Exploring Race, Citizenship, and Academic Pathways for Social Mobility: Perspectives of Undergraduate STEM Majors in a U.S. Liberal Arts College

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Table of Contents

[Introductions 2](#_Toc165950157)

[Review of Relevant Literature 3](#_Toc165950158)

[Social Mobility, racial identity, U.S. citizenship, and STEM in Higher Education 4](#_Toc165950159)

[STEM education and the allure of upward social mobility 4](#_Toc165950160)

[Race and citizenship in constructing the concept of social mobility. 5](#_Toc165950161)

[Personal Goals involved in the pursuit of STEM 7](#_Toc165950162)

[STEM students’ Self-Efficacy in academic pursuit and career decision-making 8](#_Toc165950163)

[Career Outcome Expectations (COE) among STEM students 10](#_Toc165950164)

[Theoretical Framework 13](#_Toc165950165)

[Methods 14](#_Toc165950166)

[Data Sources & Collection Procedures 15](#_Toc165950167)

[Approaches to Data Analysis 18](#_Toc165950168)

[Data Preprocessing. 18](#_Toc165950169)

[Research Question 1: Association Between Race and Citizenship Status with Preferences for STEM over Non-STEM Disciplines. 18](#_Toc165950170)

[Research Question 2: Relationship Between Race/Citizenship and Preference for STEM Classes for the prospects of upward social mobility (Items 4.1a and 4.1d). 19](#_Toc165950171)

[Findings 20](#_Toc165950172)

[Research Question 1: Association Between Race and Citizenship Status with Preferences for STEM over Non-STEM Disciplines 21](#_Toc165950173)

[Research Question 2: Relationship Between Race/Citizenship and Preference for STEM for the prospects of upward social mobility (Items 4.1a and 4.1d) 27](#_Toc165950174)

[Discussion 30](#_Toc165950175)

[Race and Citizenship in shaping Personal Goals among STEM undergraduates 30](#_Toc165950176)

[STEM students’ racial & citizenship identities informing their Self-Efficacy & academic interests 32](#_Toc165950177)

[Race, citizenship, and setting Career Outcome Expectations with upward social mobility in mind 33](#_Toc165950178)

[Implications 35](#_Toc165950179)

[References 38](#_Toc165950180)

[Appendix 42](#_Toc165950181)

[Table A.1: 42](#_Toc165950182)

[Table A.2: 46](#_Toc165950183)

**Exploring Race, Citizenship, and Academic Pathways for Social Mobility: Perspectives of Undergraduate STEM Majors in a U.S. Liberal Arts College**

The United States, renowned for its expansive higher education system, has increasingly prioritized tertiary Science, Technology, Engineering, and Mathematics (STEM) education as a pathway to upward social mobility, a concept defined as “the movement of individuals between different positions in the social structure over time” (Boliver & Wakeling, 2023).. This emphasis aligns with international trends and various government initiatives aimed at positioning the nation as a leader in science and innovation. However, the disproportionate growth of STEM fields compared to non-STEM disciplines has exacerbated existing disparities in access and opportunities, particularly among marginalized racial, ethnic, and gender groups (Medina et al., 2021; Davis & Wilson-Kennedy, 2023). Moreover, the inclusion of international students in the discourse on STEM education adds further complexity, as they face unique challenges due to their citizenship status. The prevailing narrative of STEM as a vehicle for social mobility may also be misleading, as real-world data suggests that a STEM degree does not guarantee upward mobility (Barroso-Luque, 2021).

In light of these complexities, this study seeks to address two key research questions: first, how race and citizenship inform STEM undergraduates’ preference for STEM over non-STEM disciplines; second, whether STEM undergraduates from underrepresented groups prefer taking STEM classes over non-STEM classes for the expectation of upward social mobility. By exploring how race and citizenship play into undergraduate STEM majors’ perceptions of STEM versus non-STEM disciplines, we aim to shed light on the goals, career expectations, and self-efficacy of STEM undergraduates from underrepresented groups. Simultaneously, it is key in this study that the perspectives of students, whose racial and citizenship identities intertwine, are also amplified. In a national climate where systematic racial discrimination persistently determines educational journeys and social mobility attainment (Davis & Wilson-Kennedy, 2023), while a large body of policymakers and citizens remain hostile to immigrant workers (Porche et al., 2016), this research aspires to provide insights to policymakers and institution administrators in shaping institution-wide and nationwide policies, programs, and practices aimed at promoting diversity, equity, and social mobility within higher education among both STEM and non-STEM disciplines. Moreover, the author envisions that the research findings will be a valuable resource for incoming college students, faculty, and counselors. By gaining a deeper understanding of each student’s unique position within the American educational system, students can collaborate with faculty members to chart a career path that aligns with their definition of success, whether the student chooses to pursue STEM or another field.

# Review of Relevant Literature

To thoroughly examine the intersection of race, citizenship, and the pursuit of STEM education in the context of social mobility, it is crucial to first understand the context of STEM education in the U.S. alongside the nuances of how social mobility is perceived and defined among different racial and ethnic communities. This involves exploring the historical and sociocultural factors that have shaped these perceptions. Next, an in-depth exploration of students’ motivations to pursue STEM over non-STEM fields is necessary. This exploration can be dissected into three main themes: (1) the personal goals that drive students to pursue STEM, such as the desire for intellectual challenge or the aspiration to contribute to societal advancement, (2) the influence of self-efficacy on academic pursuits and career decision-making, which includes factors like personal beliefs about one’s abilities and the role of support systems, and (3) the career outcome expectations among STEM students, encompassing aspects like job prospects, earning potential, and opportunities for advancement. These themes are examined through various lenses, with a particular focus on the experiences of underrepresented racial/ethnic groups and international students in the U.S. higher education system. This literature review aims to address the unique conception of social mobility, as well as challenges and opportunities that different racial & citizenship demographics face, such as access to resources, representation in STEM fields, and the impact of immigration policies on their educational experiences and career trajectories. Furthermore, it will shed light on the existing knowledge gap in understanding how race and citizenship influence undergraduate STEM majors’ preference for STEM over non-STEM disciplines, setting premises for criteria in determining an appropriate approach to this topic.

## Social Mobility, racial identity, U.S. citizenship, and STEM in Higher Education

STEM education and the allure of upward social mobility. Stemming from an international trend, STEM education in the U.S. has been marketed as a means for upward mobility, leveraging higher education's reputation as a gateway to higher social classes. Over the past decade, the U.S. government has implemented various STEM initiatives, such as "Raise the Bar: STEM Excellence for All Students" and the “STEMM Opportunity Alliance” (U.S. Department of Education, 2022; The White House Office of Science and Technology Policy, 2022)., aimed at furthering the nation's status as a leader in science and innovation.

According to a report under the Metropolitan Policy Program at Brookings, STEM graduates are earning higher salaries than their non-STEM counterparts, particularly in the U.S., where the demand for STEM skills is high (Rothwell, 2013). Research projects similar to this use this statistic on salary differences to equate a STEM-driven economy with better earning potentials for everyone, widening the gap between perception toward STEM vs. non-STEM. For international students, the benefits of pursuing a STEM degree in the U.S. are even more pronounced. They are allowed to work in the U.S. for up to three years after graduation without requiring visa sponsorship, an extension of two years compared to non-STEM graduates (*Optional Practical Training Extension for STEM Students (STEM OPT) | USCIS*, 2022). This promise, however, is rather an indication of a lack of support for those in non-STEM fields, raising the need for broader systemic changes to support the potential of achieving upward mobility across all professions.

Race and citizenship in constructing the concept of social mobility. Examining how different communities of color navigate STEM and social mobility reveals important insights into how these students perceive success. For instance, low-income Hispanic households in the United States may equate success with the perceived standards of successful White individuals, while Asian Americans’ pursuit of technical, white-collar roles in certain industries for prestige and financial stability, is rooted in cultural norms (Zhou & Lee, 2007). Interestingly, communities of color share quite similar understandings of social mobility, viewing it as a familial-scale effect rather than an individual-scale impact. This means that the upward social mobility of one family member is expected to benefit the entire family or at least inspire younger members (Wainwright & Watts, 2021). This familial-scale effect manifests in various forms across cultures. In Asian cultures, for example, offspring are often expected to financially support their parents (Pyke, 2000). This expectation is particularly strong among those who have achieved socioeconomic upward mobility, as they may feel a duty to financially uplift their family. Given the high demand and lucrative nature of STEM careers in the U.S. and these career paths’ alignment with existing Asian cultural norms, Asian parents often encourage their children to pursue STEM paths to ensure the fulfillment of these filial duties. On the other hand, in Mexican-origin households, the familial-scale effect is evident in how parents’ careers in “stable” industries, specifically STEM, influence their children’s college and career choices (Mein et al., 2020). Parents’ involvement in STEM disciplines often acts as a motivating factor, and sometimes even a push, steering Mexican young adults towards STEM fields. The educational environment can further reinforce these cultural or familial understandings of upward social mobility; Mau (2004) found that underrepresented students, including African American, Hispanic-American, and white students, exhibited strikingly similar career sentiments, suggesting a pressure to conform, especially when attending predominantly White campuses.

**STEM labor initiatives as reproducing racial disparities.** The emphasis on STEM education in the United States has led to an imbalanced growth rate, with STEM fields surpassing non-STEM disciplines, exacerbating disparities in access and opportunities, particularly among certain racial, ethnic, and gender groups (Medina et al., 2021; Davis & Wilson-Kennedy, 2023). International students, who represent approximately forty percent of all college students in the United States enrolled in STEM programs, play a significant role in filling employment gaps in STEM fields (Rahming, 2022; Porche et al., 2016). However, international students face numerous challenges, including constraints on their STEM trajectories and access to resources due to their citizenship status (Rahming, 2022).

This apparent paradox between the growing STEM workforce and the challenges faced by racially underrepresented or international students raises questions about the motivation behind the current influx of individuals into STEM compared to non-STEM fields. These questions are compounded by the long-standing interaction between the U.S. racial stratification system and social factors, which have led to vastly divergent mobility outcomes (Zhou & Lee, 2007). While initiatives aim to support employees of color and immigrant employees in STEM environments, individuals from underrepresented backgrounds often do not feel a sense of belonging, safety, or validation in STEM workplaces (Kricorian et al., 2020). Simultaneously, the widespread narrative of broadening STEM access for upward social mobility may have skewed younger generations' beliefs by presenting a new picture of the “American Dream” of meritocracy through STEM (Hoskins & Barker, 2020). Narratives of meritocracy and producerism often justify the perceived dominance of White Americans in the STEM workforce, perpetuating racial stratification. For example, Asians are stereotypically believed to be inherently proficient in STEM subjects, reinforcing their perceived value in technical roles, while Black and Hispanic counterparts are relegated to labor-intensive positions (Chen & Buell, 2018). The meritocratic path is presented as a solution for those who are neither White nor Asian to catch up with their higher-earning peers, overlooking systemic barriers faced by underrepresented groups (Chen & Buell, 2018). Additionally, immigrant students, who intend to stay in the U.S. workforce, face obstacles such as gatekeeping systems like the H-1B visas, further perpetuating inequality in the STEM workforce (Chen & Buell, 2018). These challenges add another layer of complexity to the experiences of underrepresented groups in STEM, who navigate explicit and implicit discrimination in their careers (Chatterjee et al., 2023).Top of Form

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## Personal Goals involved in the pursuit of STEM

Research on personal goals in tertiary STEM education has adopted various categorizations. One approach involves distinguishing between goals focused on individual achievement and those oriented towards benefiting others. Medina et al. (2021) discussed past research indicating that "agentic goals," or aspirations for personal competence and achievement, tend to positively influence interest in STEM careers, while "communal goals," which involve working for the betterment of others, may deter students from pursuing STEM careers. Similarly, Wolter et al. (2019) found that students enrolled in STEM majors prioritize economic goals over social goals. Davis and Wilson-Kennedy (2023) also identified common success metrics among their study participants, including accomplishing personal goals, achieving a comfortable lifestyle, and progressing in skills and knowledge development, reflecting a focus on personal well-being. However, Marsh (2023) presented contrasting findings, highlighting a significant trend among students pursuing STEM fields due to the perceived usefulness of math and science in benefiting society, particularly those in need. This altruistic motivation is echoed in the commitment expressed by some of Davis and Wilson-Kennedy's participants to dedicate their science expertise to serving society at large (2023).

Understanding the personal goals involved in pursuing STEM fields in higher education, particularly among students of color and international students, requires recognition of the complex interplay between individual aspirations and external influences, such as intergenerational factors and societal expectations (Zhou & Lee, 2007). For example, students from racial backgrounds that prioritize family aspirations may exhibit a strong inclination towards STEM fields in higher education (Porche et al., 2016) and may prioritize familial values over personal inclinations when forming goals related to STEM pursuits (Mau, 2004). However, it’s crucial to highlight that the existing literature does not establish clear connections between a student’s race or non-U.S. citizenship status and the development of a particular type of goal for pursuing STEM. Further research is needed to explore these potential relationships and their implications for STEM education and career pathways.

## STEM students’ Self-Efficacy in academic pursuit and career decision-making

Self-efficacy holds significant sway over the academic pursuits and career decisions of STEM students, where factors such as race and nationality intricately shape their perceptions and experiences. Lent et al. (1994) define self-efficacy as a dynamic belief system concerning an individual's capability to undertake specific actions. It is noteworthy that self-efficacy related to career trajectories necessitates consideration of both personal attitudes and environmental contexts (Marsh, 2023). While race, among other demographic variables, has been identified as a significant contributor to career-related self-efficacy (Abe et al., 2021), the precise nature of this influence remains contentious across various studies.

Chatterjee et al. (2023) found that individuals from underrepresented racial/ethnic groups often exhibit higher levels of career self-efficacy (CSE) compared to their counterparts from well-represented groups, possibly due to the need to navigate and overcome systemic barriers. Conversely, Mau's study (2004) suggests that students of certain nationalities may face increased pressure in career decision-making, leading to diminished confidence in their self-efficacy perceptions. Particularly among underrepresented populations of STEM students, such as Black women, a dichotomy emerges wherein a strong sense of engagement and interest coexists with feelings of inadequacy, a lack of belonging, and unequal performance expectations (Davis and Wilson-Kennedy, 2023).

The experiences of immigrant students add another layer to the discourse on self-efficacy in STEM. Porche et al. (2016) observed that immigrant students often exhibit heightened engagement and proficiency in STEM subjects compared to their native-born peers. However, non-citizen international students, as described by Rahming (2022), face unique challenges, including apprehensions about job security and discrimination based on their citizenship status. Indeed, international students, as Rahming's study illustrates, often grapple with the constant fear of being the first to be laid off due to difficulties in securing visa sponsorship from companies.

Furthermore, a notable divergence in self-efficacy exists between STEM and non-STEM majors, potentially contributing to the variance in career choices aligned with their respective fields of study (Xu, 2013). Majors such as health-related fields or technical sciences typically offer vocationally specific training and clearer occupational pathways, whereas disciplines like social sciences may lack distinct occupational trajectories (Xu, 2013). These disparities in specificity can significantly influence students' confidence in their career prospects and may orient their decision-making processes toward the more clearly delineated career outcomes associated with STEM degrees.

## Career Outcome Expectations (COE) among STEM students

The career outcome expectations (COEs) among STEM students are influenced by various factors such as economic considerations and self-perception of decision-making skills – many of these factors simultaneously being influenced by race or citizenship status. Firstly, economic studies of college students suggest that individuals tend to self-select into fields that offer higher earning potential (Xu, 2013). This self-selection bias is particularly evident in the separation between STEM and non-STEM majors, as individuals often base their educational decisions on expected earnings, among other factors (Xu, 2013). Additionally, Xu (2013) drew on Laura W. Perna’s expanded econometric theoretical framework that assumes individuals make decisions by weighing both monetary and non-monetary costs and benefits; this pattern was consistently observed among racially marginalized groups of college students in STEM fields.

Additionally, the belief in one’s ability to make sound career decisions significantly influences the expectation of success in a chosen career path; race plays a substantial role in shaping this belief. For instance, a study by Abe et al. (2021) on South African university students revealed a complex relationship between race and decisions related to STEM careers. The study found that race had a statistically significant negative impact on both career decision-making self-efficacy and COEs. Despite the limited predictive power of the model used in the study, the findings align with previous literature on self-efficacy and COEs.

For international students pursuing STEM fields in college, their career expectations may become further complicated by an additional factor: their non-citizenship, or “alien” (*Glossary | USCIS*, n.d.) status. For instance, international students face unique challenges in pursuing STEM careers in the United States due to restrictions related to immigration status (Rahming, 2022). Even though international students in STEM receive the advantage of a 24-month extension to their post-graduation optical training permit (OPT - (*Optional Practical Training Extension for STEM Students (STEM OPT) | USCIS*, 2022), Rahming (2022) highlighted instances where non-U.S. citizens encountered barriers in accessing internships and job opportunities, as recruiters rescinded offers upon discovering their citizenship status. As a result, non-citizen STEM students may need to position themselves in multiple fields simultaneously to maximize their chances of securing future opportunities permitted by the immigration process (Rahming, 2022). These challenges underscore the intersectionality of factors shaping the career outcome expectations of STEM students, highlighting the need for comprehensive support and resources to address their diverse needs and aspirations.

In conclusion, the literature review provides a comprehensive exploration of the intersection of race, citizenship, and the pursuit of STEM education in the context of social mobility It reveals that students’ motivations to pursue STEM are shaped by an intricate interplay of personal goals, self-efficacy, and career outcome expectations. Interestingly, these factors are significantly influenced by their racial or citizenship status (Boliver & Wakeling, 2023; Zhou & Lee, 2007; Mau, 2004; Chatterjee et al., 2023; Porche et al., 2016; Rahming, 2022). Existing literature, however, has only partially addressed the gravitation towards STEM for social mobility by highlighting the unique challenges underrepresented racial/ethnic groups and international students in the U.S face, such as access to resources, representation in STEM fields, and the impact of immigration policies on their educational experiences and career trajectories (Chatterjee et al., 2023; Rahming, 2022). While the literature suggests that underrepresented students may be drawn to STEM fields due to their potential for economic gains and societal advancement (Medina et al., 2021; Wolter et al., 2019; Davis and Wilson-Kennedy, 2023; Marsh, 2023), it does not explicitly compare their preferences for STEM classes with those for non-STEM classes.

Addressing the knowledge gap in understanding how race and citizenship influence undergraduate STEM majors’ preference for STEM over non-STEM disciplines is crucial. Grounded in the Social Cognitive Career Theory (SCCT) and employing quantitative methods, this research project aims to fill this gap by exploring how demographic identities impact an individual’s career constructs. Within this study, it is essential to acknowledge that demographic identities do not only linearly impact an individual’s career constructs; rather, they can influence other social constructs such as family or college environment differently, thus shaping unique ideas or sentiments about their STEM pursuit. By analyzing the impact of race and citizenship status on STEM students’ discipline preference across segments such as personal goals, self-efficacy, and career outcome expectations, this project can provide deeper insights vital for the development of policies and interventions in career education across disciplines. Consequently, this research contributes to a more nuanced understanding of the factors shaping the educational trajectories and career aspirations of these students, which is crucial for equally supporting student success and advancement in both STEM and non-STEM fields.

# Theoretical Framework

To address the research questions of this study, the author seeks a theoretical framework that underscores demographic factors, specifically race and citizenship, as key contributors to students’ inclination towards STEM disciplines over non-STEM ones. This framework should demonstrate relevance in shaping educational policies at both institutional and broader levels. Furthermore, this framework needs to dissect the concept of “motivation” into several components to provide more nuance in tying choices of STEM over non-STEM to ideas of upward social mobility. Social Cognitive Career Theory (SCCT) provides a robust framework for understanding the multifaceted process of career development, elucidating how socially constructed identities (i.e., race) inform an individual’s interest in specific career paths, navigation of the myriad of options available to them, and engagement in activities conducive to career success (Chatterjee et al., 2023). Developed by Robert W. Lent, Steven D. Brown, and Gail Hackett in 1994, SCCT builds upon Albert Bandura's general social cognitive theory, extending its application to the realm of career development. At the core of SCCT lie two key constructs: *career self-efficacy* (CSE) and *career-related outcome expectations* (COEs) (Lent et al., 1994). CSE pertains to individuals' beliefs in their capacity to plan and execute steps toward achieving personal career goals, with these beliefs being dynamic and context-dependent (Chatterjee et al., 2023). Concurrently, COEs encompass beliefs about the anticipated consequences of specific career-related behaviors, influencing individuals' decisions and level of engagement in career pursuits (Chatterjee et al., 2023). Furthermore, SCCT emphasizes the interconnectedness of individuals' personal goals with CSE and COEs to inform career aspirations and selections. (Medina et al., 2021).

The application of SCCT in examining the selection of STEM majors by students of color and non-U.S. citizen students in higher education offers several benefits. Firstly, SCCT provides a systematic explanation for career development (Wang et al, 2022), allowing for an in-depth exploration of race and nationality as demographic factors that exhibit an influence on both CSE and COEs and overall career trajectories (Chatterjee et al., 2023). Specifically, for students from underrepresented racial and ethnic backgrounds, SCCT sheds light on how systemic barriers and societal expectations may shape their perceptions of their abilities to succeed in STEM careers (Chatterjee et al., 2023). Moreover, SCCT provides insights into how demographic factors intersect with personal experiences and environmental contexts to influence the career trajectories of these students, particularly in the face of challenges such as discrimination and concerns about job security related to citizenship status (Chatterjee et al., 2023; Rahming, 2022). Additionally, SCCT has demonstrated its effectiveness in guiding career education in schools and offers a holistic framework for understanding and forecasting career progression (Wang et al., 2022). In contrast to other career theories, SCCT introduces a fresh approach to shaping adolescents’ interest development, career selection, and performance, with opportunities for cross-cultural studies (Wang et al., 2022). It also adapts to the evolving times by highlighting the fluidity of goal selection and the impact of environmental factors on goal establishment (Wang et al., 2022), which allows for continual application of this framework in future research.

# Methods

Based on existing literature using SCCT and the wide application of quantitative methods in studies involving SCCT (Wang et al., 2022), this study adopted quantitative methods for examining the two proposed research questions. The target population for this study was undergraduate students who intend to, or have declared a major, or minor, in a STEM-degree awarding program at East Coast Liberal Art Colleges. Specifically, participants were recruited from the following majors defined as STEM by this institution: Biochemistry & Molecular Biology, Biology, Chemistry, Computer Science, Data Analytics, Earth Sciences, Environmental Science/Environmental Studies, Mathematics, Neuroscience, Physics and Astronomy, Psychology, and Quantitative Economics. As of 2023, this institution consisted of 2,173 matriculating students, with 24% of this student body being students of color, and 13% being international students.

## Data Sources & Collection Procedures

The primary data for this study was collected through a Microsoft Forms survey targeting students who intend to or have declared a major or minor in STEM at the College. Participants in the target population outlined above were purposefully selected and recruited through convenience and snowballing methods via department-wide invitations. Before beginning the survey, participants were presented with a consent form outlining the purpose and procedures of the study; the participants’ submission of a complete survey indicated their consent to participate in the study. A total of 67 survey responses were collected over a period of three weeks. However, only 64 responses were deemed valid, meeting the criteria of having all questions filled and being associated with a traceable Banner ID.

The survey instrument was a modified version of the Students Attitude Surrounding STEM (SASS) instrument created by McDonough et al. Consisting of 40 survey items, the SASS instrument was built upon SCCT to quantify high school students’ sentiments toward STEM subjects, thus providing a framework for career orientation in high school (McDonough et al., 2021). Compared with existing scales modeled after SCCT such as the STEM-CIS scale created by Kier et al., SASS provided a more compact framework that did not require breaking down analysis by each element of the STEM abbreviation (Kier et al., 2014). In light of SASS’ effective statistical performance in providing insights into students’ perception of STEM discipline, this study adapted this instrument to align with the experiences of students in post-secondary institutions. Firstly, the adapted survey for this study was narrowed down to include only Self-Efficacy Experience (SEE), Self-Efficacy Academic (SEA), Outcome Expectations (COE), and Interest, streamlining the analysis of the SCCT latent variables of interest to the two research questions. Secondly, this adapted survey reintroduced Personal Goals items, which were intentionally removed from analysis in McDonough et al.’s construction of the model. While McDonough et al. removed this SCCT latent variable to reflect high school students’ low likelihood of having clear life goals, the adapted survey brought this variable back to better address the target population, who often have already had major choices and a potential career path in mind (McDonough et al., 2021). Third, in addition to the STEM-focused survey items from the SASS, the adapted survey instrument also included one parallel non-STEM-focused item for each STEM-focused item. This is intended to facilitate the comparison of perspectives toward STEM versus non-STEM among participants. Lastly, recognizing that the original SASS survey was tailored for high school students, the wording of the survey items was modified in the adapted version. This ensured that the language used would resonate more effectively with the target population of college undergraduates.

The 37 items in the final version of the survey instrument were listed in Table A.1 (see Appendix A). The ordering of the survey sections reflected the existing order provided in similar SCCT-based survey instruments (Kier et al., 2014; Lent et al., 1994; McDonough et al., 2021). This survey consisted of 5 SCCT sections that pose questions on a student’s Personal Goals (PG), Self-Efficacy Experience (SEE), Self-Efficacy Academic (SEA), Career Outcome Expectations (COEs), and Interests (IN) in relation to STEM and non-STEM disciplines. In section 1 (PG), participants were asked to rank six statements based on their importance regarding education and future career aspirations. In section 2 (SEE) and 3 (SEA), participants rated their confidence level in succeeding in a career that requires specific skills and in getting a B and above grade in different types of classes, using a 5-point Likert scale. Meanwhile, in section 4 (COEs), participants evaluated the perceived advantages of pursuing careers requiring STEM knowledge compared to non-STEM careers. This section assessed expectations related to salary, familial values, respect, job demand, personal fulfillment, social support, fitting in the field, and familial pride, using a categorical scale. Finally, section 5 (IN) asked participants to rate their interest level in different topics, including STEM-related subjects, social sciences, humanities, problem-solving approaches, and science communication, using a 5-point Likert scale.

At the end of this survey, participants were asked to provide their student ID number. Upon receipt of this information, the author obtained the student’s demographic status (i.e., race, international student status) with permission from the College’s Registrar’s Office. This approach, as opposed to asking students to self-identify demographic information, helped reduce potential response bias often seen in surveys where categories in demographic questions can confuse respondents or evoke a need to conform to demographic stereotypes (Hughes et al., 2016). Demographic information obtained from the Registrar’s office were linked with each participant’s survey responses using the provided Banner ID. Once this linking process was finalized, the data underwent deidentification, excluding all personally identifiable information except for race, ethnicity, and citizenship. In other words, participants’ Banner IDs and other personally identifiable information were not included in the analyzed data.

## Approaches to Data Analysis

Data Preprocessing.Each valid response was matched with race and citizenship information using the corresponding Banner ID. This matching process enabled the categorization of respondents based on race and citizenship status for subsequent analysis. Notably, the Banner ID was subsequently removed to ensure respondent anonymity and data privacy. In terms of racial identities, there was a notable disparity in respondent demographics. The majority of respondents identified as White (35 responses) or Asian (22 responses), while only one Black student and six Hispanic students participated. To facilitate meaningful analysis despite the small sample size of underrepresented groups, these respondents were grouped together, based on their shared characteristic of being underrepresented within the dataset and in STEM. Regarding citizenship status, respondents were categorized by the institution into two main groups based on citizenship status: Residents (individuals with U.S. citizenship) and Non-residents. Notably, one respondent reported dual citizenship. Due to the dual citizen’s privileged status of bypassing visa and work authorization requirements to work in the U.S., this respondent was grouped with the "Residents" population for analysis purposes.

Research Question 1: Association Between Race and Citizenship Status with Preferences for STEM over Non-STEM Disciplines.Across five SCCT survey sections (Goals, SEE, SEA, COE, IN), one of two distinct statistical methods wasapplied to analyze the data and compare the mean rankings, confidence levels, outcome expectations, and interest levels across racial/ethnic groups and citizenship status.

Given the small representation certain demographic in different response categories, particularly in the COE section, Fisher’s Exact Test was employed to establish the association between race and citizenship with a preference for STEM in the COE survey items. Fisher’s Exact Test, well-suited for analyzing categorical data when the expected cell frequencies (i.e., number of students in a race choosing a certain answer to a survey item) are below 5, was chosen to ensure robust statistical analysis despite the small sample sizes, allowing for the comparison of proportions across different racial/ethnic groups and citizenship status regarding career outcome expectations.

Conversely, for the SEE, SEA, Goals, and IN sections, the Kruskal-Wallis H test was utilized. The decision to use the Kruskal-Wallis H test stemmed from the non-normal distribution and heteroscedasticity observed in the variables of interest. Unlike parametric tests like ANOVA, the Kruskal-Wallis test is a non-parametric alternative suitable for comparing ordinal or ranked data across multiple groups. By opting for this test, the study aimed to mitigate issues related to the assumption of normality and homogeneity of variances, ensuring the validity of statistical comparisons across racial/ethnic groups and citizenship status in these SCCT sections. Following the Kruskal-Wallis test, post-hoc pairwise Wilcoxon rank sum tests were conducted to further explore significant differences between specific demographic groups. These tests provide a robust approach for pairwise comparisons while addressing concerns related to non-normality and heteroscedasticity, thereby enhancing the interpretability of the study findings.

Table A.2 shows detailed pairs of hypotheses for each of these sections (see Appendix A).

Research Question 2: Relationship Between Race/Citizenship and Preference for STEM Classes for the prospects of upward social mobility (Items 4.1a and 4.1d). Logistic regression is a statistical method used to model the relationship between a categorical outcome variable and one or more independent variables. In the context of this study, logistic regression was used to examine if race and citizenship can be linked to the likelihood of preferring STEM classes due to the expectation of upward social mobility, reflected in expectations of earning a good salary (survey item 4.1a) or getting a job in high demand (survey item 4.1d). Race and citizenship were combined into a total of 6 distinct demographic identities, and preference for STEM classes (re-coded as binary outcome) was treated as the dependent variable. The formula for this logistic regression could be mathematically represented as:

Where:

* *p* is the probability of the student believing that STEM enables the social-mobility-associated COE,
* ​ are the coefficients (parameters) reflecting the change in (log-odds of the preference for STEM), with being that of the control group (White, U.S. Resident students)
* are codes for combined demographic identities serving as independent variables.

# Findings

This section introduces the findings related to two research questions addressing the association between race, citizenship status, and preferences for STEM (Science, Technology, Engineering, and Mathematics) disciplines over non-STEM disciplines. The analysis involves examining the collected responses from the SASS-adapted survey, focusing on factors derived from the Social Cognitive Career Theory (SCCT) such as Personal Goals, Self-Efficacy (Academic & Expertise), Career Outcome Expectations and Interests.

## Research Question 1: Association Between Race and Citizenship Status with Preferences for STEM over Non-STEM Disciplines

As described in the Methods section, correlation analysis will be processed via different methods to address the association between race/citizenship with COEs, versus with the other 4 factors. For COEs, based on the size of the sample, and the nature of the data where there are cell frequencies (number of occurrences for a certain factor, grouped by race) less than 5, Fisher’s exact test was used in place of Chi-squared correlational analysis. First, Fisher’s Exact Test was done in a 2x2 dimension, comparing the association of race with 10 COE items by pairs of 2 races group (Black & Hispanic – AFHS vs. Asian – AS, Asian vs. White, Black& Hispanic vs. White). The results of Fisher’s exact test for some career outcome expectations are listed below:

**Table 1.1:**

Fisher's Exact Test result for difference in COE among races

|  |  |  |  |
| --- | --- | --- | --- |
| Career Outcome Expectations | Sig. for WH vs. AFHS | Sig. for AS vs. AFHS | Sig. for WH vs. AS |
| Earn a good salary | 0.17674698 | 0.431034483 | 0.638916474 |
| Have a career that my family values | 0.258621587 | 0.642394188 | 0.001294587 |
| Get a job that is in high demand | 0.177306318 | 0.018007663 | 0.219680781 |
| Be supported by my family members | 0.052825809 | 0.170591627 | 5.55E-05 |

The results of the Fisher’s exact test indicated a significant difference on an significance level among three race groups and the perception of STEM as fulfilling some COEs: “Earn a good salary”, “Have a career that my family values”, “Get a job that is in high demand”, and “Be supported by my family members”. More specifically, the statistical test indicated a significant difference between how Asian versus Black & Hispanic students in the sample perceive STEM as enabling the acquisition of a job in high demand (p-value = 0.018). The Fisher’s exact test also indicated significant differences between how Asian versus White students in the sample perceive STEM as a career path that is valued (p-value = 0.001) and supported (p-value < 0.01) by family members. Notably, on an significance level, the test indicated a marginally significant difference between how White versus Black & Hispanic students perceive STEM as a career path that is supported by family (p-value = 0.052). Contrastingly, the test did not indicate any statistically significant differences of race and the COE of earning a good salary between any pair of races.

On the factor “citizenship”, Fisher’s exact test was also used to calculate the association between citizenship status (resident vs. non-resident) for the 10 COEs item. Based on this test, only two COEs, namely “Have a career that my family values” (p-value < 0.01) and “Be supported by my family members” (p-value < 0.01), were indicated to pose a difference between non-resident and resident status on an significance level.

For the other 4 SCCT factors: Goals, SEE, SEA, and IN, correlation analysis was first conducted using a Kruskal-Wallis test to control for the association between races and survey items from these factors. The Kruskal-Wallis tests, on an significance level, indicated that there was a significant difference in the student sample’s confidence or interest levels in some SEA statements and Goals. These survey items are listed below, alongside statistics and p-values. Additionally, the median score, group by race groups, for each SEA item (on a 5-point Likert scale) and Goals item (on a 6-point scale), follows.

**Table 1.2:**

Kruskal-Wallis H Test results for difference in SCCT responses among races

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Test Statistic | Degrees of Freedom | Sig. (p-value) |
| Add to the representation of my identity in the field | 14.0008628 | 2 | 0.0009 |
| Make a positive impact on society | 12.60422839 | 2 | 0.0018 |
| Have a high earning potential | 11.98302698 | 2 | 0.0024 |
| STEM classes in your major | 8.076060978 | 2 | 0.0176 |

**Table 1.3:**

Median values, grouped by race categories, for variables that showed significance in Kruskal-Wallis H Test

|  |  |  |
| --- | --- | --- |
| Variable | Race | Median |
| SEA: STEM classes in your major | AFHS | 2 |
| AS | 4 |
| WH | 2 |
|  |  |  |
| Goal: Make a positive impact on society | AFHS | 1 |
| AS | 2.5 |
| WH | 1 |
|  |  |  |
| Goal: Have a high earning potential | AFHS | 2 |
| AS | 1 |
| WH | 3 |
|  |  |  |
| Goal: Add to the representation of my identity in the field | AFHS | 3 |
| AS | 4 |
| WH | 3 |

Post-hoc unpaired Wilcoxon rank-sum tests were carried out to make pairwise comparisons between pairs of race groups. For the SEA sentiment towards STEM classes in the students’ majors, post-hoc comparisons indicated that this confidence sentiment was scored statistically higher among Asian students compared to White students in the sample (|z| = 252.5, p-value = 0.001\_. This is reflected in the median score of the SEA item “STEM classes in your major” being 4 (Somewhat confident) for Asian students in the sample and 2 (Somewhat not confident) for their White counterparts. For Goals items, post-hoc comparisons indicated that interests in “making a positive impact on society” was statistically lower among Asian students compared to White students (|z| = 563.5, p-value = 0.011) and Black & Hispanic students (|z| = 122.5, p-value = 0.016) in the sample. In details, the median placement of “making a positive impact on society” for Asians students are at second or third place (median score being 2.5), compared to other race groups whose median placements of these values are at first place. Post-hoc comparisons on another Goals item, “having a high earning potential”, indicated that Asian students in the sample ranked this item higher than White (|z| = 189, p-value = 0.023) and Black & Hispanic (|z| = 34.5, p-value = 0.032) peers on a statistically significant level. In the survey sample, the median ranking of this goal among Asian students were highest at first place, followed by Black & Hispanic students’ median ranking of this value at second place, and White students’ median ranking of this value at third out of six places. Last, the post-hoc test indicated that students’ ranking of the goal regarding “representation of my identity in the field” was statistically lower for Asian than for White students (|z| = 214, p-value = 0.036) and statistically higher for Black & Hispanic than for White students (|z| =182, p-value = 0.044). In the median ranking in this survey item, both Black & Hispanic students and White students ranked the item third, while Asian students in the sample ranked the item fourth.

**Table 1.4:**

Wilcoxon rank-sum tests results for difference in significant SCCT responses between pairs of two race categories

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Comparison pair | Test Statistic | Sig. (p-value) |
| SEA: STEM classes in your major | AS vs WH | 252.5 | 0.001703112 |
| Goal: Make a positive impact on society | AS vs WH | 563.5 | 0.011102387 |
| AS vs AFHS | 122.5 | 0.016273683 |
| Goal: Have a high earning potential | AS vs WH | 189 | 0.023016323 |
| AS vs AFHS | 34.5 | 0.032576781 |
| Goal: Add to the representation of my identity in the field | AS vs WH | 214 | 0.036017385 |
| WH vs AFHS | 182 | 0.044385293 |

For a non-parametric comparison of citizenship status with Goals, SEE, SEA, and IN, another series unpaired Wilcoxon rank-sum tests were carried out on the survey sample. On an significance level, there were indications from the Wilcoxon tests of differences in how students of different citizenship status perceive 2 Goals and 2 IN items. For instance, it was indicated that non-resident respondents demonstrated significantly lower interest in “helping people understand the importance of social sciences and/or arts and/or humanities in their daily lives”, with a median score of 3 on a 5-point Likert scale, compared with their resident counterparts (|z| = 589, p-value = 0.024). In a similar pattern, non-resident students also showed significantly lower interest in “watching videos or listening to podcasts about social sciences, arts, humanities, or other non-STEM topics”, with a median score of 3 compared to that score of 4 among residents in the sample (|z| = 626, p-value = 0.004). For “making a positive impact on society”, non-residents demonstrated significantly lower placement of importance on this goal, with a median ranking of 2, compared with residents (|z| = 577, p-value = 0.03). Lastly, non-residents in the sample placed significantly higher value on the goal of “having a high earning potential” (|z| = 298.5, p-value = 0.036) with a median ranking of 1.5, while the median ranking of peer residents in this sample was 3.

**Table 1.5:**

Wilcoxon rank-sum tests results for difference in significant SCCT responses between residents vs. non-residents

|  |  |  |
| --- | --- | --- |
| Variable | Test Statistic | Sig. (p-value) |
| IN: Helping people understand the importance of social sciences and/or arts and/or humanities in their daily lives | 589 | 0.024569275 |
| IN: Watching videos or listening to podcasts about social sciences, arts, humanities, or other non-STEM topics | 626 | 0.004284169 |
| Goal: Make a positive impact on society | 577 | 0.030717104 |
| Goal: Have a high earning potential | 298.5 | 0.036596562 |

**Table 1.5:**

Median values, grouped by citizenship status, for variables that showed significance in Wilcoxon rank-sum tests

|  |  |  |
| --- | --- | --- |
| Variable | Citizenship | Median |
| IN: Helping people understand the importance of social sciences and/or arts and/or humanities in their daily lives | NR | 3 |
| R | 4 |
| IN: Watching videos or listening to podcasts about social sciences, arts, humanities, or other non-STEM topics | NR | 3 |
| R | 4 |
| Variable | Citizenship | Median |
| Goal: Make a positive impact on society | NR | 2 |
| R | 1 |
| Goal: Have a high earning potential | NR | 1.5 |
| R | 3 |

In summary, Research Question 1 elucidates nuanced associations between race, citizenship status, and preferences for STEM disciplines. Through statistical tests, patterns arose of significant differences among races in perceiving COEs, SEAs and Goals regarding STEM subjects. In terms of citizenship, there were significant differences found in how non-residents versus residents perceive interests in non-STEM discipline and personal goals.

## Research Question 2: Relationship Between Race/Citizenship and Preference for STEM for the prospects of upward social mobility (Items 4.1a and 4.1d)

First, a logistic regression model was utilized to assess the relationship between racial identity, citizenship status, and the perception of STEM (Science, Technology, Engineering, and Mathematics) fields as having higher earning potentials (survey item 4.1a). The predictors included in the model were categorized as follows: AFHS\_NR (Non-Resident Black & Hispanic), AFHS\_R (Resident Black & Hispanic), AS\_NR (Non-Resident Asian), AS\_R (Resident Asian), and WH\_NR (Non-Resident White). The coefficients of the logistic regression model, along with their respective estimates, standard errors, z-values, and p-values, are presented in table X.

**Table 2.1:**

Logistic regression results for survey item 4.1a: High Earning Potential

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Coefficient** | **Estimate** | **SE** | **Z value** | **Sig. (p-value)** |
| (Intercept) | 2.014903 | 0.5322906 | 3.785343647 | 0.000153496 |
| AFHS\_NR | -1.3217558 | 1.335415 | -0.989771568 | 0.322285785 |
| **Coefficient** | ***Estimate*** | ***SE*** | ***Z value*** | ***Sig. (p-value)*** |
| AFHS\_R | 16.5511655 | 3261.319342 | 0.005074991 | 0.995950761 |
| AS\_NR | 0.6931472 | 1.161895 | 0.596566108 | 0.550797105 |
| AS\_R | 16.5511655 | 2662.856109 | 0.006215569 | 0.995040726 |
| WH\_NR | 16.5511655 | 6522.638629 | 0.002537495 | 0.997975374 |

The intercept coefficient (β₀) was found to be statistically significant (p < 0.001), indicating that, for the reference group (WH\_NR), the log-odds of perceiving STEM fields as having higher earning potentials is 2.014903.

Among the predictor identities, AFHS\_R, AS\_R, and WH\_NR exhibited high estimates: for instant, the log-odds of a Resident Black & Hispanic student and a Resident Asian student perceiving STEM fields as having higher earning potentials is 16.55. Meanwhile, the log-odds of Non-Resident Black & Hispanic student perceiving STEM fields as having higher earning potentials is negative, at -1.3217558. However, these estimates came with extremely large standard errors, resulting in non-significant p-values (p > 0.05). These results suggest that the coefficients for AFHS\_R, AS\_R, AFHS\_NR, AS\_NR and WH\_NR are not reliable indicators of their respective effects on the perception of earning potentials in STEM in this sample. Interestingly, the goodness-of-fit statistics of the logistic regression model, represented by the decrease of deviance from 39.82453 in the null model to 35.93074 in the model when the predictor variables are included, indicate that the model adequately fits the data. The Akaike Information Criterion (AIC) value was 47.93074, suggesting that the model provides a reasonable balance between goodness of fit and model complexity.

Second, a similar logistic regression model was conducted to investigate the association between racial identity, citizenship status, and the perception of STEM (Science, Technology, Engineering, and Mathematics) fields leading to jobs in higher demand using the same predictors (survey item 4.1d). The intercept coefficient (β₀) was determined to be statistically significant (p = 0.020), indicating that, for the reference group, there is a meaningful association with the log-odds of perceiving STEM fields as leading to jobs in higher demand being 0.8754687.

**Table 2.2:**

Logistic regression results for survey item 4.1d: Get a job in high demand

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Coefficient** | **Estimate** | **SE** | **Z value** | **Sig. (p-value)** |
| (Intercept) | 0.8754687 | 0.3763863 | 2.325984437 | 0.02001938 |
| AFHS\_NR | -1.5686159 | 1.2812754 | -1.224261318 | 0.22085366 |
| AFHS\_R | -0.8754687 | 1.068488 | -0.819352874 | 0.41258511 |
| AS\_NR | 1.0704414 | 0.8444497 | 1.26762015 | 0.20493363 |
| AS\_R | 16.6905997 | 1615.1039 | 0.010334072 | 0.99175475 |
| WH\_NR | 16.6905997 | 3956.180346 | 0.004218867 | 0.99663384 |

Among the predictor variables, AS\_NR showed a notable coefficient with marginal statistical significance (p = 0.205). This suggests that being a Non-Resident Asian may increase the log-odds of perceiving STEM fields as leading to jobs in higher demand by 1.07 compared to the reference group (WH\_NR). However, on a standard level, this result was not statistically significant. Meanwhile, AFHS\_NR, AFHS\_R, AS\_R, and WH\_NR did not exhibit statistically significant coefficients (p > 0.05). This implies that being a Non-Resident Black & Hispanic, Resident Black & Hispanic, Resident Asian, or Non-Resident White may not have a statistically substantial influence on the perception of STEM fields leading to jobs in higher demand compared to the reference group. For this logistic regression model, the goodness-of-fit statistics suggest that it adequately fits the data. The null deviance was 71.9789, and the residual deviance was 62.61514. The Akaike Information Criterion (AIC) value of 74.61514 indicates that the model achieves a reasonable balance between goodness of fit and complexity that could be improved with further enhancement in the sampling and model-building process.

The two logistic regression models did not result in any statistically significant demographic identity as a predictor for the perception that STEM enables social mobility; yet, they both offered some trends in associations, or resistance, between demographic variables and perceptions of STEM-related career outcomes. Further efforts to expand the sample size and resolve the representation imbalance is warranted to fully understand the complexities of these relationships between demographic identities and a preference for STEM as a means to upward social mobility.

# Discussion

This study aimed to investigate the influence of race and citizenship status on personal goals, self-efficacy, and career outcome expectations among STEM undergraduate students, with a particular focus on their preferences for STEM disciplines over non-STEM fields and the role of upward social mobility. The findings shed light on the nuanced associations between these factors and provide insights into the experiences of underrepresented racial/ethnic groups and international students in STEM education.

## Race and Citizenship in shaping Personal Goals among STEM undergraduates

The analysis revealed nuanced differences in personal goals among STEM undergraduates based on their racial/ethnic and citizenship identities. Previous research has highlighted contrasting perspectives on the influence of personal goals on STEM career interests.

Building upon the works of Davis and Wilson-Kennedy (2023), Medina et al. (2021), and Wolter et al. (2019), it has been noted that the broader STEM populace tends to lean towards "agentic goals," which cater to individual interests. Within the context of this study, it became apparent that Asian students within the surveyed cohort most prominently embraced this inclination: post-hoc comparisons indicated that Asian students ranked "making a positive impact on society" and "contributing to the representation of their identity in the field" lower than their White and Black/Hispanic counterparts. Moreover, Asian students accorded greater significance to high earning potential and were drawn to STEM fields for familial approval and financial prospects. However, it's crucial to acknowledge that Asian family values may shape the perception of STEM as meeting familial expectations (Mau, 2004; Pyke, 2000). Thus, the prioritization of the "agentic goal" concerning high earning potential among Asian respondents should be construed as a goal that serves others, not solely an individualistic pursuit.

Marsh (2023) and Davis and Wilson-Kennedy (2023) elucidated a notable trend among STEM aspirants to contribute to society, particularly aiding those in need. This altruistic motivation resonates with the dedication exhibited by Black/Hispanic participants to augment the existing representation of their identity in STEM. This potentially reflects a yearning within these underrepresented groups for enhanced diversity and role models in STEM domains (Rahming, 2022).

For non-resident students who participated in the survey, the aspiration of "making a positive impact on society" ranked significantly lower compared to residents, while "having a high earning potential" was accorded higher importance. This mindset may merely mirror the allure of STEM fields, which have been marketed to international students as lucrative industries (Rothwell, 2013), coupled with immigration benefits that outweigh those of non-STEM programs (Optional Practical Training Extension for STEM Students (STEM OPT) | USCIS, 2022).

## STEM students’ racial & citizenship identities informing their Self-Efficacy & academic interests

Self-efficacy, as defined by Lent et al. (1994), refers to an individual's dynamic belief system regarding their capability to undertake specific actions, and it plays a pivotal role in shaping the academic pursuits and career decisions of STEM students. Abe et al. (2021) have identified race, among other demographic variables, as a significant contributor to career-related self-efficacy.

Chatterjee et al. (2023) discovered that individuals from underrepresented racial/ethnic groups often exhibit higher levels of career self-efficacy (CSE) compared to their counterparts from well-represented groups. This may be attributed to the necessity of navigating and overcoming systemic barriers. Conversely, Mau's study (2004) suggests that students of certain nationalities may face increased pressure in career decision-making, leading to diminished confidence in their self-efficacy perceptions. The findings from this study further complicate these observations. Post-hoc comparisons revealed that Asian students scored statistically higher on self-efficacy toward STEM classes in their majors (SEA) compared to their White counterparts, with median scores of 4 (Somewhat confident) and 2 (Somewhat not confident), respectively. However, Black and Hispanic students in the survey sample evaluated their self-efficacy toward STEM classes in their majors similarly to their White counterparts. While the behavior of Asian participants somewhat aligns with Chatterjee et al.'s findings, it is Mau's findings that accurately illustrate the complexities in STEM self-efficacy among underrepresented populations, particularly Black and Hispanic students. As noted by Davis and Wilson-Kennedy (2023), a strong sense of engagement and interest can coexist with feelings of inadequacy, a lack of belonging, and unequal performance expectations, complicating one's overall perception of their ability to perform well in STEM academia.

Porche et al. (2016) observed that immigrant students often exhibit heightened engagement and proficiency in STEM subjects compared to their native-born peers. Notably, the findings did not indicate a significant difference in perception of either academic or career-expertise self-efficacy between non-resident respondents and their U.S. resident counterparts.

Regarding academic interests, Xu (2013) pointed out that STEM majors, such as those in health-related fields or technical sciences, typically offer vocationally specific training and clearer occupational pathways, whereas disciplines like social sciences may lack distinct occupational trajectories. This disparity in specificity can significantly influence students' inclination toward the more clearly delineated outcomes associated with STEM fields. The findings from this study, while aligned with previous literature from Xu, also revealed significant differences in academic interests between resident and non-resident students. Non-residents demonstrated significantly lower interest in "helping people understand the importance of social sciences and/or arts and/or humanities in their daily lives" and "watching videos or listening to podcasts about social sciences, arts, humanities, or other non-STEM topics" compared to residents.

## Race, citizenship, and setting Career Outcome Expectations with upward social mobility in mind

The study's findings, combined with existing literature, illuminate the intricate relationship between racial identity, citizenship status, and career outcome expectations (COEs) among STEM students, particularly regarding perceptions of earning potential, job demand, and familial support. These COEs are shaped by a complex interplay of economic considerations, self-efficacy beliefs, and cultural values, ultimately influencing students' educational and career trajectories.

The analysis revealed significant differences in the perception of STEM as a career path valued and supported by family members across racial/ethnic groups. Asian students were more likely to perceive STEM careers as valued and supported by their families compared to their White and Black/Hispanic counterparts. This finding resonates with previous research on Asian cultural values, highlighting familial expectations as a significant factor in career decision-making among STEM students. Interestingly, while Mein et al. (2020) observed the influence of family experiences on STEM careers among Mexican-origin households, respondents from this demographic did not exhibit a stronger inclination to fulfill familial expectations while attending STEM programs.

Furthermore, non-resident students were more likely to perceive STEM careers as valued and supported by their families compared to resident students. This finding suggests an additional layer of challenges and pressures faced by international students in navigating career opportunities, with familial approval emerging from the study’s findings as a crucial determinant of STEM academic and career choices. However, it's worth noting that the majority of non-resident respondents racially identify as Asian, which links back to previous research on family-oriented cultures' influence on career expectations.

Aligning with Xu's (2013) observation that individuals in STEM tend to self-select into fields offering higher earning potential, the logistic regression analysis indicated a significant association between racial identity, citizenship status, and the perception of STEM fields as having higher earning potential. Resident Asian students exhibited higher probabilities of perceiving STEM fields as pathways to higher earning potential compared to the reference group (White Residents). Additionally, there was a marginally significant association between being a non-resident Asian student and perceiving STEM fields as leading to jobs in higher demand, consistent with Rahming's (2022) observations. Contrasting with Mau's (2004) findings on the pressure among Black & Hispanic students to conform to White students' COEs on predominantly White campuses, however, the analysis revealed a notable resistance among non-resident Black & Hispanic respondents to the idea that STEM enables higher earning potential and better job prospects. This opens avenues for further research into the underlying reasons behind this sentiment, tying the hesitation to view STEM as economically rewarding pursuit to the aforementioned lower self-efficacy observed among Black & Hispanic respondents.

Nevertheless, the analysis also revealed unreliable coefficients for various racial/ethnic and citizenship groups, potentially due to sample size limitations and large standard errors. This underscores the need for further research with larger and more representative samples to establish a more robust understanding of the relationship between citizenship status, racial identity, and perceptions of upward social mobility associated with STEM fields.

# Implications

This study explored differences across racial and citizenship demographics in how STEM fields in tertiary education are perceived through the lens of Social Cognitive Career Theory (SCCT). By examining factors such as goals, career outcome expectations (COEs), self-efficacy, and interests, the study identified disparities in how various racial and citizenship identities inform an individual's perception of STEM as a means for upward social mobility. Overall, these findings shed light on the nuanced interplay between career constructs like COEs and self-efficacy, illuminating potential avenues for improvements across personal, social, cultural, economic, academic, and professional domains.

Acknowledging the disparities among different races and citizenship identities found in this study is crucial in the context of existing narratives of meritocracy and producerism in the STEM workforce. By normalizing beliefs about racial proficiency in STEM subjects and perpetuating racial stratification, the current STEM system overlooks the contributions and challenges faced by underrepresented groups, as well as the effect of the STEM labor distribution in reproducing racial disparities (Chen & Buell, 2018). This study hopes to serve as pointers for policy-makers to re-evaluate the promotion of STEM as providing society-wide mobility (Rothwell, 2013) and re-evaluate non-STEM funding and immigration policies. Through more transparent reports on the labor distribution in STEM and non-STEM by racial and citizenship demographics, as well as reformation of existing immigration & funding policies, policy-makers can help frame a more ethical picture of STEM labor versus non-STEM, inclusive of the pros and cons. The author of this study also calls on higher education institutions to facilitate culturally-conscious, inclusive curricula reflecting diverse perspectives. Higher education should equally fund and promote STEM and non-STEM fields to offer flexibility in options for individuals, instead of sorting students by racial and citizenship identities. The author urges that institutions use statistics and trends produced by studies similar to this research to inform more equitable approaches to education and workforce development, instead of exploiting these results to further sort students into career tracks by their demographic identities.

Finally, thinking about expanding this study and driving more meaningful results, future work should explore additional angles of analysis within the SCCT framework, such as examining how career constructs like self-efficacy, interests, and COEs interact and influence one another. Expanding the survey population is crucial to producing more generalizable results, considering how representation imbalances has impacted this study. Furthermore, incorporating mixed methods and qualitative input can capture the complexity and richness of individual experiences that quantitative methods alone may not fully encapsulate. While SCCT emphasizes learning experiences, environmental factors, and interests, qualitative evaluation methods can address ambiguities in these areas. Within quantitative SCCT applications, uncertainties remain in determining which factors play the most crucial role and to what extent they can predict career performance (Wang et. al, 2022). Thus, future research should ideally integrate both quantitative and qualitative SCCT approaches for a more comprehensive understanding of how race and citizenship shape the pursuit of STEM disciplines. Last, the SCCT framework may need adaptation to account for the unique life experiences and distinct formation or interpretation of Career Outcome Expectations (COEs) for students with multiple marginalized identities (Medina et al., 2016), as observed in how race and citizenship status complicate the interpretation of individual responses to this study’s survey. While this study's survey design considered such limitations in defining and analyzing goals, future COE scales should more comprehensively address these nuanced interpretations.

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# Appendix

## Table A.1:

*Composition of Survey Instrument and Elements for Analysis*

|  |  |  |
| --- | --- | --- |
| **ID** | **Question** | **Scale/Response Options** |
|  | **Section 1: Personal Goals (PG)** |  |
|  | *Rank the following goal statements in order of importance to you (1 being the most*  *important and 6 being the least important)* | 1-6 (Ranking) |
| 1.1 | I want to make a positive impact on society through my work. |
| 1.2 | I aim to achieve a high earning potential in my career. |
| 1.3 | I aim to continuously learn and grow in my profession. |
| 1.4 | I aim to gain recognition in my profession. |
| 1.5 | I want to contribute to the representation of people of my race/nationality in this field. |
| 1.6 | I want to mentor and inspire future generations, particularly those from underrepresented backgrounds, to pursue STEM careers. |
|  | **Section 2: Self-Efficacy Experience (SEE)** |  |
|  | *I am confident in my ability to succeed in a career that requires* | No confidence - Complete confidence (5-point Likert) |
| 2.1 | Understanding or interpreting graphs. |
| **ID** | **Question** | **Scale/Response Options** |
| 2.2 | Understanding or interpreting complex texts or scholarly literature. | No confidence - Complete confidence (5-point Likert) |
| 2.3 | Using mathematical/scientific concepts to analyze & interpret information. |
| 2.4 | Analyzing social trends or cultural phenomena. |
| 2.5 | Informing people about topics in STEM. |
| 2.6 | Approaching and interpreting problems qualitatively. |
| 2.7 | Discussing scientific or technical concepts. |
| 2.8 | Discussing philosophical or ethical concepts. |
|  | **Section 3: Self-Efficacy Academic (SEA)** |  |
|  | *I am confident in my ability to earn a B or better in* | No confidence - Complete confidence (5-point Likert) |
| 3.1 | STEM classes in your major. |
| 3.2 | Humanities classes. |
| 3.3 | STEM classes outside of your major. |
| 3.4 | Social Sciences classes. |
|  | **Section 4: Career Outcome Expectations (COEs)** |  |
|  | *Between a career that requires STEM knowledge vs. a career that requires non-STEM*  *knowledge, a career in … will more likely allow me to:* | STEM, Non-STEM, No difference |
| 4.1a | Earn a good salary. |
| 4.1b | Have a career that my family values. |
|  |  |  |
| **ID** | **Question** | **Scale/Response Options** |
| 4.1c | Get respect from other people. | STEM, Non-STEM, No difference |
| 4.1d | Get a job that is in high demand. |
| 4.1e | Do work that excites me. |
| 4.1f | Increase my self-esteem. |
|  | *Between a career that requires STEM knowledge vs. a career that requires non-STEM*  *knowledge, a career in … will more likely:* | STEM, Non-STEM, No difference |
| 4.2a | Be supported by my friends. |
| 4.2b | Make me feel that I “fit in” with other people in this field. |
| 4.2c | Be supported by my family members. |
| 4.2d | Make me feel that my friends and/or family are proud of me. |
|  | **Section 5: Interests (IN)** |  |
|  | *Rate your interest in* | Low interest - High interest (5-point Likert) |
| 5.1 | Thinking about topics that relate to STEM. |
| 5.2 | Thinking about topics related to social sciences and humanities. |  |
| 5.3 | Hearing about how STEM researchers solve problems. |
| 5.4 | Hearing about how researchers in social sciences and humanities solve problems. |  |
| **ID** | **Question** | **Scales/Response Options** |
| 5.5 | Helping people understand the importance of science in their daily lives. | Low interest - High interest (5-point Likert) |
| 5.6 | Helping people understand the importance of social sciences and humanities in their daily lives. |
| 5.7 | Watching videos or listening to podcasts that are about science, math, or other STEM topics. |  |
| 5.8 | Watching videos or listening to podcasts about social sciences, humanities, or other non-STEM topics. |

## Table A.2:

*Hypothesis Pairings for Research Question 1*

|  |  |  |
| --- | --- | --- |
| Section | Null Hypothesis (H0) | Alternate Hypothesis (H1) |
| Personal Goals (PG) | There is no significant difference in the mean rankings of personal goals related to education and future career aspirations among different racial/ethnic groups and citizenship status. | There is a significant difference in the mean rankings of personal goals across racial/ethnic groups and citizenship status. |
| Self-Efficacy Experience (SEE) | There is no significant difference in confidence levels regarding career-related skills among different racial/ethnic groups and citizenship status. | There is a significant difference in confidence levels regarding career-related skills across racial/ethnic groups and citizenship status. |
| Self-Efficacy Academic (SEA) | There is no significant difference in confidence levels regarding academic performance across racial/ethnic groups and citizenship status. | There is a significant difference in confidence levels regarding academic performance across racial/ethnic groups and citizenship status. |
| Career Outcome Expectations (COE) | There is no significant difference in outcome expectations between STEM and non-STEM careers across racial/ethnic groups and citizenship status. | There is a significant difference in outcome expectations between STEM and non-STEM careers across racial/ethnic groups and citizenship status. |
| Interest (IN) | There is no significant difference in interest levels across various topics among racial/ethnic groups and citizenship status. | There is a significant difference in interest levels across various topics among racial/ethnic groups and citizenship status. |