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From Secondary STEM Endorsement Completion to Postsecondary Enrollment and STEM Major Choice

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ABSTRACT

This study examined the association between STEM endorsement completion and postsecondary enrollment and STEM major choice among Texas public high school students. Using statewide longitudinal data from the Texas Education Research Center, we followed 106,788 students who entered 9th grade in 2014 and graduated in 2018. Guided by Social Cognitive Career Theory, binary logistic regression models assessed the role of STEM endorsement completion alongside sociodemographic characteristics and school academic context. Results indicated that STEM endorsement completion was strongly associated with both postsecondary enrollment and STEM major choice. Gender, race/ethnicity, socioeconomic status, immigrant status, career and technical education (CTE) participation, gifted/talented designation, and at-risk status were also significantly associated with postsecondary enrollment and STEM major choice. These findings highlight persistent equity gaps and underscore the importance of moving beyond pathway access toward equitable completion through targeted advising and structured secondary STEM supports.

Keywords: Educational pathways, high school students, postsecondary

enrollment, social cognitive career theory, STEM education, STEM endorsement, STEM major choice

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INTRODUCTION

A skilled workforce in science, technology, engineering, and mathematics (STEM) remains crucial for economic growth and national security in the United States (U.S.). In 2021, STEM occupations comprised 24% of the U.S. workforce, encompassing approximately 36.8 million workers. This represents an increase from 22% in 2011, reflecting a growing demand for STEM professionals (National Science Board [NSB], 2024). Despite its global influence in science and innovation, the U.S. lags behind other leading economies in the proportion of graduates earning degrees in science and engineering. As of 2020, only 20% of U.S. college graduates obtained degrees in STEM fields. In comparison, over 40% of graduates in China pursued STEM degrees, with Russia, Germany, Iran, and India each reporting more than 30% (Oliss et al., 2023).

This comparatively low participation in STEM degrees poses significant challenges to sustaining a qualified workforce critical for global competitiveness (Graham et al., 2013; NSB, 2024; President's Council of Advisors on Science and Technology, 2012). Much of this gap has been attributed to poor mathematics and science readiness among high school students. According to ACT (2023), only 15% of high school graduates met the ACT STEM College Readiness Benchmark in 2023, down from 20% in 2019. Beyond academic preparation, psychological and career-related factors, such as students' perceptions of STEM, self-efficacy, and career aspirations, have also been identified as important contributors to STEM educational and career pathways (Chen et al., 2024; Jiang et al., 2024; Nguyen et al., 2026; van Tuijl & van der Molen, 2016).

To enhance college and career readiness, researchers and policymakers have emphasized the importance of aligning high school curricula with postsecondary expectations and increasing students' early awareness of college and career options (Callan et al., 2006). Many states have implemented policies to enhance college and career readiness. For example, Texas introduced the Foundation High School Program (FHSP) in 2014, requiring ninth-grade students to select an endorsement pathway in areas such as STEM, Business and Industry, Public Services, Arts and Humanities, or Multidisciplinary Studies (TEA, 2014). These endorsements are

designed to provide students with in-depth knowledge in specific subject areas, aligning their high school experiences with future academic and career goals (Texas Legislature, 2013).

With Texas's population projected to grow from 29.1 million in 2020 to 42.6 million by 2060 (Texas Demographic Center, 2024), FHSP holds significant potential to enhance students' college and career readiness, particularly in addressing the growing demand for STEM professionals. Although the FHSP offers students the opportunity to pursue a specialized STEM endorsement, empirical research on STEM endorsements remains limited. Existing studies have primarily focused on program implementation, endorsement participation and completion, or have been confined to a single school district (Holzman et al., 2024; Kirksey et al., 2023). Consequently, it remains unclear whether STEM endorsement completion is associated with students' postsecondary enrollment and, among those who enroll, their choice of a STEM major. To address this gap, this study investigated the following research questions:

- RQ1: To what extent are Texas high school students' sociodemographic characteristics, school academic context, and STEM endorsement completion associated with their enrollment in public postsecondary education in Texas?
- RQ2: For students who enrolled in public postsecondary education in Texas, to what extent are their sociodemographic characteristics, school academic context, and STEM endorsement completion associated with their choice of a STEM major?

LITERATURE REVIEW

In response to concerns about alignment between secondary and postsecondary outcomes, a substantial body of research has examined college and career readiness (CCR) and the role of educational policies in supporting student success. This literature review explores the foundations of CCR and policy developments in Texas, followed by research on postsecondary pathways, particularly in STEM. These strands of scholarship provide important context for understanding how personal, academic, motivational, and environmental factors shape students' STEM success.

College and Career Readiness

Over the past decade, the education community has shown growing interest in the concept of CCR (Gee et al., 2021; Perry et al., 2018). Conley (2012) defined CCR as the ability of students to qualify for and succeed in entry-level, credit-bearing college courses or career training programs without the need for remediation. His framework outlines four essential dimensions of readiness: cognitive strategies, content knowledge, learning skills and techniques, and

transition knowledge and skills. At its core, CCR emphasizes that high school graduates should be prepared to succeed in a broad range of high-quality postsecondary opportunities (Conley, 2012).

Many states have revised high school curricula and graduation standards to align with CCR frameworks. These initiatives have focused on preparing students in subject-specific areas (Conley & French, 2014; Malin et al., 2017), aligning K-12 curriculum with college-level expectations (Hooker & Brand, 2010), and identifying strong indicators of readiness, such as advanced coursework or enrollment in college-preparatory programs (Darling-Hammond et al., 2014; Gottfried et al., 2023). Although CCR initiatives have expanded, most continue to emphasize academic college preparation, while career readiness, particularly in vocational or technical fields, receives comparatively less attention (Mattern et al., 2014). This imbalance may limit students' exposure to alternative pathways and practical training opportunities aligned with the demands of today's STEM workforce. Therefore, CCR programs should not only strengthen students' academic preparation but also cultivate non-cognitive skills, such as motivation, resilience, and self-regulation, which are essential for both educational attainment and workforce success (Mattern et al., 2014).

The Texas Case

As CCR continues to shape national education policy, Texas has emerged as a leading state in implementing systemic reforms that align secondary education with postsecondary and workforce expectations. In a comparative review of state policies, Blume and Zumeta (2014) ranked Texas highest on college-readiness measures, including dual enrollment, advanced coursework, and PK-20 data systems. Since the early 2000s, the Texas Legislature has enacted a series of reforms to expand postsecondary attainment and align high school curricula with workforce needs, reflecting CCR principles of academic rigor, career exploration, and accountability.

House Bill 1 (HB 1), passed in 2006, introduced a more rigorous curriculum and emphasized standardized testing and accountability measures, laying the groundwork for the 2011 implementation of the State of Texas Assessments of Academic Readiness (STAAR) and end-of-course exams (Texas Education Agency [TEA], n.d.). In 2009, House Bill 3 (HB 3) expanded the role of career and technical education (CTE) in high school curricula by allowing students to count CTE courses toward selected math and science credits (TEA, 2010). CTE has been recognized as a key lever for advancing both academic and workforce readiness and has become central to Texas reforms linking high school curricula with postsecondary and career outcomes (Stone, 2014).

In 2013, amid criticism of high-stakes testing and concerns that high school graduates lacked real-world skills, the Texas Legislature passed House Bill 5 (HB

5). This legislation marked a pivotal shift by integrating CCR principles into a redesigned graduation plan, the FHSP, which encourages students to explore career interests while meeting rigorous academic standards (Latham Sikes, 2018). To further support earlier planning, House Bill 18 (HB 18), enacted in 2015, extended CCR instruction to grades 7 and 8. Together, HB 5 and HB 18 contribute to the broader goals of Texas's 60x30TX strategic plan, which aims to ensure that 60% of young adults aged 25–34 to hold a certificate or degree by 2030 (Texas Higher Education Coordinating Board, 2022). Overall, the FHSP endorsement system reflects a policy-driven approach to embedding CCR principles into high school education, providing students with structured opportunities to align their academic experiences with postsecondary goals.

Pursuit of STEM

Prior research demonstrates that background characteristics, school academic context, motivational factors, and learning environments interact in complex ways to influence students' enrollment and persistence in STEM programs in postsecondary education. This section reviews the literature on these factors, highlighting how they collectively contribute to students' pursuit of STEM disciplines.

Students' Characteristics

Demographic factors such as gender, race/ethnicity, socioeconomic status (SES), and first-generation status strongly influence STEM pathways. Despite ongoing national efforts to diversify the STEM workforce, disparities persist. Women, for example, comprised only about one-third of the U.S. STEM workforce as of 2019, with notably lower representation in engineering (16%) and computer science (26%) (NSB, 2022). Similarly, students from historically marginalized racial/ethnic groups, such as Black, Hispanic, and American Indian/Alaska Native students, remain underrepresented in STEM majors (Garrison, 2013; Neally, 2022).

SES and first-generation status further impact STEM opportunities. Bettencourt et al. (2020) argue that early academic tracking and access to resources disproportionately affect first-generation students, particularly when combined with racial or gendered disadvantage. Niu (2017) found no universal effect of SES on STEM major choice but reported that higher SES Black students were more inclined to pursue STEM than their White peers, suggesting that SES influences may depend on racial context.

Educational Context

Students' school academic context is central to access to and persistence in STEM pathways. High school mathematics and science achievement has consistently been linked to students' later STEM participation. Stronger

preparation in these subjects is associated with greater interest in STEM fields (Warne et al., 2019), a higher likelihood of enrolling in STEM majors (Adelman, 2006; Chang et al., 2023; Tyson et al., 2007), and greater persistence to degree completion (Maltese & Tai, 2011). Conversely, weaker foundations are associated with the need for remedial coursework, extended time to degree, and higher attrition rates (Chen, 2013).

In addition to traditional academic coursework, CTE provides another pathway through which students develop the skills and dispositions associated with STEM persistence. High-quality CTE programs that integrate rigorous academics with applied learning experiences have been shown to expand students' science capital, reinforce competence beliefs, and connect classroom knowledge to tangible STEM careers (Brunner et al., 2023; Castellano et al., 2012; Stone, 2014).

Other educational designations also influence STEM enrollment and attainment. English learners, for example, frequently encounter barriers to advanced math and science courses (Francis & Stephens, 2018). Participation in special education is often associated with reduced college access and completion (Newman et al., 2011; Wells, 2025), while students in gifted programs are more likely to pursue STEM majors (Vu et al., 2019).

Beliefs and Motivations

Beyond educational experiences, students' beliefs and motivations, particularly related to mathematics and science, are consistently associated with students' STEM trajectories. For instance, students with higher STEM self-efficacy (Sakellariou & Fang, 2021; Sahin et al., 2023) and greater confidence in mathematics (Moakler & Kim, 2014) are more likely to pursue and persist in STEM disciplines. Likewise, students who have a higher level of STEM motivation (Zhang et al., 2021), express stronger STEM career interest during adolescence (Sadler et al., 2012), or indicate an intention to major in STEM in high school (Bottia et al., 2015) have a higher likelihood of enrolling in STEM majors in college.

In addition, personal goals operate as proximal influences on academic and career decision-making. Eccles (2009) emphasized that students' academic and career choices are influenced by the goals they set and the values they attach to those goals, which in turn shape both their course-taking and longer-term educational trajectories. Within career development research, personal goals represent concrete intentions that organize behavior and sustain effort over time (Lent et al., 1994; Lent & Brown, 2013). In STEM contexts, Nicholls et al. (2007) found that students' intentions and goals were among the strongest predictors of STEM enrollment.

Learning Environment

Supportive learning environments are crucial for fostering STEM interest and engagement, particularly among historically underserved students. Persistent disparities in STEM participation are rooted in systemic barriers such as limited mentorship, underrepresentation in curricula, and implicit bias (Alfred et al., 2019; Kricorian et al., 2020). These barriers often lead to early disengagement, especially for women of color, who are frequently excluded from formative STEM opportunities, further undermining their confidence and persistence (Alfred et al., 2019). Instructional and academic support can help counter these barriers. Approaches such as inquiry-based instruction, project-based learning, and real-world problem-solving help students connect classroom content to broader societal issues and make STEM career pathways more tangible (Sadler et al., 2014; Sahin et al., 2023).

Teachers and counselors are likewise central to cultivating supportive environments that sustain students' STEM trajectories. By recognizing early and subtle signs of disengagement and responding with timely interventions, they can help students remain engaged before problems escalate into more disruptive behaviors (Almeda & Baker, 2020). In collaboration with teachers, parents also play a key role by modeling growth mindsets, exposing students to diverse role models, and actively challenging stereotypes about who can become scientists (van Tuijl & van der Molen, 2016). Recent evidence further indicates that structured STEM pipeline programs targeting underrepresented students can improve postsecondary STEM enrollment and degree completion (Cohodes et al., 2026). Overall, efforts to improve STEM engagement and success must extend beyond isolated classroom activities to include career education, teacher training, and parental involvement that help students build confidence and competence.

THEORETICAL FRAMEWORK

This study was guided by social cognitive career theory (SCCT; Lent et al., 1994), which extends Bandura's (1986) general social cognitive theory to explain how individuals develop career interests, set goals, and make educational and occupational choices. SCCT emphasizes the roles of self-efficacy (confidence in one's ability to succeed in specific tasks), outcome expectations (beliefs about the likely consequences of certain actions), and choice goals (intentions to pursue particular academic or career paths). These factors, together with personal inputs (e.g., gender, race/ethnicity), learning experiences, and contextual supports and barriers, help explain individuals' determination to make a particular academic or career choice (Lent et al., 1994; Lent et al., 2003). SCCT has been widely applied in STEM education research to explain how both individual backgrounds and environmental contexts shape students' motivation, intentions, and persistence in STEM fields (e.g., Byars-Winston & Rogers, 2019; Lent et al., 2003; Sevilla &

Snodgrass Rangel, 2023; Wang, 2013).

In this study, choice goals are conceptualized as STEM endorsement completion, reflecting students' sustained intentions to pursue a STEM major in college. STEM endorsement completion may also reflect students' confidence in their ability to succeed in advanced mathematics and science (self-efficacy) and their beliefs about the benefits of the STEM endorsement for future educational or career opportunities (outcome expectations). Choice actions are measured by postsecondary enrollment and STEM major selection, respectively. In addition, demographic characteristics and school academic context are included to capture how personal inputs and learning experiences are associated with students' postsecondary enrollment and STEM trajectories. Collectively, these elements position endorsement completion as a critical bridge between students' demonstrated STEM interests, as reflected by their enrollment in STEM endorsement during high school, and their postsecondary enrollment and STEM choice.

RESEARCH METHOD

Data Source

This study utilizes restricted-use statewide longitudinal data from the Texas Education Research Center (ERC), which connects student-level records across the TEA, the Texas Higher Education Coordinating Board, and the Texas Workforce Commission. The ERC system integrates demographic characteristics, academic performance indicators, course-taking patterns, program participation, and postsecondary enrollment outcomes, creating a comprehensive view of students' educational trajectories (Texas ERC, n.d.). The longitudinal and statewide scope of the ERC data makes it well-suited for analyzing STEM pathways and postsecondary transitions among diverse student populations.

Population and Sample

The study population consisted of a cohort of students who entered ninth grade in Texas public high schools in Fall 2014 and graduated in Spring 2018. Within this population, 114,181 students enrolled in STEM endorsement at some point during high school. Of these, 7,393 students were excluded because their STEM endorsement completion, high school graduation status, or both could not be determined. The final sample therefore included 106,788 students, of whom 81,713 (76.5%) completed the STEM endorsement requirements and 25,075 (23.5%) did not complete the requirements.

Variables and Measures

Dependent Variable

The dependent variable for RQ1 was students' immediate enrollment in a public postsecondary institution following high school graduation. This variable was coded dichotomously: students who enrolled in a Texas public 2-year or 4-year institution by Fall 2018 were coded as 1 ($n = 64,178$; $p = 60.1\%$), and those who did not enroll were coded as 0 ($n = 42,610$; $p = 39.9\%$).

For RQ2, the dependent variable was students' choice of a STEM major among those who entered Texas public postsecondary education institutions. STEM majors were defined in this study as fields in mathematics and statistics, biological and biomedical sciences, physical sciences and science technologies, computer and information sciences, and engineering and engineering technologies. Social and behavioral sciences were excluded. Students who declared a STEM-related major were coded as 1 ($n = 22,623$, $p = 35.3\%$) and 0 otherwise ($n = 41,555$, $p = 64.7\%$).

Independent Variables

The key independent variables included sociodemographic characteristics and high school academic context. Sociodemographic variables consisted of gender (female or male), race/ethnicity (Asian, Black, Hispanic, Multiracial, Native American, Pacific Islander, or White), economic disadvantage status (yes or no), and immigrant status (yes or no).

Academic context variables included students' English proficiency, dropout risk, special education services, gifted and talented program enrollment, and CTE participation. English proficiency was measured using two indicators: limited English proficiency (LEP) and participation in an English as a second language (ESL) program. Students were classified into three groups: (1) English proficient (non-LEP), (2) LEP students not participating in ESL (LEP without ESL), and (3) LEP students participating in ESL (LEP with ESL). Dropout risk was captured using a binary indicator derived from the Public Education Information Management System (PEIMS) based on 13 state-defined criteria associated with background and academic performance. CTE participation was categorized into three levels based on the coherence and depth of coursework: no CTE, some CTE, or a coherent sequence of CTE courses. Finally, students' choice goals were operationalized as STEM endorsement completion at the time of high school graduation in Spring 2018.

Data Analysis

The analysis proceeded in two stages. First, descriptive statistics were used to describe the sample characteristics. Second, binary logistic regression analyses

were employed to examine the extent to which STEM endorsement completion, along with students' sociodemographic characteristics and school academic context, predicted immediate postsecondary enrollment and choice of a STEM major among enrolled students. To assess multicollinearity, we estimated variance inflation factors (VIFs) and found that all VIF values were below 3 for both models, suggesting no multicollinearity concerns (Myers, 1990).

Limitations

Several limitations should be noted. First, although the analyses controlled for multiple student and school-context characteristics, they did not account for prior academic achievement (e.g., standardized test performance, GPA, or prior advanced coursework). Because students with stronger academic preparation are more likely to enroll in postsecondary education and pursue STEM majors, the observed associations may partially reflect differences in prior academic preparation rather than STEM endorsement completion itself. Second, key SCCT constructs were not directly measured. Instead, STEM endorsement completion was used as a behavioral proxy for choice goals, limiting precision in assessing underlying mechanisms. Other important influences, such as parental involvement and school climate, were also unavailable. In addition, students enrolled in two-year and four-year institutions were combined into a single category of postsecondary enrollment, obscuring meaningful differences in selectivity, resources, and transfer pathways that may affect persistence in STEM. Future research should disaggregate these groups and incorporate additional measures to provide a more nuanced understanding of students' postsecondary trajectories.

RESULTS

Research Question 1

A binary logistic regression analysis was conducted to examine the extent to which STEM endorsement completion, along with sociodemographic characteristics and school academic context, was associated with students' postsecondary enrollment. The model fit significantly better than the intercept-only model, $\chi^2(18) = 13,701.61$, $p < .001$, with McFadden's pseudo- $R^2 = .088$. Detailed results are presented in Table 1.

Table 1*Binary Logistic Regression Results for Postsecondary Enrollment (n = 106,788)*

Variable	<i>B</i>		OR	95% CI for OR
Sociodemographic Characteristics				
Female (Reference = Male)	0.258	***	1.295	[1.137, 1.474]
Race/Ethnicity (Reference = White)				
Asian	0.385	***	1.469	[1.194, 1.808]
Black	0.005		1.005	[0.985, 1.026]
Hispanic	0.115	***	1.122	[1.054, 1.194]
Native American	-0.239	*	0.788	[0.651, 0.954]
Pacific Islander	-0.220		0.802	[0.508, 1.267]
Multiracial	0.001		1.001	[0.979, 1.023]
Economically Disadvantaged	-0.246	***	0.782	[0.682, 0.896]
Immigrant	-1.137	***	0.321	[0.175, 0.589]
School Academic Context				
LEP/ESL (Reference = Non-LEP)				
LEP without ESL	-0.419	***	0.658	[0.533, 0.812]
LEP with ESL	-0.437	***	0.646	[0.513, 0.813]
At Risk	-0.467	***	0.627	[0.487, 0.807]
Special Education	-0.256	***	0.774	[0.673, 0.891]
Gifted/Talented	0.138	***	1.148	[1.065, 1.237]
CTE (Reference = No CTE)				
Some CTE	0.133	***	1.142	[1.065, 1.225]
Coherent CTE	0.146	***	1.157	[1.075, 1.246]
STEM Endorsement Completion (Reference = Non-Completers)				
Completers	0.463	***	1.589	[1.238, 2.040]

Note. OR = odds ratio; CI = confidence interval* $p < .05$; ** $p < .01$; *** $p < .001$ *Sociodemographic Characteristics*

Gender was significantly associated with postsecondary enrollment, with female students having about 30% higher odds of enrolling in colleges and universities than male students ($B = 0.258$, $OR = 1.295$, 95% CI [1.137, 1.474], $p < .001$). Among racial/ethnic groups, Asian students had about 50% higher odds of postsecondary enrollment than White students ($B = 0.385$, $OR = 1.469$, 95% CI [1.194, 1.808], $p < .001$). Hispanic students had slightly higher odds of postsecondary enrollment ($B = 0.115$, $OR = 1.122$, 95% CI [1.054, 1.194], $p < .001$). In contrast, Native American students had about 20% lower odds of enrollment ($B = -0.239$, $OR = 0.788$, 95% CI [0.651, 0.954], $p < .05$). Black, Pacific Islander, and multiracial students did not differ significantly from White students.

Economically disadvantaged students had approximately 20% lower odds of postsecondary enrollment than their peers ($B = -0.246$, $OR = 0.782$, 95% CI [0.682, 0.896], $p < .001$). Likewise, immigrant students had about one-third the odds of enrolling in postsecondary education compared with non-immigrant students ($B = -1.137$, $OR = 0.321$, 95% CI [0.175, 0.589], $p < .001$).

School Academic Context

All school academic context variables were significantly associated with postsecondary enrollment. Compared to non-LEP students, those identified as LEP, whether with ESL support ($B = -0.437$, $OR = 0.646$, 95% CI [0.513, 0.813], $p < .001$) or without ESL support ($B = -0.419$, $OR = 0.658$, 95% CI [0.533, 0.812], $p < .001$), had lower odds of entering postsecondary education. Students designated as at risk ($B = -0.467$, $OR = 0.627$, 95% CI [0.487, 0.807], $p < .001$) and those receiving special education ($B = -0.256$, $OR = 0.774$, 95% CI [0.673, 0.891], $p < .001$) also had reduced odds of postsecondary enrollment. In contrast, gifted and talented students had about 15% higher odds of postsecondary enrollment ($B = 0.138$, $OR = 1.148$, 95% CI [1.065, 1.237], $p < .001$).

Participation in CTE was positively associated with postsecondary enrollment. Compared to students with no CTE experience, those with some CTE ($B = 0.133$, $OR = 1.142$, 95% CI [1.065, 1.225], $p < .001$) and those who completed a coherent CTE sequence ($B = 0.146$, $OR = 1.157$, 95% CI [1.075, 1.246], $p < .001$) had greater odds of postsecondary enrollment.

STEM Endorsement Completion

STEM endorsement completion was significantly associated with postsecondary enrollment. Compared with STEM endorsement non-completers, students who completed the STEM endorsement had nearly 60% higher odds of enrolling in postsecondary education ($B = 0.463$, $OR = 1.589$, 95% CI [1.238, 2.040], $p < .001$).

Research Question 2

To address RQ2, a binary logistic regression analysis was conducted. The model included sociodemographic characteristics, school academic context variables, and STEM endorsement completion as predictors. The baseline model predicting STEM major selection fit significantly better than an intercept-only model, $\chi^2(18) = 3,603.62$, $p < .001$, with McFadden's pseudo- $R^2 = .043$. Table 2 presents detailed results.

Table 2*Binary Logistic Regression Results for Choice of STEM Majors (n = 64,178)*

Variable	<i>B</i>		OR	95% CI for OR
Sociodemographic Characteristics				
Female (Reference = Male)	-0.683	***	0.505	[0.488, 0.522]
Race/Ethnicity (Reference = White)				
Asian	0.565	***	1.760	[1.663, 1.863]
Black	0.023		1.023	[0.956, 1.095]
Hispanic	0.053	*	1.055	[1.011, 1.100]
Native American	0.052		1.054	[0.772, 1.439]
Pacific Islander	0.231		1.260	[0.783, 2.027]
Multiracial	0.184	**	1.201	[1.071, 1.347]
Economically Disadvantaged	-0.055	**	0.947	[0.909, 0.986]
Immigrant	0.153		1.165	[0.896, 1.514]
School Academic Context				
LEP/ESL (Reference = Non-LEP)				
LEP without ESL	0.010		1.010	[0.893, 1.143]
LEP with ESL	0.093		1.098	[0.964, 1.251]
At Risk	-0.367	***	0.693	[0.660, 0.727]
Special Education	-0.035		0.966	[0.838, 1.113]
Gifted/Talented	0.409	***	1.506	[1.448, 1.566]
CTE (Reference = No CTE)				
Some CTE	0.106	***	1.111	[1.068, 1.156]
Coherent CTE	0.152	***	1.164	[1.117, 1.213]
STEM Endorsement Completion (Reference = Non-Completers)				
Completers	0.420	***	1.522	[1.454, 1.593]

Note. OR = odds ratio; CI = confidence interval

* $p < .05$; ** $p < .01$; *** $p < .001$

Sociodemographic Characteristics

Gender was significantly associated with the choice of STEM majors. Female students had about half the odds of choosing a STEM major compared with male students ($B = -0.683$, $OR = 0.505$, 95% CI [0.488, 0.522], $p < .001$). Among racial/ethnic groups, Asian students had higher odds of selecting a STEM major compared to White students ($B = 0.565$, $OR = 1.760$, 95% CI [1.663, 1.863], $p < .001$). Hispanic students ($B = 0.053$, $OR = 1.055$, 95% CI [1.011, 1.100], $p < .001$) and Multiracial students ($B = 0.184$, $OR = 1.201$, 95% CI [1.071, 1.347], $p < .001$) also had higher odds of STEM enrollment. Black, Native American, and Pacific Islander students did not differ significantly from White students. Economically disadvantaged students had slightly lower odds of choosing a STEM major than their peers ($B = -0.055$, $OR = 0.947$, 95% CI [0.909, 0.986], $p < .001$). Immigrant status was not significantly associated with STEM major choice.

School Academic Context

Several school academic context variables were significantly associated with STEM major choice. At-risk students had lower odds of choosing a STEM major than students who were not designated as at risk ($B = -0.367$, $OR = 0.693$, 95% CI [0.660, 0.727], $p < .001$). In contrast, gifted and talented students had about 50% higher odds of choosing a STEM major than their peers ($B = 0.409$, $OR = 1.506$, 95% CI [1.448, 1.566], $p < .001$). CTE participation was positively associated with STEM major selection. Compared to students who did not participate in CTE, those with some CTE coursework ($B = 0.106$, $OR = 1.111$, 95% CI [1.068, 1.156], $p < .001$) and those completing a coherent CTE sequence ($B = 0.152$, $OR = 1.164$, 95% CI [1.117, 1.213], $p < .001$) had greater odds of pursuing a STEM field. LEP status (with or without ESL support) and special education status were not significantly associated with STEM major choice.

STEM Endorsement Completion

STEM endorsement completion was significantly associated with STEM major choice. Compared with STEM endorsement non-completers, students who completed a STEM endorsement had about 50% higher odds of choosing a STEM major ($B = 0.420$, $OR = 1.522$, 95% CI [1.454, 1.593], $p < .001$).

DISCUSSION

The results of this study show that STEM endorsement completion emerged as a strong and consistent predictor of both postsecondary enrollment and STEM major choice. In addition, students' sociodemographic characteristics and school academic contexts were significant predictors of these outcomes. These findings extend the STEM education research literature by demonstrating how a structured secondary STEM pathway can translate early engagement into sustained postsecondary participation, aligning with international calls for coherent STEM systems that emphasize persistence rather than short-term aspirations (Kricorian et al., 2020; Sahin et al., 2023; Sakellariou & Fang, 2021).

Sociodemographic Characteristics

Within SCCT, sociodemographic characteristics function as personal input influencing opportunities and constraints in students' pathways to postsecondary enrollment and STEM major choice. Gender differences were especially pronounced in this study. While female students were more likely than male students to pursue postsecondary education, they were less likely to choose STEM majors once enrolled. This pattern reflects well-documented disparities in STEM participation (Riegle-Crumb et al., 2011; Sadler et al., 2012; Sakellariou & Fang, 2021; Wang & Degol, 2017; Zhang et al., 2019). STEM education research has

shown that these gaps are driven less by achievement differences than by inequitable access to sustained identity-affirming STEM learning environments, classroom participation norms, and science identity (Carlone & Johnson, 2007; Charlesworth & Banaji, 2019; Hazari et al., 2013).

Race/ethnicity was also associated with the study outcomes, but its influence is not uniform and may be impacted by distinct contextual factors for each group. Hispanic students demonstrated higher odds of enrolling in college and pursuing STEM compared to White peers. This finding challenges deficit-oriented narratives and aligns with research highlighting the resilience and aspirational capital of Latinx students in STEM when supported by culturally affirming educational contexts (Crisp & Nuñez, 2019). Asian students were likewise more likely to enroll in college and pursue STEM, consistent with prior studies linking family expectations and exposure to STEM careers with students' academic choices (Lowinger & Song, 2017; Sahin et al., 2023). Black students did not differ significantly from White peers in either outcome, differing from prior research documenting underrepresentation in postsecondary education (Garrison, 2013) and lower STEM participation among Black students (Sahin et al., 2023). However, this should not be interpreted as an absence of systemic barriers; rather, it may indicate that inequities emerge earlier through differential access to advanced coursework, mentoring, and STEM-rich learning opportunities (Kricorian et al., 2020; Morton & Parsons, 2018).

Economic status was negatively associated with both college enrollment and STEM major selection, which is consistent with prior STEM education and higher education research showing that financial hardship constrains access to STEM coursework, advising, and enrichment opportunities (Engle & Tinto, 2008; Perna, 2006). These findings may also underscore the importance of scholarships, tuition waivers, and targeted institutional support to improve retention and outcomes for economically disadvantaged students in STEM (Ajayi et al., 2026).

Immigrant students had a lower probability of enrolling in college, reflecting well-documented barriers during postsecondary transitions, such as access to aid, and limited college knowledge (Gándara & Contreras, 2009; Suarez-Orozco et al., 2022). However, immigrant status was not associated with STEM major selection. This finding suggests that cultural expectations and pragmatic considerations may encourage immigrants who do enter postsecondary education to pursue high-status and economically secure fields such as STEM (Feliciano, 2006; Sikora & Pokropek, 2021).

School Academic Context

School-based academic contexts played a central role in shaping STEM trajectories. Participation in CTE, particularly coherent sequences, was positively associated with both postsecondary enrollment and STEM major choice. This may

suggest that CTE courses help students build self-efficacy in STEM-related skills, which can strengthen students' interest and confidence in pursuing STEM (Spillers & Lovett, 2022). Recent STEM education research further shows that integrated academic–applied STEM experiences strengthen science identity and motivation, particularly for historically underserved students, reinforcing the role of career-connected learning in sustaining STEM pathways (Brunner et al., 2023; Plasman & Myles, 2024).

Similarly, gifted/talented students were more likely to enroll in college and select STEM majors, consistent with research showing that gifted identification and access to advanced learning opportunities are associated with higher college-going rates and STEM-related major selection (Helal et al., 2026; Vu et al., 2019). In contrast, at-risk students had lower odds of both outcomes, likely reflecting systemic barriers, such as limited access to rigorous coursework, fragmented advising, and socioeconomic instability (Archer et al., 2012).

LEP students, with or without ESL, had lower odds of enrolling in college. This finding aligns with previous research, suggesting that linguistic barriers may reduce enrollment opportunities (Djita et al., 2023). Likewise, students receiving special education services were less likely to enroll in college, mirroring national data on their lower transition rates compared to the general student population (Newman et al., 2011). However, once enrolled, neither group differed from their peers in the likelihood of selecting STEM majors, suggesting that LEP and special education status may function more as barriers to college entry than to STEM choice.

STEM Endorsement Completion

STEM endorsement completion was one of the strongest predictors of both postsecondary enrollment and STEM major selection. As a behavioral indicator of students' academic goals, STEM endorsement completion reflects sustained engagement in advanced math and science coursework, motivation to pursue STEM, and confidence in STEM-related abilities. This finding affirms SCCT's assertion that choice goals represent future-oriented commitments (Lent & Brown, 2013). Prior research similarly shows that choice goals and related aspirations guide students' academic choices and persistence by shaping course-taking behaviors and sustaining motivation (Almeda & Baker, 2020; Archer et al., 2012). For students in STEM pathways, these commitments are especially critical because early enrollment in rigorous mathematics and science courses predicts later STEM degree attainment and reduces attrition from STEM fields (Adamuti-Trache & Andres, 2008; Wang, 2013). Unclassified students had much lower odds of enrolling in college than the completers but showed a similar likelihood of choosing STEM majors. Because this group disproportionately includes low-income, at-risk, LEP, and special education students, missing endorsement or

graduation data may mask structural inequities in access to advanced STEM pathways and program placement.

Viewed through SCCT, STEM endorsement completion reflects students' sustained choice goals while embedding them in learning environments that support self-efficacy and outcome expectations. This study contributes to the STEM education literature by empirically demonstrating how secondary STEM pathway completion functions as a measurable indicator linking high school STEM engagement to postsecondary participation, advancing current efforts to move from access-oriented reforms toward persistence-focused STEM systems that emphasize both opportunity structures and science identity development (Hazari et al., 2010; Kricorian et al., 2020; Sevilla & Snodgrass Rangel, 2023).

IMPLICATIONS AND CONCLUSION

Grounded in SCCT (Lent et al., 1994), findings of this study contribute to contemporary STEM education by illustrating how coherent secondary STEM pathways, rather than isolated coursework, can positively influence students' postsecondary participation and STEM degree enrollment through sustained engagement and structural support, consistent with recent experimental evidence that structured STEM pathway programs causally improve postsecondary STEM enrollment and degree completion (Cohodes et al., 2026). Although situated within a Texas policy context, these findings contribute to broader international conversations about designing secondary STEM systems that move beyond access toward sustained participation and alignment with postsecondary STEM trajectories. Translating these insights into actionable practices is essential for reducing inequities, improving postsecondary access, and strengthening the STEM pathway. The following implications outline how educators, school leaders, and policymakers can leverage these findings to design more equitable and effective STEM pathways.

First, persistent disparities in postsecondary enrollment and STEM participation by gender, race/ethnicity, socioeconomic status, and immigration background indicate that inequities in STEM pathways are influenced by both relational conditions and institutional structures within secondary education. Addressing these disparities requires attention to how advanced programs are designed, accessed, and experienced across student groups. STEM education research suggests that inclusive classroom practices, sustained mentorship, and exposure to diverse STEM professionals are associated with stronger academic confidence and continued engagement in rigorous coursework (Garibay & Vincent, 2018; Sakellariou & Fang, 2021; Wang & Degol, 2017). Meanwhile, equitable participation depends on transparent identification processes, inclusive recruitment into coherent CTE sequences and advanced coursework, and systematic advising that guides students through key academic milestones. Strengthening both the

cultural and structural dimensions of secondary STEM pathways can broaden participation and improve alignment with postsecondary STEM enrollment (van Tuijl & van der Molen, 2016).

In addition, STEM endorsement completion, as an indicator of future-oriented commitments that draw on both personal agency and supportive environments, illustrates how structured pathways can translate students' goals into concrete outcomes. STEM education research has long emphasized that advanced mathematics and science course-taking plays a critical role in shaping postsecondary STEM participation, not only by building content knowledge but also by reinforcing students' expectations of success in STEM-related fields (Adamuti-Trache & Andres, 2008; Archer et al., 2012). The present findings extend this literature by demonstrating that formal pathway completion, beyond initial enrollment, serves as a measurable mechanism linking high school STEM engagement to postsecondary enrollment and STEM major selection. Although all students in this study expressed initial STEM interest through endorsement enrollment, nearly one-quarter did not complete the requirements by graduation. This gap highlights the importance of moving beyond access to ensuring successful completion.

For state and district leaders, the challenge lies not only in providing endorsement pathways but also in supporting students through to completion. Science education scholarship increasingly calls for persistence-oriented STEM systems that track progression across key milestones rather than focusing solely on entry points (Kricorian et al., 2020; Sevilla & Snodgrass Rangel, 2023). Monitoring completion rates across districts and student subgroups can help identify inequities, while directing resources to schools with lower rates can address advising gaps, program limitations, or structural barriers that hinder students' choice and persistence in STEM pathways. Targeted investments in schools with lower completion rates may strengthen alignment between secondary preparation and postsecondary expectations.

At the school level, school counselors could offer early and sustained advising to students and their families, helping them overcome obstacles and reinforcing the link between endorsement completion and postsecondary outcomes. To further strengthen students' transition into postsecondary STEM pathways, high schools could expand partnerships with colleges and universities to better align expectations for STEM preparation. Such collaborations can help students sustain momentum, increasing their likelihood of both choosing and persisting in STEM once enrolled (Ralston et al., 2013). Ultimately, ensuring STEM endorsement completion requires coordinated efforts among teachers, counselors, families, and policymakers.

Finally, this study opens several directions for future research in STEM education. Longitudinal analyses could examine whether STEM pathway completion predicts not only initial enrollment but also longer-term outcomes such

as STEM persistence in college, degree attainment, and workforce entry. Further investigation could explore how endorsement completion interacts with self-efficacy, outcome expectations, and interests to shape students' postsecondary trajectories in STEM. Mixed-methods approaches would also deepen understanding of how students experience pathway requirements, advising systems, and institutional support. Such inquiry would advance STEM education scholarship by clarifying how structured secondary pathways influence sustained participation and long-term STEM trajectories across diverse student populations.

AI DISCLOSURE STATEMENT

During the preparation of this manuscript, the authors used Claude solely for language editing and improving the structure of the manuscript. The authors reviewed and approved all revisions and assume full responsibility for the final manuscript.

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Bios

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