

Community College and University Collaboration for STEM Teacher Preparation

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We examined a collaboration between a community college and a university that aimed to encourage STEM majors to pursue science and mathematics teaching careers. This qualitative study examined the impact of recruiting students and offering UTeach replication courses at a community college on students' interest in teaching and actual matriculation rates into an educator preparation program. Several barriers were identified, including nuanced financial barriers, interinstitutional challenges (ex., the way courses were transferred), student inability to move to the university's location, and cultural differences at the university campus that decreased student interest in matriculation. The study also found that the program increased student interest in STEM teaching, strengthened student confidence in their teaching ability, and materially changed students' educational plans.

Keywords: community college partnership; STEM teaching; educator preparation; barriers to transfer

A qualified science, technology, engineering, and mathematics (STEM) labor force is essential to the United States. Such a workforce serves as “the foundation for effective employment, immigration, science and technology, education, and national security policies” (Hira, 2022, p. 31). This is a concerning need, with the National Science Foundation (2018) projecting

that the United States may see more than 2 million vacant STEM jobs in 2025. In addition, there has been a shortage of diversity in both STEM education and the STEM workforce. In fact, in 2018 over 730,000 students received a STEM degree but only 25.9% of that number “were underrepresented racial minorities (Blacks, Hispanics, Alaskan/American Indian, and two or more

ances)” (National Center for Education Studies, 2019). Furthermore, women in STEM have continued to be an under-represented group even though women “are more likely than men to earn college degree” (Koch et al., 2022, p. 1). These shortages have also been present in STEM teacher candidates.

Although the STEM teacher shortage has been documented for decades, it continues to grow (Ingersoll & Perda, 2010; Possy, 2018; National Academy of Sciences, National Academy of Engineering, & Institute of Medicine, 2007, 2010; National Commission on Mathematics and Science, 2000; Watt et al., 2007). In fact, according to the U.S. Department of Education (2023), in the academic year 2022–2023, 31 states experienced a shortage of mathematics teachers and 34 states experienced a shortage of science teachers. In addition to teacher shortages, there has been a growing mismatch between the racial and ethnic diversity of the U.S. student population and that of its teacher population, threatening to hinder equitable instruction (Ingersoll et al., 2019).

In response to both needs, the faculty at Stephen F. Austin State University (SFA, 2024) developed the JacksTeach program, a replication of the University of Texas at Austin’s (UT Austin) UTeach program, which was created to recruit undergraduate STEM majors into the field of teaching. In order to support the JacksTeach program, SFA faculty applied for the National Science Foundation’s Robert Noyce Teacher Scholarship Program with a project entitled the Talented Teachers

in Training for Texas eXpanded (T4X) in 2020 (Hubbard et al., 2021). This application expanded previous work with a focus on increasing the enrollment of community college students as STEM majors pursuing teacher certification. Specifically, a new partnership with Lone Star College-Houston North (LSC-HN) was initialized and used to expand SFA’s efforts to produce highly effective, highly trained, and diverse STEM educators. LSC-HN was formed in fall 2019 out of three educational centers in the Lone Star College system, which were specifically chosen because they were in high-needs locations. LSC-HN assigns every student a mentor, offers only 8-week courses, and prides itself on personally adaptive support (Lone Star College, 2024). LSC-HN’s individualized support and mentorship made it an ideal partner for SFA and the UTeach replication program.

Purpose of the Study

This qualitative study examined the partnership between SFA and LSC-HN and the partnership’s efforts to recruit diverse teacher candidates for enrollment in the SFA educator preparation program. This research was guided by the following research questions:

1. What influence did the UTeach replication courses (JacksTeach courses) have on STEM-teacher recruits’ interest in teaching and perception that they were prepared to teach?
2. What barriers prevented prospective teachers from entering

an educator preparation program?

Program Overview

The T4X program offered two SFA JacksTeach courses at LSC-HN taught by LSC-HN faculty hired as SFA adjunct faculty. JacksTeach Step 1 was a one-credit exploratory course in which students learned about the theories and practices of inquiry-based STEM teaching, learned the process of designing and preparing lessons, and obtained firsthand experience in planning and implementing lessons in elementary classrooms. JacksTeach Step 2 was similar, but it allowed students to explore teaching through lesson planning and implementation in middle school classrooms. Additionally, all students enrolled in the LSC-HN JacksTeach program were assigned a mentor teacher from Aldine Independent School District who allowed students to observe them and provided feedback and coaching after the students taught lessons. Given the unique constraints experienced by LSC-HN students, these courses were combined into a single course. This combined course was offered twice, and therefore two cohorts of students were invited to participate in interviews for this study. Following the completion of the course, students were encouraged to apply for the T4 scholarship. This scholarship would award \$15,300 annually to each winning student so they could pursue a STEM degree with a 7–12 teaching certification through the JacksTeach program at SFA. The

scholarship required that the recipient make a 2-year commitment to teach in a high-needs school for each year the scholarship was awarded.

Literature Review

UTeach

The UTeach program began at UT Austin in 1997. The program was rooted in the passage of Texas Senate Bill 994 (1987), which did away with education majors for secondary teachers, instead requiring they take an “academic major or interdisciplinary academic major including reading, other than education” (Goodell & Koç, 2021, p. 3). Following this mandate, the number of teachers in Texas sharply declined. For example, “in 1991–1992, UT Austin prepared 51 math and science teachers,” but in 1996–1997 it prepared only 31 (Goodell & Koç, 2021, p. 3).

This decline in STEM teachers, and the revelation that those preservice teachers who remained in the teacher pipeline found their training less satisfactory, led to the creation of the UTeach teacher preparation model. The UTeach program was built upon three guiding principles: “first, STEM majors are recruited as early as their freshman year; second, pedagogy courses are designed specifically for the program; and third, master and mentor teachers provide detailed guidance with early and intensive field experiences” (Backes et al., 2018, p. 185).

UTeach was created to meet the need for science teachers, but it later

expanded to include math teachers and spread to 43 universities across the nation (Goodell & Koç, 2021). UTeach has been successful, utilizing an approach to recruit STEM majors to become teacher candidates while simultaneously providing a pathway for STEM teaching credentials. Students in UTeach take courses in their major along with classes intended for future teachers in a streamlined 4-year degree plan (Backes et al., 2018). This seamless pathway enables students to pursue a traditional STEM major while earning a teacher certification.

Community Colleges and STEM Teacher Recruitment

One area in which STEM teacher recruitment can, and should, focus is the community college student population. This opportunity is highlighted by the fact that nearly “40% of the nation’s teachers, including teachers of science and mathematics, completed some of their mathematics or science courses at community colleges” (National Research Council & National Academy of Engineering, 2012, p. 2). In fact, over 40% of college students begin their post-secondary education at a community college, with an even higher percentage of Latinx and Black students beginning at a community college (Shapiro et al., 2017). Regarding recruitment of STEM teachers who are representative of the national population, it is important to note that “fifty-two percent of Hispanic students, 44 percent of African American students, 55 percent of Native American

students, and 45 percent of Asian-Pacific Islander students attend community colleges” (National Research Council & National Academy of Engineering, 2012, p. 2).

Transfer Barriers for Community College Students

Despite the large number of students across the nation at community colleges, many community college students do not continue their education at a university. In fact, data from the National Student Clearinghouse found that transfers from community colleges to universities dropped by almost 8% from the fall of 2021 to the fall of 2022 (NSC Blog, 2023). This is not a new trend; instead, this is a decline that has “been [occurring] since the [COVID-19] pandemic began in 2020, and this is especially true for upward transfers” (NSC Blog, 2023). We must examine and work to better understand the barriers that community college transfer students face when they are deciding whether to continue their educational endeavors.

While the barriers to transferring are often unique and personal to individual students, there are some commonalities. Financial barriers have often been noted as a challenge, as the average tuition at a university is \$6,000 more per year than community college tuition (Sandrin et al., 2023). Even with scholarship assistance, this challenge remains; in their 2023 study, Sandrin et al. (2023) found that while their scholarship “was significantly helpful, 35%

of students still mentioned remaining financial barriers” (p. 10).

Another well-documented set of barriers is interinstitutional issues, such as transfer credits, articulation agreements, and differences between advising structures. Many of the issues transfer students face include the “lack of clear articulation agreements, remedial courses (such as math prerequisites) that do not transfer, and poor advising” (Sandrin et al., 2023, p. 5). Furthermore, transfer students have often cited cultural differences as a barrier to transferring. The transfer student population has often been “heterogeneous with regard to age, race/ethnicity, family income, and college preparation” (Sandrin et al., 2023, p. 5). Tobolowsky and Cox (2012) argued that university administrations were often unaware of the varied needs of diverse populations and frequently neglected to work toward better serving those needs. But understanding these barriers and addressing them is key to empowering community college students to become science and mathematics teachers.

Theoretical Framework

This study utilized Bronfenbrenner’s social ecological model as a conceptual framework. Bronfenbrenner (1979) asserted that the “ecological environment is conceived as a set of nested structures, each inside the next,” that contribute to a person’s development (p. 3). These structures and systems range from the immediate, such as home, to the broader, such as societal norms and

cultures. No matter their level of immediacy, Bronfenbrenner argued that all elements of a person’s social ecology are impactful.

Specifically, Bronfenbrenner’s theory includes five systems: the microsystem, mesosystem, exosystem, macrosystem, and chronosystem. The microsystem contains the elements that have direct contact with a person, such as a person’s family, work, school, and friends. The mesosystem contains the connections that occur between the various microsystems in a person’s life. For example, a person’s home life can impact their ability to participate in a school setting. The exosystem contains informal and formal structures, such as the government, that can impact a person without direct interaction. Similarly, Bronfenbrenner (1979) argued that macrosystems are societal beliefs or norms that impact a person without direct contact. Last, the chronosystem “contains both internal and external elements of time and historical content” that include events such as a global pandemic (Kilanowski, 2017, p. 295). Bronfenbrenner’s theory can help us understand how a student’s college and career paths are influenced by interrelated contexts. It is clear that “students develop within many spaces including home, school, and workplace” and that all these social structures are important to understand (Packard, 2012, p. 59).

When applied to the examination of prospective STEM students’ experiences, Bronfenbrenner’s social ecological model guides researchers to first consider the immediate structures, such as home and

background, and then broaden the consideration to how courses and instructors impact students. Finally, when utilizing the social ecological model as a conceptual framework, researchers must examine the systematic structures that can positively or negatively influence students, such as advising procedures and cultural norms at community colleges and universities.

Methodology and Data

Methodology

This study employed a qualitative methodology to examine community college students' experiences while they were being recruited to transfer to a university to pursue a STEM teaching certification. Merriam and Tisdell (2016) asserted that "qualitative researchers are interested in understanding how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences" (p. 5). The ability to understand the student's individual experiences, barriers, and responses is integral to creating effective recruitment and support programs that meet the diverse needs of students.

Data/Data Analysis

This qualitative study employed multiple sources of data, including instructor reflections, researcher observations, and semistructured interviews conducted with students. The semistructured interviews highlighted the unique

experiences of participants, shedding light on their motivations and the challenges they faced as students. The data were informally analyzed independently by each of the three of us using the constant-comparison method (Merriam & Tisdell, 2016). The data were then formally analyzed through open coding, which was unitized to identify units (Lincoln & Guba, 1985). Finally, the units were placed into themes.

Participants

All students who enrolled in the JacksTeach courses at LSC-HN were informed of the study and invited to participate after completing the courses. The students who chose to participate have been identified with a pseudonym. As depicted in Table 1, five students were interviewed in this study.

Findings

The themes that emerged from these data include interest in developing an altered perspective on the teaching profession, increased interest and confidence in STEM teaching, changes in educational plans, and varied barriers to entering an educator preparation program.

Altered Perspective on the Teaching Profession

As a result of their participation in the JacksTeach courses, three of the participants indicated that their perspective on teaching changed from negative to

Table 1

Participant Profiles

Participant	Participant profile
Kevin	Kevin is an African man and a nontraditional student. Kevin has a Bachelor of Science in industrial chemistry and a Master of Business Administration, both of which he earned in his home country of Nigeria. At the time of the study, Kevin was seeking asylum and had lived in the United States for over 10 years. He was initially pursuing a nursing degree. He was married with four kids and worked a full-time job as a bus driver.
Joshua	Joshua is a Hispanic man and a traditional student. He worked multiple part-time jobs. Joshua had graduated from a large school district in a metropolitan city in Texas. At the beginning of the study, Joshua was an engineering major, but upon completion of the courses, Joshua changed his major to mathematics.
Courtney	Courtney is a White woman and a traditional college student. She was majoring in biology and had graduated from a large school district in a large metropolitan city in Texas. She was a member of the National Honor Society and the National Technical Honor Society. Courtney was a full-time student and did not have outside employment.
Deborah	Deborah is a Hispanic woman and a nontraditional student. Deborah worked full-time and was a single mother with two young children. She graduated from a large school district in a metropolitan city in Texas. Deborah was an undeclared major.
Amy	Amy is a female, first-generation international student. Originally from Egypt, at the time of the study Amy was seeking asylum. Amy was a traditional, full-time student who did not work. Amy was a biology major and her initial plan was to earn a biology degree and then go to medical school.

positive. Kevin revealed that before the courses he:

wasn't too much interested in teaching because [he had] a misconception about the behavioral disposition of the students

because of the news and media about a lot of situations that goes on in schools, and how students are very disrespectful to teachers, but that [his] perspective changed when [he] took the program,

especially when [he] went to the schools, and different schools, and [he] saw these children and the students. [He understood] better that sometimes they have to be with the teacher's attitude, not, basically, with the students.

Deborah held a similar view. She commented, "I think teachers are great, honestly. I think it is something that takes a lot of effort and passion. It's a great profession, but it's not the easiest, and it's undervalued." She went on to say that she, "always had kind of an interest in teaching but [she] kind of figured [she] would hate it because of the district [she] attended." She further explained that she "saw how a lot of teachers were being treated by students, and [she] figured most of the kids won't have respect." She revealed that the courses provided an opportunity to "kind of go out there and experience it firsthand rather than just be biased negatively." Similarly, Courtney stated,

I wasn't interested [in teaching] at all because I never really liked being around kids too much 'cause I know that a lot of my classmates behave bad, and I'm like, "Oh well. I'm very nonconfrontational, and I don't think I'd be able to discipline them." So I wasn't very interested in it.

But at the conclusion of the courses, Courtney concluded, "I'm more interested now 'cause after teaching I was like, 'Well, it doesn't seem like discipline is gonna be too much of a struggle.'" Although the participants had an interest in teaching, many of them initially

allowed their negative views of teaching, most of which were based on discipline issues, to prevent them from pursuing a career in teaching. This negative perception is an example of the macrosystems that impact a person (Bronfenbrenner, 1979). The responses suggested that there is currently a societal belief that public schools are chaotic and disordered, and this perception impacted the participants until they were able to engage in first-hand experiences, which provided another viewpoint.

Increased Interest in STEM Teaching

Three of the participants expressed an increased interest in STEM teaching as a result of participating in the JacksTeach courses. Amy praised the class, saying, "The whole class was amazing. I mean, really made me have more interest in teaching." As a result of enrolling in these courses, Amy began working as an elementary and middle school tutor and a teacher in a summer program.

Deborah attributed her increased desire to teach to the first-hand classroom exposure she received in the courses, revealing that "the Step 1 and 2 courses were interesting because [she] always had kind of an interest in teaching, so it was a chance to kind of go out there and experience it firsthand rather than just be biased negatively." Kevin reiterated the ways in which his enrollment in the JacksTeach courses increased his teaching interest, explaining that the courses "emphasized practical experience, which

is what I'm more interested in." The participants also credited the course curriculum with increasing their interest in pursuing a career in STEM education.

Increased Confidence in Teaching

Not only did participation in the JacksTeach courses lead to an increased interest in STEM teaching, it also led to an increased confidence in teaching ability. Three of the participants specifically conveyed how their confidence in certain aspects of teaching increased as a result of participating in the JacksTeach courses. Courtney shared, "I also like that we got to go into classrooms and teach real students and observe teachers teaching their students 'cause I feel like it gave me some confidence about interacting with students."

When Amy described how her increased desire to teach led her to find tutoring and summer teaching positions, she expressed, "With the skills that I learned from JacksTeach, I started to go out into the field with confidence that I can handle kids. I can do it." Deborah not only expressed an increased confidence in teaching, but also an increase in comfort, stating, "I'm a very nervous person when it comes to public speaking, but when it came to the second time going up there [teaching], I felt a little more comfortable." Deborah did admit that she "wasn't a hundred percent confident, but it was a big improvement from the beginning, so that did make [her] kind of more open and comfortable to teaching." As a result of participating in the JacksTeach courses, most of the

participants gained an increased confidence in teaching.

Changes in Educational Plans

Participation in the JacksTeach courses led most of the students to make changes to their educational plans. Only one of the participants, Deborah, specifically stated she made no change to her educational plan after taking the JacksTeach courses. Deborah was still undecided about her future educational and career plans, voicing her concern about the length of the experience, stating "it just wasn't enough [time] for me to make a decision on if I wanted to go with that, to go that route."

However, after participating in the course, Kevin decided to change his educational plans and pursue a teaching career path. Although Kevin was not eligible for the transfer scholarship that was a part of the program, he stated, "I'm still going to follow [the] teaching profession." Amy did not change her major from biology, but she added a double major, explaining that "I'm still Associate of Science Biology track, but, like, my plan in my head [is] I'm going to be doing the double majors—the biology and the education." It is important to note that Amy is the only participant who received the T4 scholarship and transferred to SFA. Joshua decided to change his major from engineering to mathematics as a result of taking the JacksTeach courses, explaining "[I] actually do plan on teaching." Courtney revealed that as a result of the JacksTeach courses she decided to continue with her education. "So getting

the JacksTeach class really helped me decide that I want to continue education and helped me decide which career I want to go into.” The JacksTeach courses were effective in encouraging participants to consider a career in STEM teaching. Again, these experiences are examples of ways that society’s macrosystems impacted the participants prior to their firsthand classroom experiences.

Barriers to Transferring

Four of the five participants experienced a specific barrier related to transferring to the university at which they could participate in the teacher preparation program. Kevin applied for, but did not receive, the transfer scholarship due to his unique circumstances. He revealed that he “was not qualified because of [his] citizenship.” The scholarship was funded by a U.S. government grant, and one of its stipulations was that recipients hold U.S. citizenship or permanent residency. This requirement disqualified Kevin from the scholarship.

Joshua revealed that his barrier was a lack of connection to the SFA campus and the city of Nacogdoches. Joshua visited the campus after the spring semester ended, when the university was not in session. The town in which the university is located is a rural area with a population of approximately 32,000. Because he came from a large city with a population of over 2 million, the rural environment was a culture shock for Joshua. He noted that

the people drive slow, the weather was so gloomy, like, ugh. And

there was hardly anybody there when I went because obviously, I mean, school was over. But I just did not, I don’t know, I didn’t really like the ambience too much and I always got lost.

Joshua’s struggle with the cultural shift from an urban to a rural setting illustrates a macrosystem phenomenon and demonstrates the importance of a sense of belonging (Bronfenbrenner, 1979). A sense of belonging is “the subjective feeling of deep connection with social groups, physical places, and individual and collective experiences” (Allen et al., 2021, p. 87). The environment in which Joshua was raised influenced his sense of belonging, and that impacted his decision to consider transferring.

Amy explained that she was anxious about the application process as a first-generation student. She stated,

But what makes me hesitant is that I am not familiar with the application process. So I’m the oldest in my family and my parents did not graduate from here, so I’m, like, a first-gen kind of. . . I mean I don’t have anyone to ask, “What should I do?”

This barrier is a common one faced by first-generation students. Unlike first-generation students, second-generation students have “help navigating, transitioning to college, and succeeding once there” (Horowitz, 2019, p. 11). The impact of Amy’s direct environment, her family, is illustrative of Bronfenbrenner’s microsystems, which are transformative. Amy also did not receive the scholarship as she was also

seeking asylum. She completed the application without realizing that this disqualified her. The inability of both Amy and Kevin to receive the scholarship based on their citizenship status is a clear example of the exosystem, which, as Bronfenbrenner (1979) explained, is “one or more settings that not do not involve the developing person as an active participant” (p. 237). Neither Kevin nor Amy was given a voice in the government policies that determined scholarship funding for people seeking asylum, yet these policies had a strong negative influence on their lives and careers.

Deborah faced a personal barrier as a nontraditional student, explaining,

Since I am a mother of two, I wasn't able to transfer to the university. So, it wasn't something that was realistic for me 'cause I couldn't just move my whole family down there, which would've been a great opportunity, but that just kind of prevented me from doing it.

Discussion

These five prospective STEM teachers present a window into the variety of barriers and opportunities experienced by STEM majors who consider a career in teaching, particularly at community colleges. Perhaps most notable is that two members of the group did not qualify for federal teacher-certification scholarships even though by becoming STEM teachers at high-needs schools they would have fulfilled the stated

objectives of the program concerned, which “seeks to increase the number of K–12 teachers with strong STEM content knowledge who teach in high-need school districts” (Robert Noyce Teacher Scholarship Program, 2024). It is particularly troubling that only one of the five students matriculated to the university that actively recruited them to pursue STEM teaching, and that the student who matriculated was the one traditional White student in the group. This raises the question of how parts of the structure of the program and the grant may perpetuate historic patterns of advantage and disadvantage.

This study also confirms well-known challenges experienced by community college students: students are often cost sensitive, issues with credit transfer and institutional culture can dissuade students, and geography is often a limiting factor. It is noteworthy that these barriers were robust enough to withstand the \$15,000 scholarship and the work that faculty from both institutions did to ameliorate them.

On a brighter note, the study concluded that realistic teacher previews did affect the students' confidence in their ability to teach, interest in teaching, and even aspirations for future study. While it did not achieve placement on the direct route to STEM teacher certification for most students, the program did successfully engage students in considering STEM teaching and becoming inclined toward teaching.

Recommendations for Practice

Financial Support

This study highlighted the role that financial support played in the lives of the participants. The participants indicated that their initial, and often continued, interest in the program stemmed from the scholarship opportunity. However, even with scholarship assistance, finances are a challenge, with Sandrin et al. (2023) finding that while “[a] scholarship was significantly helpful, 35% of students still mentioned remaining financial barriers” (p. 10). Current scholarship opportunities appear inadequate to support the financial needs of many transfer students. Creating paid internships and paid clinical teaching opportunities are promising alternatives that can mitigate financial burden.

Supports

One of the participants, who identified as a first-generation student, pointed to unique challenges they experienced when navigating steps in the transfer process, including applying and advising. Mikell and Davis (2022) advocated for the provision of mentorship outside of the academic advisor to assist the student in navigating the system and to “act as academic support since first-generation students cannot typically rely on parents or other close family members to relay their experiences in the college system” (p. 39).

New Program

The JacksTeach program was a new program offered to students who were enrolled at the community college. As JacksTeach was a new, unfamiliar program, there were challenges with participation, student buy-in, and interest. The program leaders devoted a great deal of time to advertising and to educating the student population about the program in an effort to increase student participation. Researchers noted that the best form of advertising came in the form of first-cohort students sharing their experiences with other students and encouraging them to enroll in the JacksTeach courses. This demonstrates the reality that building a new program often takes time. There must be a commitment from both institutions, their administrations, and their faculty to give such programs both the time and resources needed to grow enrollment over time.

Location

Many of the students revealed that while they were interested in applying for the transfer scholarship, there were challenges associated with physically relocating to a different city to transfer. This inability to relocate is an important consideration for partnerships between universities and community colleges. As these partnerships develop, institutions might consider developing programs that will allow these students to complete their bachelor’s degree online or complete the courses remaining in their

bachelor's degree on the community college campus. These options could alleviate the barrier that physical relocation creates to completing a STEM bachelor's degree.

Conclusion

Understanding the experiences, successes, and obstacles of the student participants in this study is essential to increasing the transfer and success rates of former community college students who attempt to complete a 4-year STEM teaching degree. Research that considers the systematic structures of the community college and university, the curriculum, and the personal background of students will enable institutions to create impactful programs that can help fill the need for highly effective, fully certified STEM educators across the nation.

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