Developing and Recasting STEM Centers as Institutional Bridges and Entry Points

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This position paper discusses the existent research focused on STEM centers at colleges and universities, focusing on their critical role to support students from racially minoritized backgrounds. The objective of this work is to present a potential framework to recast the role of these institutional STEM centers at both community colleges and four-year institutions to ensure effective support and transfer of students, especially those from historically marginalized backgrounds. We discuss the importance of these STEM centers as access points, articulate specific actions these centers should take, and advocate for more robust STEM center networks. We utilize data from a recent Louis Stokes Alliance for Minority Participation (LSAMP) Pre-Alliance Planning grant to provide some additional evidence for our argument and posit that STEM centers on campuses can be hubs for connection, facilitate engagement in diverse areas of STEM work, and help establish integral relationships for historically marginalized students' success. We will also discuss critical resources needed when developing STEM centers to help serve traditionally marginalized students. Further, STEM centers can serve as pivotal points in a network, especially between community colleges and four-year institutions to assist in successfully transferring students and conferring bachelor's degrees to underrepresented students. As part of a network, STEM centers can facilitate cross-institutional partnerships, support students through the transfer process, and meaningfully address some of the systemic challenges historically marginalized students face.

Keywords: STEM centers; community colleges; transfer; student retention

Purpose

At a national level, there has been a notable emphasis on establishing the K-16 pipeline to increase retention and success of women and students from historically minoritized racial groups (e.g., Black and Hispanic students) in science, technology, engineering, and math (STEM) disciplines (National Science Foundation, 2019). The development of STEM centers

on college campuses has been deployed as one approach to promote student success, especially for students from historically minoritized backgrounds. Still, there is limited research on these units' role, effectiveness, and operationalization in promoting student success (Carlisle & Weaver, 2018). According to the Network of STEM Education Centers (2021), "STEM education centers and related offices are hubs of campus-based efforts leading transformation of undergraduate STEM education at their institutions and beyond" (para. 1).

While the prevalence and roles of these centers are growing, they are often hampered by the lack of institutional funding, turnover in leadership, and consistent pressure to seek resources through external grants (Carlisle & Weaver, 2019). Because STEM centers are continuing to evolve and increase in popularity, there has been a growing call for a concerted effort to evaluate the role of these entities and the services they provide to make them more effective for the populations they serve (Network of STEM Education Centers [NSEC], 2020).

The purpose of this study is to define further and recast the role of these institutional STEM centers at both community colleges and four-year institutions to ensure effective support and transfer of students, especially those from historically marginalized backgrounds. These centers' role is critical, yet further work is needed to provide guidance and resources to STEM center administrators (Carlisle & Weaver, 2020). Specifically, our results indicate that as institutions continue developing and using STEM centers, their role in encouraging access and support for historically marginalized populations is critical and deserves additional research.

In this study, we discuss the importance of these STEM centers as access points, articulate specific actions these centers should take, and advocate for more robust STEM center networks. We utilize data from a recent Louis Stokes Alliance for Minority Participation (LSAMP) Pre-Alliance Planning grant to provide some additional evidence for our argument. We posit that STEM centers on campuses can be hubs for connection, facilitate engagement in diverse areas of STEM work, and help establish integral relationships for historically marginalized students' success. We will also discuss critical resources needed when developing STEM centers to help serve historically marginalized students. Further, STEM centers can serve as pivotal points in a network, especially between community colleges and four-year institutions to assist in the successful transfer of students and the conferring of bachelor's degrees to underrepresented students. As part of a network, STEM centers can facilitate cross-institutional partnerships, support students through the

transfer process, and meaningfully address some of the systemic challenges historically marginalized students face.

Defining STEM Centers

Despite scant research in this area, STEM centers are increasingly found at four- and two-year institutions where they act as a "clearinghouse" or "umbrella unit" to monitor and promote student engagement in STEM-related activities from a centralized university perspective (Carlisle & Weaver, 2019; Wasserman, 2010). While tracking the number of STEM centers across the nation is an ever-moving target, the Network of STEM Education Centers (NSEC) aims to track and provide support to these centers as they develop and offer best practices in improving undergraduate education for all STEM students. As of August 2021, NSEC engaged with 203 STEM centers from 165 institutions, out of the 297 STEM centers across 218 institutions that have identified STEM centers (NSEC, 2021).

Regardless of institutional type, all STEM centers have the common goal of improving undergraduate education. This improvement is generally done in one of the four ways: (a) educational research, (b) student programming, (c) facilitation of communication, and (d) assistance in building partnerships. These STEM centers are funded in various ways (grant, institutional, college or departmental funded). Still, they have been established based on the emphasis placed by the Office of the President and the National Academies to encourage educational reform focused on STEM (Olson & Riordan, 2012; Singer et al., 2012). As anticipated, most of these STEM centers (89%) are at large universities that produce undergraduate, master's, and doctoral degrees, while only 6% are from schools which offer only associate degrees, bachelor's degrees, or special focused educational opportunities (NSEC, 2021). Because of the variety of funding sources, STEM centers have various structures, target audiences, locations, sizes, missions, and visions. Those highlighted in this article focus on educational reform for undergraduate STEM students through evidence-based educational interventions, support, and research dissemination (NSEC, 2021).

The Context for STEM Education

The urgency to produce a more prepared and competent STEM workforce is apparent in the research (Charette, 2013; National Science Board, 2015; Palmer & Wood, 2014). The literature highlights various barriers that include cultural, societal, and institutional components that may

hinder, and in some cases, prevent racial and ethnic minorities from successfully navigating the STEM pathway toward graduation (Benish, 2018). Attention to the role of STEM education in producing a highly skilled and innovative workforce has increased over the last several decades, driven by globalization and technological advancement (Carnevale et al., 2011; Lynn & Salzman, 2010; National Science Board, 2015). Much of the research focused on STEM fields centers on preparing students for this field and igniting excitement among students toward the STEM professions (Benish, 2018). In addition, there has been a significant increase in programming targeted at underrepresented groups, including women and minorities in STEM through K–12 student engagement and outreach programs (Valla & Williams, 2012). However, educational institutions have struggled to produce a sufficient number of STEM baccalaureate degree-holders with a recent report claiming that the United States needs over one million STEM professionals and over 100,000 STEM teachers to even reach current needs (President's Council of Advisors on Science and Technology [PCAST], 2012).

Assessments of the shortfall in STEM production has come under criticism in recent years, with some citing the approximately 11 million STEM graduates that work outside of a STEM field as evidence that we have too many, not too few, STEM degree-holders (Charette, 2013; National Science Board, 2015; Salzman, 2013). Yet even those who disagree with the dire projections acknowledge that there are a large number of unfilled STEM jobs (Charette, 2013) and that students who graduate in STEM fields have a lower probability of being unemployed than do their non-STEM colleagues (Salzman, 2013).

The National Governors Association (2012), among others (Bahr et al., 2017; Hagedorn & Purnamasari, 2012; PCAST, 2012), has argued that the best way to fill the unmet need of STEM professionals is to recruit and retain students from historically disadvantaged backgrounds. Specifically, students of color have long been underrepresented in STEM (Bystydzienski & Bird, 2006; Leslie et al., 1998; Settles et al; 2006; Simon et al., 2017). While significant gains have been made in recent years in increasing ethnic minorities in STEM education and interest through high school, the number of late-undergraduate study STEM dropout rates for women and students of color (e.g., Black and Hispanic) are concerningly higher than their White, male counterparts (National Science Foundation, 2019). Research indicates that students of color have been shown to experience lower retention rates and persistence than White students, both in higher education and STEM disciplines (Museus et al., 2018). The underrepresentation of students in these groups is problematic for

our nation's economic vitality as it increases equity gaps between racial groups, as STEM jobs are among the highest paying and most stable workforce opportunities (Carnevale et al., 2011). In addition, given the current shortfall of STEM workers, technological advances and innovations may be stymied if an increasing segment of society continues to not be fully engaged in the STEM workforce.

The Role of Community Colleges

In recent years, scholars have begun to focus more attention on the role of community colleges as an educational entry point to STEM baccalaureate degrees and workforce outcomes (Bahr et al., 2017). This would help ameliorate inadequate production and increase the equity of employment opportunities for students from historically disadvantaged backgrounds (Bragg, 2012; Hagedorn et al., 2006). As portals of postsecondary access and equity, there is no level of the postsecondary system more important to marginalized populations than community colleges (Arbona & Nora, 2007; Bush & Bush, 2010). In fact, most students of color (57% of all Hispanic and 52% of all Black students) enrolled in postsecondary education are at two-year colleges (American Association of Community Colleges [AACC], 2015). Thus, the greatest potential for increasing STEM graduates of color is by focusing on community colleges, where these students are overrepresented (Ong et al., 2011; McKinney & Burridge, 2015; Mullin, 2011; Jackson et al., 2013).

Community colleges house a significant population of potential STEM talent, particularly among students of color (Bahr et al., 2017), and STEM centers can be helpful to connect support this talent toward the STEM workforce (Kezar & Holcombe, 2020). In considering effective and innovative strategies that are situated to support students of color in STEM across institutional boundaries, STEM centers are ideal bridges for connecting community college STEM students to four-year institutional resources (Kezar & Holcombe, 2020). Further substantiating the role of STEM centers and their role in transfer student success is vital in the discourse of ensuring a prepared STEM workforce and supporting STEM talent among historically marginalized populations (Carlisle & Weaver, 2019). If the desire is to provide a holistic approach to overall STEM success, STEM centers that span four- and two-year institutions are key to that success.

Historically Disadvantaged Students in STEM

Research focused on inequity, or systemic challenges, in STEM outcomes by race and socioeconomic status has been well documented (Anderson

& Kim, 2006; Riegle-Crumb & King, 2010; Xu, 2013). Our study aligns with the expansive literature, as students who attended community college are likely in a lower socioeconomic status and more likely to be part of minority groups. Many studies have found that historically disadvantaged students face barriers including lack of representation of teachers in their schools, minimal support systems, and insufficient mentoring throughout their K–12 schooling (Bowen et al., 2005; Carnevale & Rose, 2004; Carr & Kefalas, 2009) and throughout postsecondary education that hinder their potential pursuit of a STEM degree or profession (Bahr et al., 2017; Crisp et al., 2009; Gándara & Contreras, 2009; Saenz & Ponjuan, 2009; Wang, 2017).

For example, one study found that African Americans are significantly underrepresented in STEM majors, where their probability of pursuing a STEM major is half that of their White peers (Carnevale et al., 2017). Further, that choice of major was in turn associated with 50% lower lifetime earnings than their White peers. Some of the barriers identified by research include lack of support (Maltese & Cooper, 2017), underprepared teachers (Darling-Hammond, 2006), insufficient school resources (Callan et al., 2006; Carnevalle & Rose, 2004), insufficient personal resources (Bergerson, 2009; Bowen, 2006), and other sociocultural factors that hinder student college-going behavior (Arbona & Nora, 2007; Saenz & Ponjuan, 2009). Once in college, STEM students of color face organizational barriers, including lack of access to resources and role models, and they experience being overlooked and unsupported more than their White peers (Espinosa, 2011; Kohli & Pizarro, 2016; Prescod, Haynes-Thoby et al., 2020). Additionally, U.S.-born students of color often report more negative experiences and pressures than non-U.S.-born students of color (Fries-Britt et al., 2010).

Research has shown that students of color, who are primarily first-generation college students, engaged in mentoring experiences by peers, faculty, or staff are more likely to persist in STEM fields, although their grades are not necessarily directly impacted (Bonous-Hammarth, 2000; Engle, 2007). Of additional benefit to students of color are STEM courses that include evidence-based instructional practices, as they are more likely to engage students and assist with persistence (Ballen et al., 2017). Increasing the resources and adapting traditional approaches has shown to be beneficial when working with diverse student populations (Palmer, 2010). Many studies focusing on increasing diversity in STEM are within the traditional university or K–12 experiences and do not include community colleges. Despite the many essential research advancements in this area, further analyses are needed that capture particular points of

the educational pipeline, such as the bridge between community colleges and four-year institutions.

Positionality

To place this study in context, we will outline the positionality of the authors and discuss the background of the data that frame the discussion presented below. The authors include two faculty members in education, one faculty member from a math department, and a director of a STEM center at a four-year institution. Three of the authors are women, and two are faculty of color. The female faculty of color are alumnae of historically black universities, and the math faculty participated in a research program of science, engineering, and math majors her entire college career. The other author is a White male. All conduct some research in STEM education at the postsecondary level with two focusing on community college pathways to four-year institutions.

Two of the authors were involved in a project funded by the National Science Foundation (NSF), Pre-Alliance Planning: The Bridges Across Texas Louis Stokes Alliance for Minority Participation, that focused on the role of STEM centers in the support and transfer of minoritized student populations, which is where the data for this study was drawn. In addition, three of the four authors have recently had an additional NSF-funded project which will establish an undergraduate STEM center at a large R1 university. Understanding the impacts and primary needs of these STEM centers helped design a plan for the new STEM center and drove this project.

Methods

There are two sets of data being utilized for this study. First, the qualitative data that guided the discussion was collected from 35 community college students across four institutions in one large state. These students participated in focus groups specifically to identify key resources and supports for minority students in STEM disciplines who were interested in transferring from a two-year to a four-year institution.

Second, quantitative data is presented as a result of a survey sent to students at each partner campus. Using a purposive sampling approach, the survey was sent to all participating students and designed to understand the students' use and perception of the resources available on their campuses. Close to 500 students participated in the study across the six partner institutions. All of the students were from historically disadvantaged backgrounds, and most of the students (53%) who completed

the questionnaire were Hispanic, Latino, or Spanish. Most participants self-identified as White (approximately 250 students), Black or African American (about 100 students), or Other (approximately 80). There were fewer than 25 respondents who identified as American Indian /Alaska Native or Asian. Most participants were 18–25 years old (approximately 375 participants). Of the respondents, about 80% had been in college for at least two years. Students pursuing a STEM-related degree made up 58% of the respondents, and of those students, 63% were the first in their family to pursue a STEM degree.

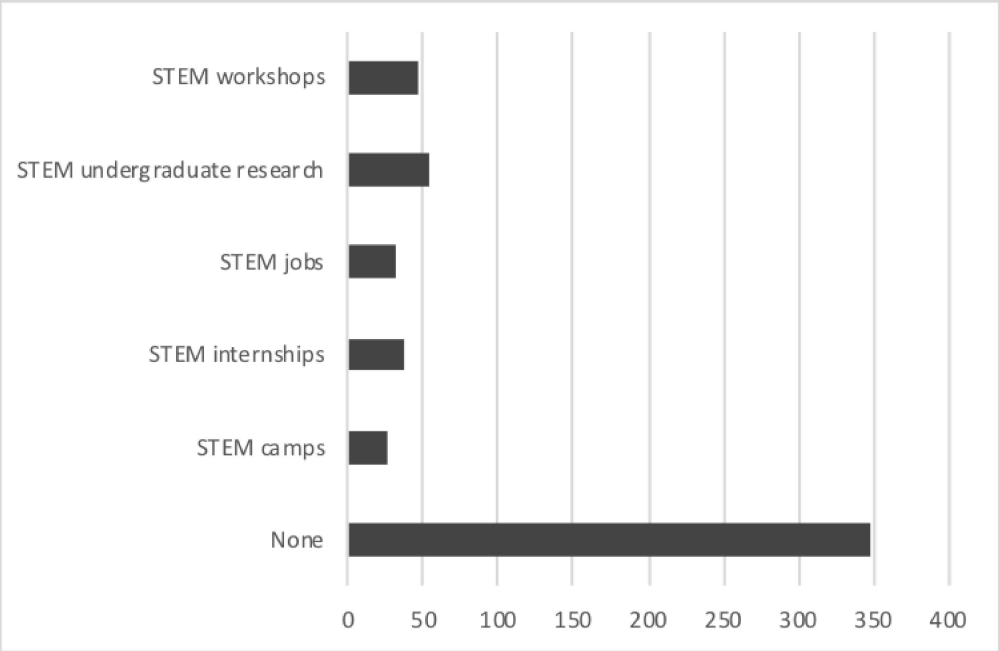
The analysis of the data was centered on understanding the role of STEM centers and the opportunities for recasting these institutional entities. The survey was structured to understand awareness and satisfaction with the STEM centers, while the qualitative data focused on students' lived experiences. To identify themes, we employed Strauss and Corbin's (1998) three-step approach to coding qualitative data: open coding, axial coding, and selective coding. It is essential to note that the focus groups were recorded and transcribed verbatim, without alteration of any kind. The process allowed for the actual experiences of students in their own voice, which is crucial in qualitative research. Because of the differing number of participants at each institution, the data results are not disaggregated by institution, and descriptors will not be used when discussing specific qualitative quotes.

Findings

As an increasing number of higher education institutions implement STEM centers to provide support and services, there is a need to define their role and outline best practices to help assess these entities (NSEC, 2020). Here, we discuss three roles that STEM centers can perform as STEM students enter the institution and two functions of the centers as part of building bridges in an external network. Naturally, these roles require institutional support, strong leadership, and clear purpose from these centers to yield success (Carlisle & Weaver, 2019).

The majority of participants in the focus groups were STEM majors. Yet most had never heard of or participated in STEM-related events, indicating a breakdown in institutional communication about existing resources available for students (see Figure 1).

Figure 1. *Student Participation in STEM Center Programming*



However, some students indicated that some fields within STEM had different schedules and degree requirements, so they were unable to attend due to scheduling and programmatic decisions:

> As a STEM major, I know the Engineering Career Fair is really big. It is a huge resource. But oftentimes, they don't let non-engineers in until after 2:00, and I know, as a chemistry student, I have labs all the time, every year, consistently.

As this student discussed, the STEM event was designed for STEM majors and often promoted through the STEM center, yet some students could not participate due to the requirements of specific majors (Deeken et al., 2020). In addition, most respondents had never interacted with STEM faculty outside of a formal classroom setting, signaling an untapped mentoring potential (Crisp et al., 2009). Interactions with STEM advisors were seen as being highly positive. While we discuss five specific suggestions for recasting and increasing the efficiency of STEM centers that benefit historically marginalized STEM students specifically, these suggestions also help nonmarginalized students.

Institutional Roles of STEM Centers

The complexity of higher education can often lead to an excess of centers for specific student groups or academic goals (Dickeson, 2010). In this cacophony of academic support, it is important that STEM centers are continuously assessed and developed to best support students. Of particular interest is the engagement and success of ethnically minoritized students

in institutions where STEM students and/or faculty are primarily White (AACC, 2015).

This study additionally resulted in a series of suggestions that could form a foundation for that assessment. The first three of these center on the institutional roles that STEM centers play. Specifically, we posit that STEM centers should focus on student integration within their campus community, facilitate engagement in diverse areas of STEM work, and serve as a resource hub for STEM students.

Student Campus Community Integration

As critical elements of campus community integration, STEM centers should host events and gatherings that help students connect with fellow STEM students and faculty. These social gatherings help build a sense of belonging and increase the opportunities for mentoring for students (Strayhorn, 2011, 2015). For example, one student shared that while they had not used the STEM center on their campus for gathering, they did seek out spaces to gather, and on their campus, the library was a critical resource for connecting with others and integrating into their community:

> I always find myself, either by myself or with a couple of friends, using the whiteboard, especially, just trying to make—make sense of all the jumbleness in our heads. You see lines and numbers everywhere. And it's quiet, too, so that helps like a lot.

Further, the connection with faculty in these spaces helps bridge the divide that many students feel and increases the chance that students will engage faculty when in need or considering further STEM education (Crisp et al., 2009). Some students shared how they had faculty willing to engage with them outside of class and how STEM centers could further enhance and normalize this level of engagement.

Facilitate Engagement Across Diverse STEM Areas

As faculty and students build connections in STEM centers, there is an excellent opportunity to increase engaging conversations and promote students' understanding of complex concepts in STEM coursework and the breadth of careers in the STEM workforce. Many students struggle with the difficulty of STEM courses, and STEM centers can be places for students to rejuvenate and better understand their end goals (Bahr et al., 2017). One student said, "If we have questions, we kind of just work together, and so in that same aspect, we're kind of, like, the same thing. So I can say, that that would be one perk to that [participating in center activities]." Similarly, students discussed how centers were also

helpful for connecting faculty and students by facilitating increased interaction between students and faculty. Further, centers can provide support and information about extracurricular experiences for STEM students (Carlisle & Weaver, 2019). As one student said concerning the role of clubs and being more engaged in extracurricular STEM activities, "sometimes you have to remind yourself that it's time-consuming, but you just have to keep going because it helps." Students need to be engaged and informed about the inherent value of these opportunities, which, as students shared, can often feel like additional work. STEM centers should be places where students can be advised and enhance their passion through engagement with other STEM students, faculty, or industry connections (NSEC, 2021).

STEM Resource Hub

Finally, STEM centers should be a hub for resources needed to be successful in STEM coursework. For example, some students discussed the option of checking out many of their expensive STEM course textbooks from their STEM center and utilizing needed software for their courses. As a hub for STEM student resources, these centers become more integrated into the fabric of STEM programs. When categorizing the identified needs and roles a STEM center could take, the top six categories all were related to resources students needed:

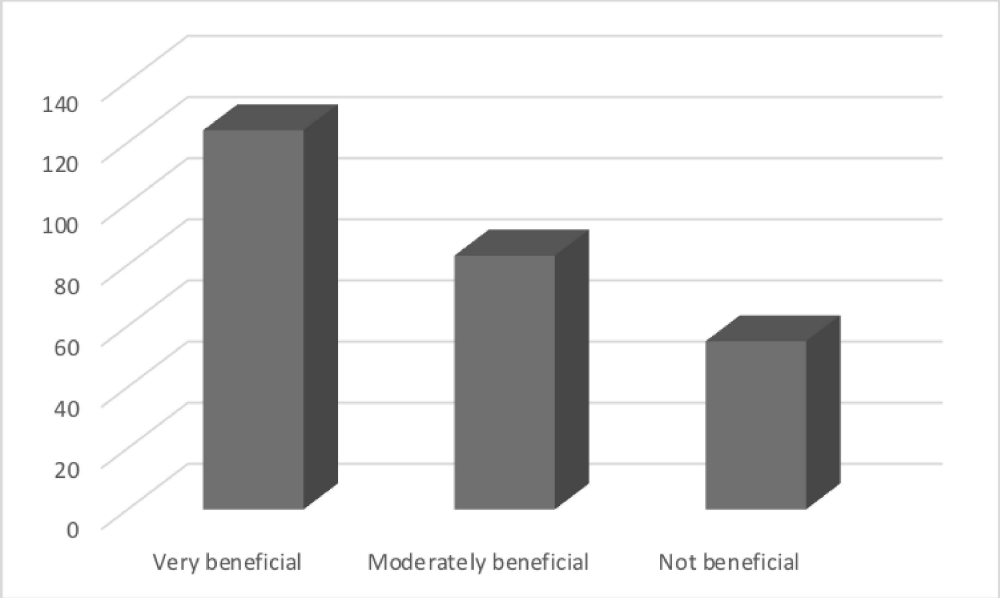
- knowledgeable and accessible STEM advisors
- better lab equipment and resources
- career guidance
- emotional support
- access to people working in industry in various STEM careers
- mentorship opportunities

As centers provide these resources, a natural connection and efficiency will be created that allows multiple STEM departments to work together to provide needed support for students in a centralized location.

One aspect of the resources students discussed was centered on mentoring and advising. Mentors can be from within the college (e.g., faculty or other students) or external from the college (e.g., STEM professionals). As centers lean into their role of being a hub for resources, they will be able to develop strong networks to support structures (Carlisle & Weaver, 2019). Further, the part of academic advisors in student success is evident in three of these categories of needs. Therefore, centers should seek to ensure that they are connected to advisors to better con-

nect students to their appropriate advisor. Results from the survey sent to students about their experiences with STEM resources illustrated that STEM advisors were incredibly beneficial (see Figure 2).

Figure 2. *Students' Perception of the Benefit of Engaging with STEM Advisors*



Fulfilling these roles will often require centers to be conveners and connectors across their campus, or as previously discussed, "the hub" for STEM-related activities.

The Role of STEM Centers in an External Network

In *Inside Higher Ed* (2021), Lavison argued that students need support, clarity, and guidance. STEM centers are ideally situated to provide this much-needed support for instructors, students, and institutions, especially related to success in STEM among underserved and underrepresented populations. According to Carlisle & Weaver (2019), STEM centers can bridge institutional efforts. Through this connection and leveraging strengths among community colleges and universities, STEM centers can maximize institutional and human resources (Carlisle & Weaver, 2019; Horii et al., 2017). Here we share two of the common suggestions for the role of STEM centers in external networks provided by students in our study. While the findings of this study highlight the role of STEM centers as it relates to an R1 institution, the common suggestions are designed to be adjusted to respond to the needs of varying institutional types and demographics.

Institutional Bridges

First, STEM centers play a role in networking among community colleges and universities (Horii et al., 2017). There are several reasons for STEM centers to focus on building strong networks. For example, supporting student transfer from two-year to four-year institutions is challenging, and additional institutional bridges would be helpful. Through these networks, centers can assist in carrying out institutional missions, provide funding, and provide training and professional development for teachers and instructors in STEM (NSEC, 2019). A few students shared that the knowledgeable advising they received helped them avoid taking unnecessary courses and consequently, be better prepared for their four-year university experience. Specifically, one student said, "I almost got into a class that I didn't need for my career and I found out that it wasn't required to transfer, and I took it out immediately.... I mean, the help is there." In a follow-up question, the student described going into a special STEM program run out of their sciences building as the location they went to obtain advice about the transfer process.

Similarly, as opportunities for virtual meetings increase, STEM centers should help share resources such as webinars and tutoring sessions across institutions to support students. In short, STEM centers can serve as critical points in a network, especially between community colleges and four-year institutions (Rocha et al., 2022; Smith et al., 2022). As part of a network, STEM centers can facilitate cross-institutional partnerships, support students through the transfer process, contribute to institutions with needed resources, and meaningfully address some of the systemic challenges historically marginalized students face (Bahr et al., 2017).

Serving as a Connection Point for Students with Faculty Between Institutions

While STEM centers have proven to assist in bridging institutional efforts, increasing institutional networking, and providing instructor training and preparation, STEM centers can also offer direct benefits to students. According to the Network of STEM Education Centers (NSEC), STEM centers can: (a) improve STEM learning experiences among students; (b) increase student enrollment in STEM undergraduate programs for all students, especially students from underserved and underrepresented populations; and (c) improve student preparation (NSEC, 2019). In rethinking their role, these STEM centers can centralize STEM-related resources. Pursuing a STEM degree can be challenging for students and difficult to navigate, but by centralizing support, or at least providing a central location to receive guidance, students will be more effectively

served. This would be especially helpful as students engage in the difficult enrollment process, locating course academic support, and preparing to transfer, as previously mentioned (Smith et al., 2021). The frustration of students is exhibited in this response from a student:

> My issue is since I'm taking like an engineering course with [a four-year institution], but it's part of [a community college], and there are certain instances where you can't find problems or, not find problems but find resources to learn it better. You can try to go online but it still doesn't help. So probably, I, don't know, start one program where individuals can find more resources to learn about it because if you go online, it's pretty vague. You can't find anything you want.

The statement is representative of many students who appreciated a physical space to discuss resources with a person. However, it is important to note that for many students, they did try to utilize online resources as well.

Streamlining the STEM experience and simplifying the process provides students a way to access multiple resources at once. Students are looking for clarity in the information provided to them. STEM centers are aligned to assist this population by not limiting support to a single intervention and designed to provide comprehensive, interrelated support among instructors, student affairs, and additional support resources, which are vital to underrepresented populations (Kezar & Holcombe, 2020). In short, STEM centers can serve as a one-stop shop for STEM students and educators, an "umbrella for all the different programs and funding sources that come and go that create longevity in support services" (Miranda, 2013, p. 6).

Conclusion

While the historical role of STEM centers has a place in student success, developing and recasting STEM centers as institutional bridges and entry points is necessary, provided the changing demographics and student needs (NSEC, 2021; Olson & Riordan, 2012). This shift in operation is essential to ensure the success of the community college and university individuals involved—STEM instructors and support staff and students, both current and prospective (Crist et al., 2009). STEM centers are ideal in bridging the gaps between community college, university resources, and human capital. This shared space can assist in alleviating any overlapping or conflicting resources and communication, allowing for a more unified and seamless experience for students (Kezar & Holcombe, 2020).

This network also allows a chance for community colleges and universities to capitalize on human and institutional resources.

Moreover, these centers can serve as very effective entry points for historically underrepresented and/or underprepared students by allowing students access to information related to the community colleges, universities, and student resources in one location (AACC, 2015). Centralizing these efforts for instructor training and professional development is also vital. Moreover, STEM centers are a great way to enhance engagement for underserved and underrepresented populations who may rely on more comprehensive support.

As we look to the future of our nation and the future of our STEM workforce, we must ensure that this workforce is representative of the talent and skills needed to perform such tasks. Much of this talent lies among our historically underrepresented populations (PCAST, 2012). Diversifying our approach to increase the representation of people that have been traditionally hidden from the STEM workforce will also result in increasing participation among all student populations. Rethinking the role of STEM centers will make our community colleges and universities more efficient and successful in their approach toward STEM students. STEM centers are key to student success and institutional effectiveness.

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Appendix A

Interview Protocol

1. Tell me about your personal and educational background.
2. What degree and/or credential are you currently seeking at (respective institution)?
3. How is that going?
4. How would you describe your experiences as an (African American/Hispanic student) in (STEM area) at (respective institution)?
5. What are some current resources (e.g., mentors, resources, seminars, workshops, studying, finances, time management, etc.) that have assisted in your retention at (respective institution) as an (African American/Hispanic student) in (STEM area)?
6. What individuals have assisted you in making your experiences positive/negative in (STEM area)? How and why?
7. What are some resources (both monetary and/or non-monetary that would make your experiences better in (STEM area)?
8. What can your institution do to make your experiences in (STEM area) better?
9. If you could develop/provide/incorporate 2 resources/programs, etc. to assist you as an (African American/Hispanic student) in (STEM area) at (respective institution) what would it be?
10. Is there anything else that you would like for us to know about your experiences as an (African American/Hispanic student) in (STEM area) at (respective institution)?

Appendix B

Survey Instrutment

I. Tell me a little about yourself
   a. Age (18–21; 22–25; 26–29; 30–33; 34–37; 38+)
   b. What is your ethnicity? (Black/African American; Caucasian; Hispanic/Latino(a); Native American; Pacific Islander; Other: please list)
   c. What is your employment status? (full-time; part-time; none)
      If employed, how many hours/week do you work? (5–9; 10–14; 15–19; 20–24; 25–29; 30–34; 35–39; 40+)
   d. What is your military status? (Active; Reserve; Veteran; IDK). What is your marital status? (Married/Remarried; Single; Divorced; Widow; Separated)
   e. Are you a primary caregiver? (Y/N)
   f. If you answered yes to question, who are you the primary caregiver for? Check all that apply. (Will only appear if the response to "e" is yes.)
      - f.i. Siblings
      - f.ii. Parents
      - f.iii. Children
      - f.iv. Other
   g. What is the highest level of education of mother and father?
      - g.i. Mother
        - g.i.1. Elementary school
        - g.i.2. Middle school/Junior high
        - g.i.3. High school
        - g.i.4. Some college (no college degree)
        - g.i.5. Associate degree
        - g.i.6. Bachelor's degree
        - g.i.7. Advanced degree (Master's, Doctorate)
        - g.i.8. Professional degree (Medical, JD, etc.)
      - g.ii. Father
        - g.ii.1. Elementary school
        - g.ii.2. Middle school/Junior high
        - g.ii.3. High school
        - g.ii.4. Some college (no college degree)

g.ii.5. Associate degree
g.ii.6. Bachelor's degree
g.ii.7. Advanced degree (Master's, Doctorate)
g.ii.8. Professional degree (Medical, JD, etc.)

II. Tell me about your postsecondary education
   a. How many years have you been in college? (0–1; 2–3; 4–5; 5–7; 7+) (round up to the nearest year)
   b. What is your current institution? (El Centro College, McLennan Community College, South Plains College, Texas Southmost College, Texas Tech University, University of North Texas at Dallas)
   c. How many years have you been at current institution? (0–1; 2–3; 4–5; 5+) (round up to the nearest year)
   d. What is your major? (break by institution; check boxes within)
   e. How many credit hours have you completed at current institution? (0–3; 4–7; 8–11; 12–15; 15+; IDK) (round up to the nearest credit hour)
   f. How are you paying for school? (state loans, federal loans, scholarships, personal, parents, all that apply)
   g. Excluding financial support, does your family support you pursuing this degree? (Y/N/IDK)
   h. When are you scheduled to graduate? (Fall 2017; Spring 2018; Fall 2018; Spring 2019; Fall 2019; Spring 2020; after Spring 2020; IDK)
   i. What is your method of transportation to your current institution? (personal vehicle; public transportation; walk; carpool; other)
   j. How long (in time) is your commute from home to school? (5–15 minutes; 16–30 minutes; 31–45 minutes; 46 minutes to an hour; more than an hour) (round up to the nearest hour)
   k. How long (in time) is your commute from home to school? (5–15 minutes; 16–30 minutes; 31–45 minutes; 46 minutes to an hour; more than an hour) (round up to the nearest hour)
   l. As a community college student, do you plan to transfer from the community college to a university? (Y/N/IDK) (will only appear for community colleges)

m. Are you pursing a STEM (Science Technology Engineering Mathematics)-related degree? (Y/N/IDK)
n. Are you the first in your family to pursue a STEM degree? (Y/N/IDK) (This will only appear for those who answered yes to question "j")
o. How likely are you to pursue a STEM-related career? (very likely; somewhat likely; not likely)

III. As a student, tell me about your STEM experiences
a. How often do you interact with faculty and staff in STEM (Science Technology Engineering Mathematics) areas at your institution outside of class time? (Frequently; Occasionally; Rarely; Never; does not apply (select N/A if you are not pursuing a STEM degree))
b. Do you regularly meet with STEM students to study? (Y/N)
c. Did you feel you were well prepared to pursue a STEM degree? (only if they said they are in STEM) (Will only appear if answered yes to II-l)
d. Do you feel prepared to pursue a degree in a STEM-related area? (Y/N/IDK) (Will only appear if answered N/IDK to II-l)
e. Have you participated in any of the following? (STEM internships, STEM jobs, STEM camps, STEM undergraduate research, STEM workshops) (Y/N)

IV. Institutional Resources
a. What resources/programs are currently <u>available</u> at your institution? Select all that apply.
    a.i. Tutoring
    a.ii. Scholarships
    a.iii. Clubs
    a.iv. Advisors
    a.v. Counseling
    a.vi. Success centers
    a.vii. Other, please list.
b. What STEM resources/programs are currently <u>available</u> at your institution? Select all that apply.
    b.i. STEM tutoring
    b.ii. STEM scholarships
    b.iii. STEM clubs
    b.iv. STEM advisors
    b.v. Other, please list.

c. How often do you hear about STEM-related events and programs advertised/marketed on your campus? (Frequently; Occasionally; Rarely; Never)
d. How often do you visit/participate in STEM-related events and programs on your campus? (Frequently; Occasionally; Rarely; Never)
e. How beneficial have you found the following to your experiences as a student in a STEM? If you are not pursing a STEM degree, select N/A.
    - e.i. STEM tutors?
        - e.i.1. Very beneficial
        - e.i.2. Moderately beneficial
        - e.i.3. Not beneficial
        - e.i.4. N/A
    - e.ii. STEM scholarships?
        - e.ii.1. Very beneficial
        - e.ii.2. Moderately beneficial
        - e.ii.3. Not beneficial
        - e.ii.4. N/A
    - e.iii. STEM clubs?
        - e.iii.1. Very beneficial
        - e.iii.2. Moderately beneficial
        - e.iii.3. Not beneficial
        - e.iii.4. N/A
    - e.iv. STEM advisors?
        - e.iv.1. Very beneficial
        - e.iv.2. Moderately beneficial
        - e.iv.3. Not beneficial
        - e.iv.4. N/A
    - e.v. Counseling/success centers or coaching?
        - e.v.1. Very beneficial
        - e.v.2. Moderately beneficial
        - e.v.3. Not beneficial
        - e.v.4. N/A
f. Rate your overall satisfaction with your interactions with STEM faculty.
    - f.v.1. Satisfied
    - f.v.2. Neutral
    - f.v.3. Dissatisfied
g. What has been your general experience <u>inside</u> the classroom as it relates to STEM faculty support?

g.i. Positive
g.ii. Neutral
g.iii. Negative

h. What has been your general experience outside of the classroom as it relates to STEM faculty support?
   h.i. Positive
   h.ii. Neutral
   h.iii. Negative

i. Are there STEM-related resources/programs specific to minorities (e.g., African American/Hispanics) at your institution? (Y/N/IDK). Please list.

V. List the resources that your institution does not have that you feel will be beneficial to your experiences as a student in your area.