Volume 17 (2026), pp. 63-80
American Journal of STEM Education: Issues and Perspectives
Star Scholars Press
https://doi.org/10.32674/k392sg06

Innovative Institutional Change: Improving STEM Enrollment, Completion, and Transfer Rates at a HSI Texas Community College

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ABSTRACT

Addressing higher education organizational policy, programs, and practices that improve access into STEM degree programs requires innovation, commitment, and collaboration. We relied on Lewin's change theory to study how a STEM Honors program in a Hispanic-serving community college implemented innovative inclusion-focused and high-impact initiatives and practices to expand and increase STEM enrollment,

persistence, transfer, and completion rates to regional universities. Our findings suggest that when community college STEM-related programs effectively collaborate with regional institutions, these efforts improve students' sense of belonging in STEM programs, improve the likelihood of successful transfer and completion rates, and increase participation in the STEM workforce.

Keywords: Collaborative STEM initiatives, Community Colleges, Organizational change

Editors: Dr. Taziah Kenney (Rowan College at Burlington County) | Dr. Kim C. O'Halloran (Rutgers University)

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INTRODUCTION

Disparities in educational outcomes by race and ethnicity, and gender in science, technology, engineering, and mathematics (STEM) postsecondary programs remain a vexing educational issue. Although Hispanic, Black, and female students are as likely as their White peers to declare a STEM major, historically they have a greater likelihood of switching to non-STEM degrees or leaving without a college degree (Costello et al., 2023; Riegle-Crumb et al., 2019). The low persistence and completion rates of historically underrepresented students in STEM programs present a challenge for higher education to produce enough graduates for the growing STEM workforce demand (Atindama et al., 2025; Taylor & Arbeit, 2024). While Hispanics and Black students remain underrepresented in STEM career positions requiring at least a bachelor's degree, the current number of STEM degree recipients still does not meet the nation's demand for STEM workers (National Science Board, 2024).

Scholars have found potential institutional and systemic barriers that inhibit degree enrollment, transfer, and completion rates by students' race, ethnicity, and gender (Costello et al., 2023; Estrada et al., 2016; Fry et al., 2021; McGee, 2020; Nkrumah & Scott, 2022; Nunez, 2014). While these historical disparities in STEM educational outcomes continue, this research study on community college pathways to a STEM program may provide a compelling narrative for effective and sustainable systemic institutional change.

PURPOSE AND RESEARCH QUESTION

This research study aims to understand how Hispanic-serving community colleges develop commitment, innovation, and collaboration with four-year institutions to increase student participation and completion rates in STEM undergraduate programs. The research question guiding this study is: How does a Texas Hispanic-serving community college work within and between postsecondary institutions to transform how to help all students, especially historically underrepresented students, to successfully enroll, persist, complete, and transfer to complete a STEM bachelor's degree or higher?

LITERATURE REVIEW

STEM Student Success at Community Colleges

There is ample evidence that the pathway to a four-year STEM degree for historically underrepresented students often begins at the community college (Bahr et al., 2023; Dinh & Zhang, 2021; Zhang, 2022a). Many Hispanic and Black students enroll and attend their local community college because of affordability (Hurtado et al., 2020), proximity (Sansone, 2023), and family or work obligations or both (Carales, 2020). Because community colleges often enroll more significant proportions of students historically underrepresented in STEM than four-year institutions, scholars have argued two-year institutions of higher education have the potential to promote and improve the STEM pathways for underrepresented racial and ethnic and female students (Ashcroft et al., 2021; Draganov et al., 2025; Leoni, et al., 2023; Smith & Van Aken, 2022; Varty, 2022).

However, systemic institutional barriers exist to student success in STEM programs at community colleges (Cohen & Kelly, 2018; Draganov et al., 2025; Wheatly et al., 2007). For example, students' challenges achieving success in STEM programs are related to navigating critical gateway courses (Sanders, 2021); coping with STEM faculty who have implicit bias against underrepresented students (Fox, 2020; Varty, 2022); limited opportunities for faculty mentoring (Fox et al., 2017; Williams, 2022), and challenges accessing academic support services (Perez, 2018). Consequently, students who start at community colleges aspiring to succeed in STEM programs face these challenges by successfully transferring to a four-year STEM degree program (Zhang, 2022a) and completing their STEM bachelor's degree (Griffin, 2019; Smith & Van Aken, 2020; Zhang, 2022b).

Student transfers from community colleges to four-year institutions

Scholars have argued that these institutions have the potential to promote and improve the pathways for historically underrepresented students into STEM degree programs and future careers (Ashcroft et al., 2021; Holland-Zahner & Harper, 2025; Leoni et al., 2023; Smith & Van Aken, 2022; Varty, 2022). However, upon closer review, scholars have noted that many students who start in community colleges face challenges in successfully transferring to a four-year STEM degree program (Zhang, 2022a) and completing their STEM bachelor's degree (Smith & Van Aken, 2020; Zhang, 2022b).

STEM education improvement initiatives

Scholars have developed STEM education improvement initiatives to increase understanding, development, testing, and selection of innovations to remove barriers and provide additional support that increases student enrollment and improves STEM student success (Allen et al., 2022; Costello et al., 2023; Freedman et al., 2023; Lopez et al., 2022; Nkrumah & Scott, 2022). For instance, programs such as Unified Community of Support (Kezar & Holcombe, 2017), Institutional Intentionality (National Academies of Sciences, Engineering, and Medicine, 2019), Inclusive Enrollment Honors (National Collegiate Honors Council, 2020), and Ecological Systems Framework for Educating the Whole Student (Yao et al., 2023) are types of inclusive student success initiatives developed within the last decade. These initiatives emphasized tracking institutional successes and failures, collecting empirical data to determine if postsecondary institutions improve STEM student educational outcomes.

The composite of this literature suggests a need for greater focus on community college STEM success focused initiatives that help underrepresented students who seek to transfer to a STEM academic degree program (Gray et al., 2022) and partnerships between community colleges and four-year institutions (Grote et al., 2021; Pretlow et al., 2022; Zhang, 2022a). This literature review provides a rationale to explore further intra- and inter-institutional factors that may shape students' STEM transfer rates from community to university, especially for historically underrepresented students.

THEORETICAL FRAMEWORK

Organizational researchers have relied on Lewin's organizational change model to explain how organizations change to address pressing challenges (Cummings et al., 2016; Hussain et al., 2018). Scholars have

used Lewin's three-stage model (e.g., unfreeze, change, and refreeze) to address racism in organizations (Burnes, 2020; Trenerry & Paradies, 2012). Recent education scholars have relied on Lewin's planned change theory to understand how STEM programs need to focus on and address potential institutional-level barriers to empower students to seek STEM programs, reframe how STEM programs meet students' diverse learning needs, and collaborate across units to ensure long-term success (Estrada et al., 2016). This research study used Lewin's organizational theory to see how a community college unfreezes dated institutional factors, changes STEM education programs, and refreezes efforts to improve how it serves underrepresented student groups.

Our research study builds on the STEM education literature by investigating ongoing institutional STEM education organizational change efforts that borrow from STEM student success studies. It relies on Lewin's change theory to inform the implementation of multiple integrated interventions and tracks successes and failures over ten years (i.e., 2014 to 2024) at a Hispanic-serving community college.

RESEARCH METHOD

Data Source and Sample

We conducted this research study in a Texas Hispanic-serving community college with a student population of over two thousand, and approximately 65 percent female, 42 percent Hispanic, a third over the age of 22, 40 percent have low SES status, and 35 percent have first-generation status. For the past five years, we collected data on enrollment and transfer rates, faculty instructional practices, and reflections from administrators and professional staff. The individual participants are the essential actors and observers of change who work to improve group relations within and between the focal institutions (Lewin, 1947a). Therefore, we collected interview data from local high schools and four-year institutions participating in a STEM-mission regional transfer alliance organized by the community college since 2019. The community college's Institutional Review Board approved this study's sampling, data collection, and data analysis methods.

Qualitative research design

We used an exploratory case study design to understand how this Hispanic-serving community college, in collaboration with other educational institutions, worked to improve STEM student enrollments, persistence, completions of Associate of Science degrees, transfers to universities, and completions of bachelor's degrees in STEM disciplines within the STEM-mission Regional Transfer Alliance (Baxter & Jack, 2008; Yin, 2018). This research design allowed us to effectively explore

various forms of tangible (e.g., enrollment rates) and intangible organizational (e.g., faculty practices) factors shaping students' trajectories in STEM programs across different educational sectors. Finally, we used Lewin's change theory to make meaning of the institutional leaders' steering of planning and action to implement integrated theory-grounded student success innovations that increased STEM participation and student success.

Measures

We used institutional data from multiple sources (e.g., enrollment patterns, mentoring practices) to explain the real-life interventions that are too complex for a single survey instrument to capture or implausible for control-group experimental strategies (Baxter & Jack, 2008). We critically examined and analyzed the content of project records (e.g., notes from leadership team meetings and external evaluation reports) to describe and understand the perceived quality and adaptations of the innovations and the extent of the degrees of intra- and inter-institutional collaboration efforts. In evaluation language, we utilized the case study data to examine how implementation of new programs and practices changed institutional efforts to improve educational outcomes for underrepresented students (Baxter & Jack, 2008; Fishman & Penuel, 2018).

Data analysis

We examined various organizational change initiatives focused on building activities to understand how they improved underrepresented students' sense of belonging in STEM (National Collegiate Honors Council, 2020; Rainey et al., 2018; Yao et al., 2023), faculty embrace of a culture of high expectations for inclusive STEM student success (Saenz et al., 2015; Zuckerman et al., 2024), and departmental and inter-institutional collaboration in motivating and supporting STEM student success at the intersection of race/ethnicity and gender (Kezar & Holcombe, 2019).

To measure the effectiveness of the STEM program initiatives, we measured the changes in STEM student enrollment data from 2014 to the present. Additionally, we measured changes in fall-to-fall retention rates in STEM programs to describe student persistence and their sense of belonging. Finally, we used an annual force field analysis to measure institutional change and commitment to this collaborative STEM program (Lewin, 1946, 1947a,b). Specifically, we explored the potential various internal and external forces that may drive or restrain an organizational change in initiatives or decision-making (Lewin, 1947a).

Limitations

This research study had several limitations that deserve attention. First, this study focused on one community college with a large Hispanic

student population, which may not be true for other community colleges. Next, this study spanned many years with various changes in leaders, faculty members, and professional staff at the community college and a local four-institution, which suggests that not all institutions may have a similar organizational structure to mimic the dynamics found in this study. Finally, this study relied on institutional data that may have some spurious student data and outcomes. Despite these potential limitations, our findings provide some promising and insightful best practices.

FINDINGS

This study examined how a Hispanic-serving community college collaborated with other educational institutions in a STEM-mission regional transfer Alliance. After an extensive content analysis of the institution's change work and student data, we identified five essential interrelated institution-wide innovative interventions to improve inclusiveness in STEM degree programs, to broaden underrepresented students' participation in STEM programs, and to increase their enrollment, transfer, and completion rates in STEM bachelor's degree programs.

STEM Honors program inclusive initiatives

The Honors STEM program is a hallmark and core intervention developed for all community college students, especially underrepresented student groups, pursuing a degree with a STEM focus. The program offered needs-based scholarships to attract and support the participation of academically motivated (e.g., a grade point average of 2.8 or higher) low-income community college students. Unlike other honors programs that solely focused on academic achievement, this program gave honors designation based on students' proactive academic behaviors such as meeting with a faculty mentor, attending approved STEM-related seminars or workshops, conducting undergraduate research or completing a contract for advanced academic work, involvement in career shadowing or internship, and participation in a STEM Study Abroad program.

The STEM Honors program's inaugural year enrolled six students in 2017. Since its inception, the program has had a high of thirty Honors students in one year and a median of thirteen students per academic term. In Spring 2024, the program offered ten needs-based STEM scholarships (i.e., two at the community college and eight at the transfer institution).

STEM-mission Regional Transfer Alliance (SRTA) and Steering Delegation for STEM Success (SDSS)

The SRTA was a collaboration initiative between a Hispanic-serving community college, regional secondary school districts, and local four-year institutions. It aimed to improve underrepresented students' enrollment in STEM associate programs, enhance their sense of belonging, and remove institutional barriers to transferring to bachelor's degrees in STEM disciplines at regional universities. The alliance created the SDSS as a collaborative mechanism to facilitate these stated aims.

The SDSS represented academic and student services professionals from the community college and three local universities that "steered" the collaborative action plan to increase the college's STEM student enrollments, transfers, and completions over an extended period (e.g., 2014 to 2026). They facilitated the negotiation of STEM Faculty Liaison agreements at each partner university to expand access to research opportunities and activities that encouraged underrepresented students' confidence and sense of belonging in STEM higher education. Records review in 2024 showed the STEM Faculty Liaisons at four universities continued meeting monthly with the STEM Honors Coordinator.

As part of the force field analysis late in Spring 2024, these institutional liaisons described their successes in working with the Honors STEM students. They were enthusiastic about continuing to collaborate in providing undergraduate research opportunities, expanding the success of the STEM Honors initiatives, and increasing the number of transfer successes to their universities.

Initially, the SDSS indicated a willingness to achieve the collective goals; however, eventually, the institutions viewed each other as competitors rather than collaborators in support of student recruitment and transfer success. Unfortunately, the SDSS disbanded in 2023, and all action and implementation plans reverted to the community college's leadership team, including the Vice President of Instruction.

Despite the dissolution of the SDSS, the first cohort of STEM Honors students transferred to STEM programs at universities within the STEM-mission Regional Transfer Alliance in fall 2023. Perhaps these unique inter-organizational initiatives leveraged Lewin's change theory to understand how a community college could change to improve communication, transparency, and innovative programming.

Academy of STEM Mentors

In 2021, the college initiated the Academy of STEM Mentors program to augment the Honors initiatives through mentoring relationships. The community college developed a program to formally facilitate a beneficial STEM mentor-protégé relationship to assist and

empower underrepresented students. Open to faculty at the college and the university STEM Faculty Liaisons, the Academy participates in an ongoing iterative-discursive process utilizing action research to improve mentoring relationships. Student participation in Academy sessions ranged from eight to ten students. In spring 2024, the Academy of STEM mentors program included seven STEM faculty-student protégé relationships compared to none in 2014.

Unified Academic-related Support Services

In a complementary fashion, the community college provided several academic-related support services to improve STEM students' pathways to completing a community college degree, successful four-year university transfer, and completion of a STEM bachelor's degree. For example, this included financial resources to increase professional staffing in the Honors STEM program, professional development for STEM faculty members to train them to use inclusive pedagogy and active learning methods, a STEM Student Center with peer tutoring and supplemental instructors, and an eight-week project-based and field trip-rich First Year Experience course. The amalgamation of these efforts reflected the comprehensive approach to institutional changes to support underrepresented students in STEM programs. This may suggest that the institution made a tangible commitment to institutional change to improve STEM educational outcomes for underrepresented students.

Student educational outcomes based on Institutional initiatives

Honors STEM program enrollment rates

Since 2017, when the first six students were matched with an Honors Mentor at the Hispanic-serving community college, the number of students enrolled in Honors has ranged up to as many as 30, with 13 as the median per term, which matched the number of Honors students in spring term 2024. This may suggest that the institutional initiatives positively impacted the Honors STEM program.

STEM degree program enrollment rates

The college had an average of 129 students in declared STEM majors from 2015 through 2024. The average proportion of underrepresented students was 48 percent before 2017 and rose to 54 percent through 2024. The average retention rates in STEM degree programs from fall to fall increased to 84 percent, suggesting positive learning experiences that may have encouraged them to remain in STEM programs.

STEM transfer patterns and degree completion rates

Fall 2023 saw the college's first group of STEM Honor students with project documentation of transfer to STEM programs at universities within the college-facilitated SRTA. The average number of STEM students transferring to universities in the SRTA was ten students before 2017, averaging thirteen students through 2024. Before 2017, underrepresented students seldom completed a STEM degree. However, in 2024, 66 percent (i.e., 6 of 9 students) Hispanic students completed an Associate of Science and one of two completed a STEM bachelor's degree. Hispanic students, especially Hispanic females, had the most improved academic outcomes compared to other peer groups. This may suggest that inter-intra institutional decisions to support programs like the honors program, mentoring programs, and additional professional development of STEM faculty members may have a cumulative improvement.

DISCUSSION AND IMPLICATIONS

The guiding research question for this study was, how does a Texas Hispanic-serving community college work within and between postsecondary institutions to transform how to help all students, especially historically underrepresented students, to successfully enroll, persist, complete, and transfer to complete a STEM bachelor's degree or higher? We found that the college's STEM education institutional change work, since the inception of various initiatives (e.g., STEM Honors, SRTA, and SDSS), has led to modest but positive increases in underrepresented students' enrollment, retention, and transfer rates in STEM programs.

Many factors may determine how some community college students consider pursuing a STEM academic program (Bahr et al., 2023). Earlier research showed how scholars, leaders, faculty, and practitioners attempted to improve how historically underrepresented students pursue a STEM degree program (Dinh & Zhang, 2021; Fox, 2017). Therefore, it is essential to understand how community colleges create ideal educational experiences that help these students thrive in these programs. Unfortunately, some research has often focused on a deficit-based narrative to explain the paucity of representation in these STEM programs and workforce (Duncan et al., 2023; Zeidler, 2016). That is, scholars believed that the lack of STEM enrollment for some student groups was directly related to individual characteristics (e.g., unprepared or unmotivated)

We relied on Lewin's planned social change theory to explore how institution-led collaborative initiatives could improve inclusive efforts in STEM programs (Burnes, 2020). This Hispanic-serving

institution focused on unfreezing the status quo on addressing STEM education for underrepresented students to create new partnerships and collaborations between four-year institutions (Cummings et al., 2016; Estrada et al., 2016; Lewin, 1947a). This institutional change aimed to change how they worked with students (e.g., Honors STEM program) and to refreeze improved systems to increase enrollment, persistence, transfer, and completion of STEM-related degrees.

We found that the community college unfreezing the traditional approaches of improving STEM student success by not relying on implicit bias (e.g., teaching practices) and deficit-based explanations of low rates of underrepresented STEM students (Duncan et al. 2023; Zeidler, 2016) For example, the creation of the Honors STEM program leveraged an inclusive and asset-based approach to empower these students (Hurtado et al., 2020). As a result, the community college faculty and leaders recognized that the STEM honors program acknowledges and encourages students who have innate talents that could be guided to pursue STEM education and career opportunities.

Lewin argued that a critical organizational change element requires a shared commitment to sustainable change (Lewin, 1946). We found that the STEM Regional Transfer Alliance (SRTA) created unprecedented conversations to increase transparency and collaboration between postsecondary institutions. These collaborations enhanced the likelihood of underrepresented community college students successfully transferring into STEM four-year programs (Grote et al., 2021; Kezar & Holcombe, 2020).

Similarly, the Steering Delegation for STEM Success (SDSS) was an effective institutional effort to increase the collective focus of academic administrators, faculty, and Honors professional staff on organizational change to increase inclusivity in STEM programs. The committee developed the action plan that set the performance targets at the universities and negotiated STEM Faculty Liaison agreements at their universities. However, we found that the inter-institutional delegation proved unworkable in "steering" the long-term change work. The negotiated STEM Faculty Liaison agreements proved more successful as an inter-institutional structure for the shared mission of removing barriers to transfer success and developing students' capabilities, sense of belonging, and success in STEM higher education (Rainey et al, 2018; Xu & Lastrapes, 2022).

The Academy of STEM Mentors and the STEM Student Center, staffed with peer tutors and supplemental instructors, and a project-based active-learning first-year experience course, illustrated a powerful intra-institutional commitment to foster positive learning experiences for all students, including those historically underrepresented in STEM (Anderson et al., 2019; Zaniewski, 2016). The benefits of the Academy

STEM mentor program support prior research that has shown this mentoring model is an effective academic intervention for underrepresented students (Eby et al., 2008; National Academies of Sciences, Engineering, and Medicine, 2017; Nkruma & Scott, 2022; Saenz et al., 2015; Stelter & Kupersmidt, 2020; Zuckerman et al., 2024). The college's commitment to these and other elements of building a unified community of support for STEM student success (Kezar & Holcombe, 2019; Peters et al., 2019) aims to improve their sense of belonging in STEM (Rainey et al., 2018; Xu & Lastrapes, 2022).

IMPLICATIONS FOR PROMOTING INSTITUTIONAL CHANGE

Finally, this Hispanic-serving community college relied on various organizational change initiatives focused on departmental and inter-institutional collaborations (Reinholz et al., 2021) that improved the educational outcomes for underrepresented students (Kezar & Holcombe, 2019). Other community colleges must address how they serve these students via innovative programming (e.g., Honors STEM programs, Academy of STEM mentors, Student Success Center) and faculty members who create an inclusive learning environment that enhances their sense of belonging (National Collegiate Honors Council, 2020; Rainey et al., 2018; Yao et al., 2023; Zuckerman et al., 2024). Although there were some setbacks with some initiatives (e.g., SDSS), the community college remained committed to supporting other initiatives that assisted students into STEM programs and careers. Finally, other community colleges should not work in isolation to ensure success in STEM programs. The SRTA was an effective institutional change effort that allowed the community college to work with other local universities to improve transfer pathways and STEM degree completion.

CONCLUSION

This study's findings illustrate that there are no easy or quick institutional fixes to improve STEM educational outcomes for underrepresented students. Our findings provide promising evidence that an institution's commitment to innovation and collaboration is essential to achieve institutional transformations that disrupt the reproduction of exclusivity in STEM higher education. Community colleges must commit to coordinating intra- and inter-institutional collaborations to invite all students, especially underrepresented students, to enroll, persist, and transfer into STEM programs at four-year institutions.

Future research requires additional qualitative data to help capture how these leaders make meaning of such complex collaborations and

innovative initiatives. This is especially salient due to the recent federal and state policies that have impinged these important institutional initiatives focused on certain student populations. Nonetheless, community colleges must be willing to engage in critical self-reflection and a commitment to sustainable and collaborative institutional change work that expands all students' access to STEM degree programs and the workforce.

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Note: The authors did not use OpenAI's ChatGPT or any other AI tools in the drafting, editing, or refining of this manuscript. All content was generated, reviewed, and refined solely by the authors.