instruction (-7.7), Early alert system (-6.2), Learning communities (-3.8%), Academic skills workshops (-3.1%) and Summer bridge programs (0.0%).

Transfer Support. Transfer Support elements vary in their perceived effectiveness for improving transfer outcomes. The elements most frequently rated as highly effective are Post-transfer advising (24.2%), Formal CC & University STEM collaboration (21.9%), and Pathways alignment with university (17.5%). Elements most commonly rated as less effective include Formal CC & University STEM collaboration (18.8%) and Pre-transfer advising (10.2%). Most net effective practices include Post-transfer advising (+15.2), Pathways alignment with the university (+12.5), and Formal CC & University STEM collaboration (+3.1). Elements with comparatively lower net effectiveness include Pre-transfer advising (0.0), Formal CC & University STEM collaboration (+3.1).

Across program types, job-placement effectiveness is most consistently associated with career-related experiential activities. Internships, research experiences, and networking opportunities regularly appear among the highest-rated practices for improving employment outcomes, whereas advising, academic, and social support elements tend to register weaker effects. Taken together, the results suggest that hands-on, professionally oriented experiences are perceived as the strongest levers for supporting students’ transition into the STEM workforce.

Discussion

This study provides a grant-level, cross-project view of community-college-inclusive S-STEM practices with comparable descriptors of reach (prevalence), engagement (use), and perceived impact (effectiveness) across five domains and four outcomes. Three patterns align closely with the engineering education and community college literature:

First, relationship-centered supports (especially faculty mentoring and cohort structures) are consistently prevalent, frequently used, and often rated as effective for persistence and GPA. This is consistent with work showing that structured, face-to-face mentoring strengthens connectedness, satisfaction, and social capital among undergraduate engineers. These are core program mechanisms that undergird student persistence and program satisfaction [7]. Mentoring and cohort structures appear fundamental. Faculty mentoring is among the most prevalent elements and is frequently reported as both widely used and highly effective across outcomes—especially for persistence and GPA. Regular cohort meetings show a similar persistence profile, underscoring the value of predictable contact, trust, and belonging for students who often balance work, family, and part-time enrollment. These findings argue for program designs that allocate time and staffing for sustained, relational engagement, rather than sporadic workshops or events.

Second, direct academic supports (tutoring, cohort classes, first-year STEM seminars) are rated highest for GPA, echoing evidence from two-year settings where integrated academic supports correlate with higher course performance and term-to-term continuation, even for students who initially struggle [8]. Career-oriented and social support activities are important complements, but they are not rated as highly for academic performance compared to targeted academic scaffolds. For practice, this implies that S-STEM resources should prioritize tutoring and course-embedded strategies when GPA improvement is an explicit program objective, while aligning other activities to their primary strengths (e.g., internships for jobs, transfer advising for mobility).

Third, pathway-structuring activities (pre-transfer advising, pathways alignment) are rated strongest for transfer, mirroring practice guides and partnership studies that emphasize early, coordinated advising and clearly mapped programs between two- and four-year institutions [4, 13]. Programs can sharpen their theory of change by matching elements to intended outcomes: scale advising and articulation work for transfer goals; expand authentic work-based learning for employment goals. Importantly, many projects already offer exposure activities (field trips, speaker series), but hands-on, credit-bearing, or compensated experiences are where perceived impact on employment is strongest.

Together, these patterns suggest that S-STEM projects serving community college students are most impactful when they combine high-touch mentoring and cohort-based approaches with targeted, goal-aligned practices at key decision points (course success, transfer, employment).

A fourth, practical observation is that several elements with strong perceived effectiveness—especially mentoring, tutoring, internships, and coordinated transfer advising—also demand capacity (faculty/staff time, employer partnerships, cross-institutional coordination). The lower prevalence of resource-intensive elements (e.g., success coaches, Supplemental Instruction, job shadowing) likely reflects implementation and budget constraints rather than a lack of value. S-STEM grants require that 60% of funding go toward student stipends, meaning projects must be selective in how they prioritize optional programmatic supports. This design flexibility explains why some resource-intensive elements (e.g., success coaches, Supplemental Instruction, employer-embedded activities) appear less frequently despite favorable perceptions where implemented.

Two-year colleges with or without S-STEM funding should consider sequence implementation: start with high-leverage practices that fit existing capacity (faculty mentoring, tutoring, regular cohort meetings, pre-transfer advising), then phase in more complex components (internships, research placements, success coaching) as partnerships, funding, and resources mature. These patterns have two design implications for any two-year college. First, align each element to a primary outcome and evaluate it on that outcome: academic supports for GPA, cohorts for persistence, pre-transfer advising for transfer, and internships for jobs.

If GPA is your primary objective. Protect time and staffing for tutoring in gateway STEM courses. Add a first-year STEM seminar or learning community to anchor study strategies and disciplinary identity. These elements map directly to the strongest GPA signals in the data and to evidence of increased course success and persistence in two-year settings.

If persistence is the goal. Formalize faculty mentoring and schedule regular cohort meetings. The literature and our results converge on the importance of predictable, scheduled, relationship-based engagement, especially for students who juggle work and family. Give students a reason to come to campus and spend time with peers and mentors.
If transfer is the goal. Begin pre-transfer advising in the first term and co-develop degree maps/articulation with receiving universities. These are signature features of high-performing transfer partnerships and are the strongest transfer signals in the portfolio.

If job placement is the goal. Build toward paid internships by first strengthening research exposure, networking, and employer relationships. Internships and job placement supports show the clearest perceived impact on employment outcomes.

Second, integrate elements to provide a coherent pathway for students. For example, use cohort meetings and faculty mentoring to identify academic needs early. Refer students to tutoring and early alerts for immediate support so no student gets lost in the shuffle early in the term. Now students who initially struggled are in the pipeline, making it easier for the program to connect them to research or internships in later terms. Then, establish co-advising with receiving universities prior to transfer application and enrollment.

For colleges without an S-STEM award, low-cost/high-yield starting points include formalizing faculty mentoring, scheduling regular cohort meetings, prioritizing tutoring in gateway STEM courses, and initiating pre-transfer advising early. As capacity grows, colleges can add pathway alignment, first-year STEM seminars, and, through partnerships, paid internships and research experiences.

Primary Contributions to the Literature and Current Funding Landscape
While prior CC S-STEM research and syntheses document what elements exist and why they matter (e.g., mentoring/cohorts; tutoring and learning communities; early and structured transfer advising), our study contributes comparable, cross-project descriptors of reach (prevalence), engagement (student use among implementers), and perceived impact (effectiveness by outcome)—a gap identified by the Community College S-STEM Network systematic review [5]. Second, by focusing explicitly on two-year students and transfer pathways, we complement policy-oriented resources (e.g., Transfer Playbook 2.0; CCRC pathway briefs) with practice-level priorities that two-year colleges can adopt or scale, regardless of funding status [4, 13].

Limitations
Because the survey was completed by PIs, Co-PIs, and other project personnel rather than students, ratings of program effectiveness may reflect faculty perceptions that are more positive than students' own experiences. As a result, the survey may overestimate the perceived impact of mentoring and other faculty-driven supports, highlighting the need for future research that incorporates student-level measures of engagement and outcomes.

The results are descriptive and rely on project leads' perceptions; local contexts and implementation vary by program and institution, and some elements (e.g., undergraduate research at two-year colleges) remain less common despite high ratings when implemented. Response rates vary by grant type, and some items are not applicable to all settings. These limitations reinforce the need for follow-up analyses that link specific elements to student-level outcomes (e.g., GPA changes, term-to-term persistence, transfer, and job records), and for implementation studies that clarify the dosage, staffing models, and partnership structures that make high-impact elements feasible at scale.

Overall, the survey points to a practical blueprint for two-year STEM programs: lead with mentoring and cohorts; secure course-embedded academic supports for GPA; make transfer advising explicit and early; and build toward internships and research as partnerships allow. Aligning resources to these strengths can help community colleges translate S-STEM investments into measurable gains in academic performance, persistence, transfer, and employment.

References

[1] National Science Foundation, "NSF S-STEM FAQ (NSF 25-514)," 2025. [Online]. Available: https://www.nsf.gov/funding/information/faq-nsf-scholarships-science-technology-engineering

[2] Community College Research Center, "Community College STEM Pathways Policy Fact Sheet," 2022. [Online]. Available: https://ccrc.tc.columbia.edu/publications/community-college-stem-pathways.html

[3] X. Wang, *Paving Community College Student Pathways for Equitable STEM Education*. Washington, DC, USA: National Academies Press, 2025.

[4] T. LaViolet *et al*., "Transfer Playbook 2.0: A Practical Guide for Achieving Excellence in Transfer and Bachelor's Attainment," Aspen Institute, 2025. [Online]. Available: https://highered.aspeninstitute.org/playbooks/transfer-playbook-20-practical-guide-achieving-excellence-transfer-and-bachelors

[5] M. L. Espino and E. Meza, "A Systematic Review of S-STEM Programs in Community Colleges," in *Proc. ASEE Annual Conference*, 2024. [Online]. Available: https://ccsstemnetwork.org/wp-content/uploads/2025/03/SysLit_CSCC24.pdf

[6] A. L. Dicke, "Exploring the use of faculty and peer mentoring as a tool to support engineering transfer students," in *Proc. ASEE Annual Conference*, 2023. [Online]. Available: https://peer.asee.org/work-in-progress-exploring-the-use-of-faculty-and-peer-mentoring-as-a-tool-to-support-engineering-transfer-students-transition.pdf

[7] V. Washington and J. L. Mondisa, "A need for engagement opportunities and personal connections: Understanding the social community outcomes of engineering undergraduates in a mentoring program," *J. Eng. Educ.*, vol. 110, no. 4, pp. 902–924, 2021.

[8] D. Leoni, T. Fleming, and J. McFarland, “Cultivating a STEM community for two-year college student success and persistence,” *PLOS One*, vol. 18, no. 9, pp. 1–22, 2023. [Online]. Available: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0290958

[9] Y. L. Zhang, “A dual perspective on academic advising: Challenges faced by community college transfers and faculty advisors in engineering,” *NACADA J.*, vol. 43, no. 2, pp. 72–84, 2023.

[10] D. G. Holland Zahner, “Navigating STEM major and transfer destination choices: Community college student experiences through the lens of practice theory,” *Community Coll. Rev.*, vol. 51, no. 4, pp. 538–566, 2023.

[11] H. Gutiérrez-Pulido and C. Orozco-Rodríguez, “The contribution of professional internships to the academic development of engineering and science students: a case study,” *Front. Educ.*, vol. 10, p. 1-14, May 2025, doi: 10.3389/feduc.2025.1563361.

[12] S. Vicente, M. Artiles, H. Matusovich, and C. Carrico, “The role of internships on engineering students’ expectations toward their first position after graduation,” *Educ. Train.*, vol. 66, no. 9, pp. 1246–1261, 2024.

[13] Community College Research Initiatives, “STEM Transfer Partnerships,” 2025. [Online]. Available: https://www.washington.edu/ccri/research-to-practice/stp/.

Figure 1. Program Elements by Prevalence

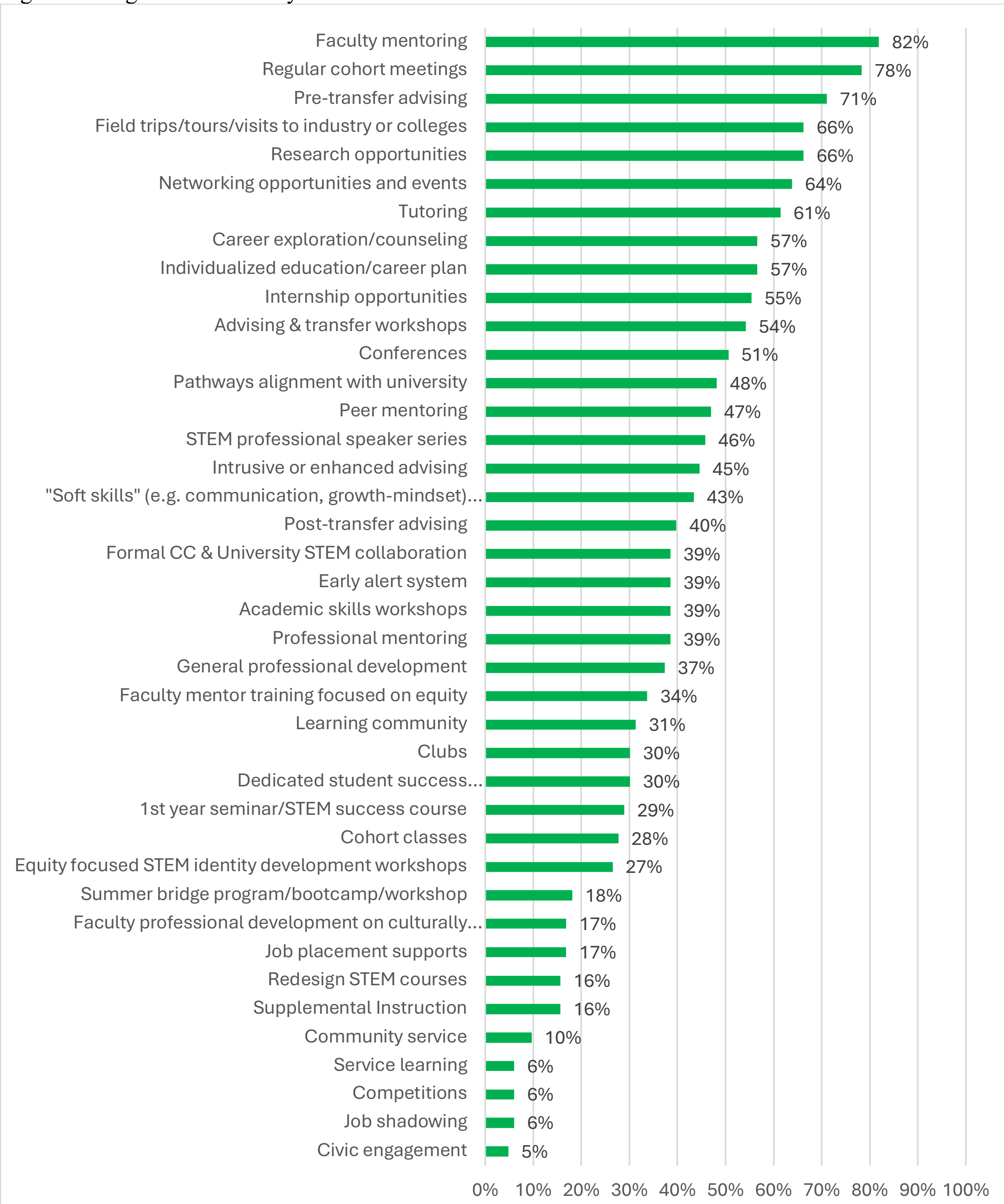

Figure 2. Ten Program Elements Reportedly Most Frequently Used by Students

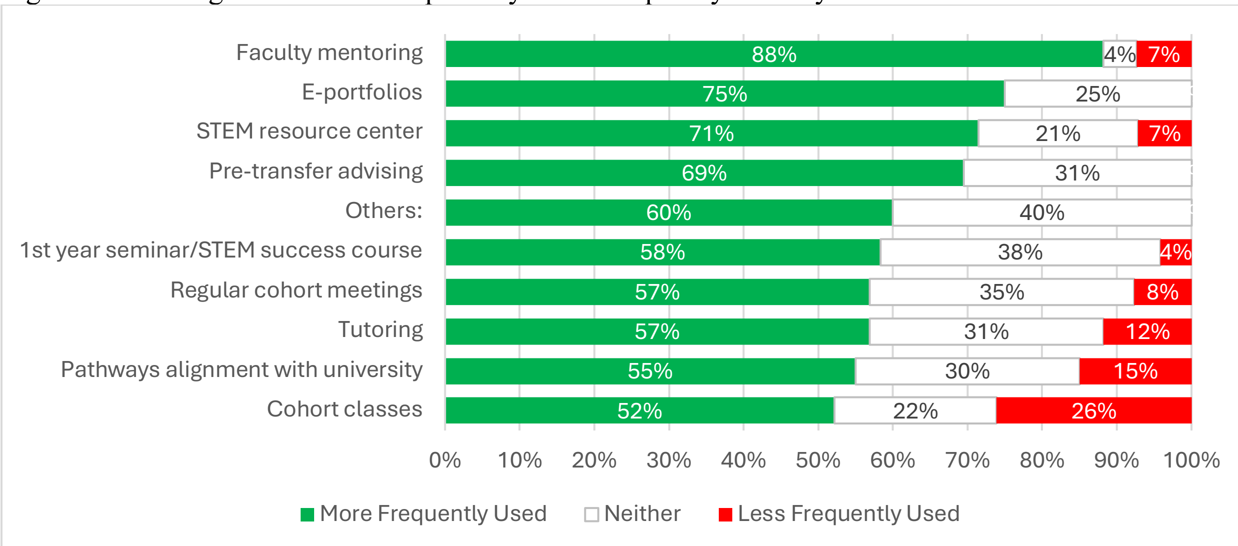

Figure 3. Ten Program Elements Reportedly Most Effective Toward Improving Student Academic Performance (GPA)

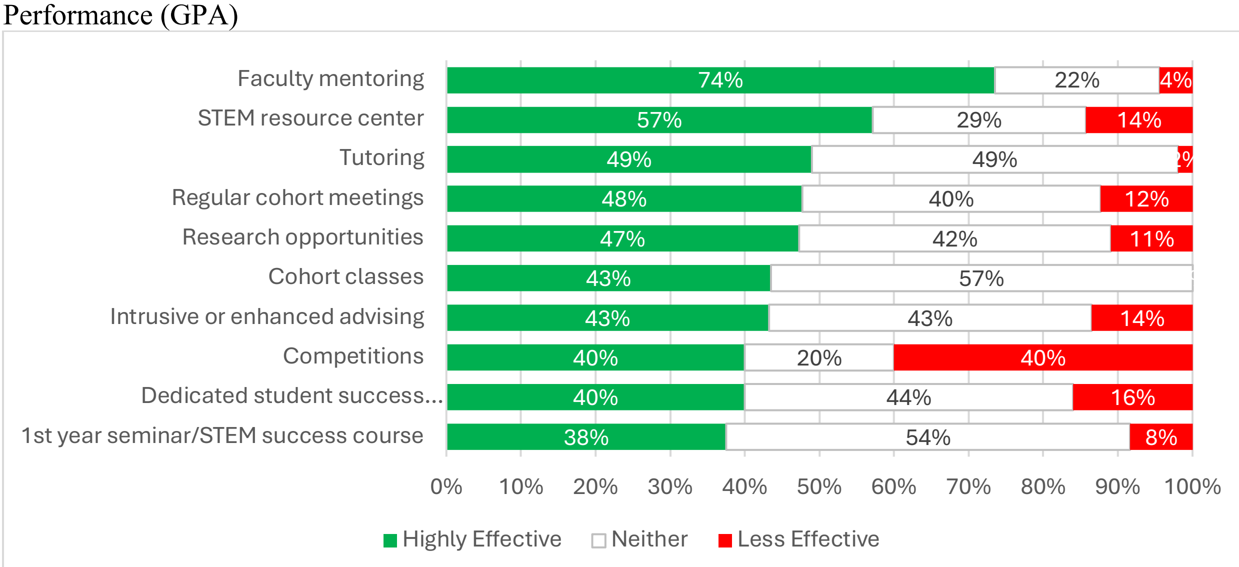

Figure 4. Ten Program Elements Reportedly Most Effective Toward Improving Persistence Toward Degree

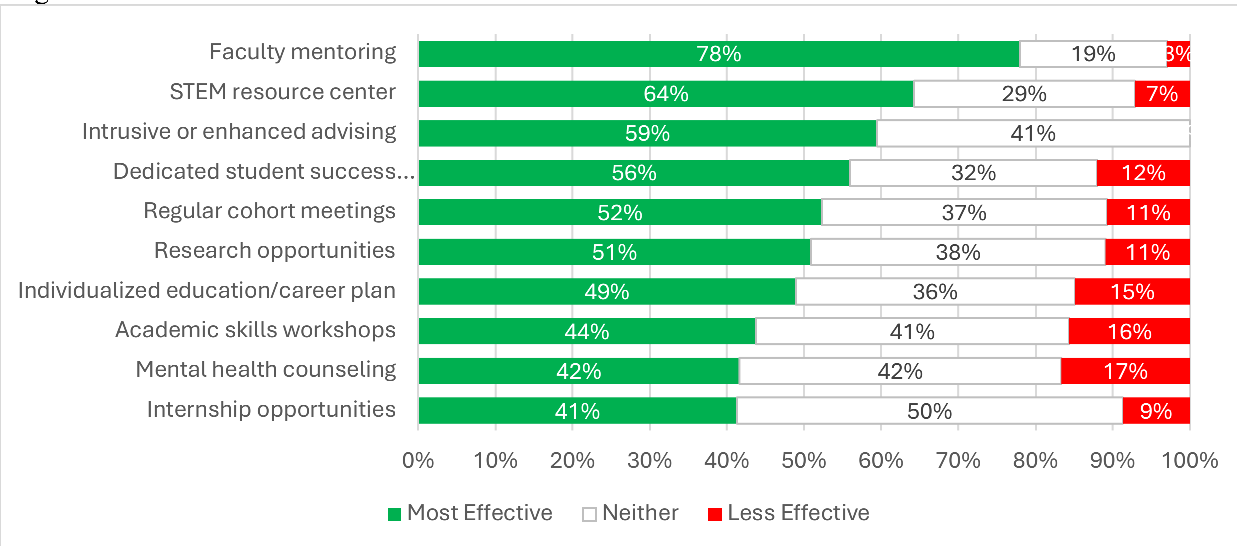

Figure 5. Ten Program Elements Reportedly Most Effective Toward Improving Transfer to a Four-year University

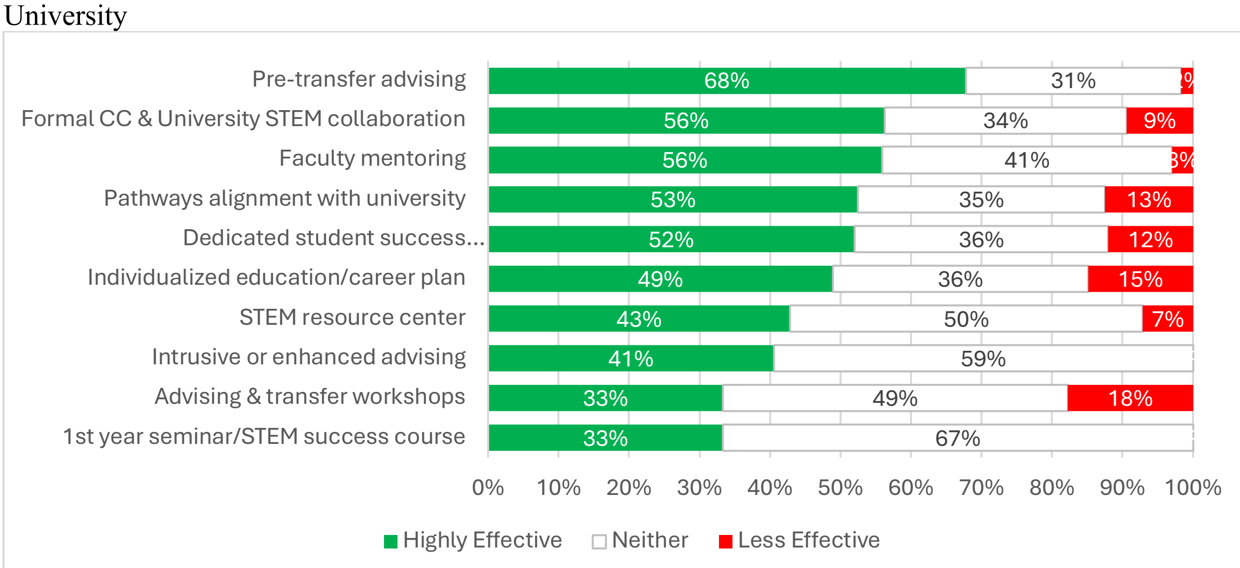

Figure 6. Ten Program Elements Reportedly Most Effective Toward Improving Student Job Placement