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Who Participates in Community College STEM Work-Based Learning?

An Exploratory Analysis of Florida Community College Students

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Executive Summary

A growing number of studies indicate that the labor market is in need of skilled science, technology, engineering, and mathematics (STEM) workers to fill the increase in STEM occupations. At the same time, the population in the US is changing, resulting in more diverse workers, many of whom remain underrepresented in STEM fields. Research suggests that high-quality work-based learning (WBL) may solve the leaky pipeline for STEM fields, particularly for students who have been historically excluded from these fields. WBL has been a key strategy for developing students' preemployment knowledge and skills through on-the-job experience. Studies also show that WBL can provide students with vital mentoring and social capital that can prepare them for the process of job hunting and improve their ability to become employed upon graduation.

Community colleges are especially important vehicles for WBL due to their diverse student populations and their partnerships with employers and industries. Most students in the US begin their postsecondary experience at community colleges, and most community college students are low income, are students of color, and/or work in addition to taking courses. Furthermore, businesses and industry leaders rely on community colleges to provide skilled workers who meet employer demands. Nevertheless, research on WBL in community colleges is scant, and even fewer studies have examined STEM WBL in community colleges. Before researchers can begin to understand the effects of STEM WBL on student outcomes, we must first examine who participates in STEM WBL in community colleges. This study explores participation in STEM WBL in Florida community colleges. We focus on internships and cooperative education courses since these are the most prevalant and identifiable in the data we obtained from the Florida College System (FCS). The Florida College System includes the 28 state colleges, which primarily offer two-year degrees and short-term certificates. Florida does not use the term "community colleges", however we use this term throughout the report to align terminology that is recognizable to similar institutions that award two-year degrees and short-term certificates. The study examines participation rates among STEM and non-STEM WBL as well as across different demographic groups.

Key Findings

1. WBL remains an underutilized strategy in community colleges for STEM majors. Only about 3% of students participated in a WBL experience while they were in a STEM major.
2. Most students who majored in STEM and participated in WBL were enrolled in a mixture of part-time and full-time status over the course of their studies.
3. Most students who majored in STEM and participated in WBL were younger than 24; however, older students had relatively high rates of WBL participation compared to their overall enrollment in the FCS.
4. Women remain underrepresented in both STEM and STEM WBL compared to their overall enrollment in the FCS. However, once women majored in STEM, they were just as likely as men to participate in WBL.
5. White and Asian males and females were more likely to particiate in STEM WBL compared to non-white males and females.
    a. Black males and females majored in STEM at lower rates than their FCS enrollment and were also less likely to participate in STEM WBL.
    b. Hispanic students majored in STEM at comparable rates to their FCS enrollment but were less likely to participate in a STEM WBL experience than Asian, White, or multiracial students were.
    c. Asian student enrollment in STEM majors and participation in STEM WBL was driven by male rather than female students.
6. STEM students who participated in a WBL experience were more likely to attain a certificate or degree than STEM students who had not participated in a WBL experience were. This appears to be driven by the timing of WBL experiences. Most students completed their WBL experience at the end of the degree program, making it more common for WBL students than non-WBL students to attain a credential.

Recommendations

1. Practitioners in STEM industry and educational fields should work toward **standardized definitions of WBL**, including standardized definitions for different WBL types (e.g. internships, cooperative education, apprenticeships).

2. Policymakers and practitioners who develop and refine state and national data systems should focus on establishing systems to ensure **consistent collection of data to capture WBL** across the FCS and national datasets, such as whether the WBL experience is paid or required for graduation and whether the opportunity is in the same sector as a student's program of study.

3. Researchers and policymakers should conduct more research to have **a better understanding of barriers to STEM WBL participation, especially for women and learners of color who are underrepresented in both community college STEM programs and STEM WBL**.

Introduction

The US continues to experience changes in its population and, subsequently, its labor force. By 2060, the Hispanic/Latinx population is projected to increase by 115%, the Black population and American Indian/Alaskan Native population by 42%, and the Asian population by 128% (Scott et al., 2018). However, the distribution of opportunity in the labor force for certain demographic groups remains unequal. For example, the unemployment rate for African Americans has been double the White unemployment rate for more than 40 years, and women continue to earn 84% of what men earn (Ajilore, 2020; Barroso & Brown, 2021; Wilson, 2019). The COVID-19 pandemic has continued to deepen persistent labor force inequities. After the pandemic began, the unemployment rate for people of color and women skyrocketed, with Black and Hispanic women bearing the brunt of job losses and labor force exits. These challenges are further compounded in fields like science, technology, engineering, and mathematics (STEM) from which women and people of color have historically been excluded. The U.S. Census Bureau predicts that these fields will increase the number of available jobs by 10% in the next 10 years compared to 3% growth in non-STEM fields, and the gender and racial/ethnic gaps in STEM are likely to excerabate hiring challenges in these fields (Fry et al., 2021; The Bureau of Labor Statistics, 2021). Thus, the fastest increases in job opportunities are occurring in STEM fields, where certain demographic groups continue to be underrepresented despite their growth in the population at large.

Research suggests that high-quality work-based learning (WBL) can be a promising approach to solving the leaky pipeline for undertapped demographic groups such as women and students of color, including for STEM fields. WBL is an approach to training in which a student completes meaningful tasks in a workplace and gains knowledge and skills needed to succeed in the workplace (Kobes et al., 2018). There are several models of WBL, including internships, cooperatives (co-ops), and registered apprenticeships. High-quality WBL experiences can yield positive relationships with coworkers and managers, increase social capital, and provide exposure to real-life, hands-on workplace environments (Ross et al., 2020). Through WBL, students can learn the technical, academic, and professional skills they need to succeed in the workplace. The Brookings Institute notes that WBL can also improve social capital and expand student networks by providing "an inroad to the informal referral process that is so common in recruitment and hiring" (Ross et al., 2020, p. 17). These short-term outcomes can lead to future employment in the students' field of study and a potential for higher wages due to their hands-on workplace experience. As a result, WBL experiences can improve access, participation, and success in the labor market for all students and may also have the potential to address employment and wage disparities for groups that have historically been excluded from certain programs of study and job sectors such as STEM.

WBL is often a component of career and technical education in high school and programs of study in four-year insitutions, but community colleges can also be important vehicles for WBL, specifically for women, persons of color, and other adults or youth whose enrollment is underrepresented in these institutions (Joy, 2022). Community colleges remain a key entry point into higher education for youth and adults in low-income households because they provide a lower-priced alternative compared to four-year universities, offer credential options that can be completed in shorter time frames, and have more flexible course scheduling options (Hillman & Weichman, 2016). This is important since community college students are more likely to be older, students of color, economically disadvantaged, employed part time, and/or caretakers or responsible for dependents (Mullin, 2012). Over half of the community college students enrolled in credit-bearing programs are women and/or students of color, and approximately one third are first-generation college students and/or come from an economically disadvantaged background (American Association of Community Colleges, 2021). Given that community colleges enroll diverse student bodies, they have a strong ability to influence the diversity, equity, and inclusion of WBL participation and employment outcomes that are impacted by WBL experiences (Spaulding et al., 2020). However, we know little about who participates in WBL in community colleges. This report draws on statewide data from Florida to examine WBL participation in community colleges, specifically for internships and co-ops. Our research delineates participation in these opportunities by program of study ("STEM" versus "non-STEM") and by demographic groups. Through this study, we hope to provide knowledge to higher education researchers and practitioners at community colleges to intentionally design and develop WBL opportunities that are inclusive of their student population and, subsequently, the future labor force.

Overview of Work-Based Learning

WBL is defined and implemented in several different forms that are not standardized across region or state (Gardner & Bartkus, 2014; Giffin et al., 2018; Spaulding et al., 2020). However, there is consensus that WBL experiences should occur outside of the classroom and should align with classroom instruction and the field of study a student is interested in pursuing. WBL experiences should also build professional and career-relevant skills to improve access to employment and careers upon completion of a degree. While many models of WBL exist, this study specifically examines credit-bearing WBL participation in internships and co-ops.[1] We focus on these two models since they are the most underresearched, especially compared to registered apprenticeships and on-the-job training (Spaulding et al., 2020).

WORK-BASED LEARNING TYPES IN THIS STUDY

Cooperatives (co-ops) are structured, multisemester learning experiences where students participate in paid, supervised work related to their academic major or field of study. Formal agreements are often required between employers, students, and the institution. Co-ops are often paid, and/or the participant receives some academic credit.

Internships are short-term learning experiences that are paid or unpaid that allow a student to incorporate knowledge and skills in the classroom with hands-on experience in a professional setting. Internships may be paid or unpaid, and the participant may or may not receive academic credit.

Co-ops are programs that allow students to earn course credit for paid

1 As noted in Appendix A, we only focus on credit-bearing WBL because we can observe credit-bearing internships and co-ops in the data we obtained from Florida.

or unpaid employment (Darche et al., 2004). According to Cedercreutz and Cates (2010), co-ops are "defined as an educational methodology in which periods of classroom instruction alternate with periods of paid discipline-related work experience" (pg. 20). Like other forms of WBL, co-ops are meant to allow students to apply the knowledge they have learned in the classroom to real-world work experiences. However, the rotation between classroom instruction and work experience sets co-ops apart from other forms of WBL (Gardner & Bartkus, 2014). Co-ops typically provide students with multiple work terms either in between or in combination with formal classroom instruction and require formal agreements between the employer, student, and instution ("Internship & Co-Op Survey Report," 2019).

In contrast, internships are more flexible and do not always have standard requirements across program majors or institutions. Internships are typically shorter and more frequently occur concurrently with coursework (Gardner & Bartkus, 2014). The inherently flexible nature of internships can be challenging for both program administrators and students. For example, the length of internships may vary along with whether the position is paid, even within an institution and program major ("Internship & Co-Op Survey Report," 2019). This can create challenges in monitoring and tracking participation and student outcomes.

Who Participates in Work-Based Learning?

As noted in a review of the literature on WBL participation, in 2016 only one fifth of adults reported completing a WBL experience, and only 14% said they participated as part of their postsecondary program (Spaulding et al., 2020). A 2020 survey of employers showed that internships were expected to increase by 3%, yet after the pandemic, internship and co-op participation decreased by 1% and 3%, respectively.[2] The 2021 survey also noted that men accounted for the majority of interns and co-ops, and the majority who participated were White ("Internship & Co-Op Survey Report," 2021). Furthermore, women are usually less likely to be paid for a WBL experience compared to men. One study found that college women are 34% less likely to be paid for their internship compared to men (Zilvinskis et al., 2020). Racial and ethnic disparities also exist within WBL, mirroring the structural barriers these groups face in the workplace (Toglia, 2017). For example, students who participate in apprenticeship programs are predominantly White

2 The report indicates that employers noted that this was likely a temporary decrease to stabilize employment after the pandemic.

(63.4%). Additionally, Black or African American workers make the lowest wages of all apprentices at more than 50% less than their White counterparts (Hanks et al., 2018). Similarly, the National Association of Colleges and Employers found that Black, Hispanic, and multiracial students are overrepresented in unpaid internships compared to White and Asian students (Collins, 2020).

Gaps in the Research and Contributions of This Study

There is a lack of research on the impacts of WBL on community college student outcomes, though the research that does exist is promising. Qualitative studies using data from interviews have demonstrated that WBL in career and technical education programs in community colleges led to perceived increases in students' technical and soft skills (Kim, 2011; Lewis-Sissoms, 2020). Quantitative studies have also demonstrated an association between WBL and students' college and career outcomes. Darche et al. (2004) found that the rate of entry into the workforce and first year earnings were higher for co-op participants compared to students who did not participate in a co-op. Other studies corroborate these findings. Blair and Millea (2004) found that co-op participants accrued benefits such as higher grade point averages, higher starting salaries, and reduced time from college to employment (Blair & Millea, 2004). Some studies have concluded that paid, longer-term WBL opportunities produce better outcomes than shorter-term, unpaid ones (Spaulding et al., 2020).

WBL may also be especially beneficial for students in STEM fields and has the potential to alleviate disparities across race, ethnicity, and gender. Black and Hispanic workers continue to be underrepresented in STEM fields compared to the percentage of the workforce they comprise. Additionally, while adult women make up the majority of postesecondary degree earners, they remain a small proportion of the degree earners in engineering and computer science (Fry et al., 2021). In Thiry et al.'s (2011) qualitative study on the impact of WBL on undergraduate STEM students, the researchers identified several major domains related to student gains from participating in WBL. These include "thinking and working like a scientist" and "becoming a professional" as students reported learning professional behaviors during their WBL experiences, including learning to work independently, understanding professional practice, and developing an identity as a scientist. Participation in WBL has also been correlated with higher graduation rates among STEM students (Stanford et al., 2017)and significantly increased the likelihood of STEM students pursuing a career in a STEM-related field (Massi et al., 2013; Stanford et al., 2017).

Given their importance in workforce development and access to a large, diverse student population, community colleges are uniquely positioned to address labor market skill gaps and disparities in STEM fields. WBL in community colleges can be used as an important strategy to advance equity and economic opportunity for all community college students (Ross et al., 2020). Current research on STEM WBL opportunities suggests positive impacts on students' college and career outcomes, yet the research is limited. For example, there is less research on internships and co-ops than on registered apprenticeships and even less specifically concerning a community college setting and STEM fields (Spaulding et al., 2020) . Furthermore, there is a critical gap in knowing who participates in these WBL opportunities. Recognizing the potential benefits of WBL to community college STEM educational and workforce outcomes, it is important that we understand who participates and how those benefits are distributed.

The current study fills the current gaps in the literature about community college STEM and non-STEM internships and co-op experiences by analyzing who participates in credit-bearing internships and co-ops across community colleges in Florida. This study is novel and contributes to both policy and practice by examining the diversity of these programs across program majors (STEM versus non-STEM) and student identity (race, ethnicity, and gender) in Florida. We used Florida as our case study due to its rich longitudinal data system and interest in understanding its WBL population. Presently, there are no national datasets available to explore these research questions, and to our knowledge, there have not been similar analyses of state data. While we caution researchers from extrapolating data from a single state to other contexts or overgeneralizing the findings in this report, we hope to be a catalyst for other studies on this topic. Our goal is to provide information to state policymakers, community college practitioners, and employers in order to better recruit and structure internship and co-op experiences for their student populations and, subsequently, the labor force and to consider ways to strengthen state data on WBL in support of these goals.

Research Design

This study uses descriptive analyses to address the following research questions:

1. Who participates in WBL experiences in Florida's community colleges? How does participation vary by STEM versus non-STEM majors?
2. How does participation in STEM WBL experiences in Florida community colleges differ by student gender, student race/ethnicity, and other student characteristics?
3. How is WBL participation associated with credential attainment? To what extent is there variance among demographic groups?

The first two research questions explore descriptive statistics about WBL participation overall as well as differences in participation by STEM major and student demographic groups. Here, we focus on how well certain demographic groups are represented in overall and specific STEM WBL opportunities (i.e., internships vs. co-ops). We compare participation in STEM and STEM WBL opportunities for each demographic group with their overall enrollment in the Florida College System (FCS). The third research question focuses on STEM WBL and attainment. In addition to examining whether students from different demographic backgrounds participate in WBL programs, we seek to understand how participation is associated with credential completion.

Sample

This study used longitudinal administrative records obtained from the Florida Department of Education's Education Data Warehouse (EDW). The data system houses student data linked across K–12 and postsecondary education. Researchers obtained the data following an external research data request and review from the Bureau of PK–20 Education Reporting and Accessibility (PERA).

The sample includes first-time-in-college students who matriculated in the FCS in the academic year 2013–2014, and the study followed them through to the academic year 2018–2019 (N = 103,363; see Appendix D for descriptive statistics regarding the total student sample). The FCS includes 28 public community and state colleges in Florida that primarily award two-year terminal and transfer degrees (Associate of Arts [AA], Associate of Science [AS], and Associate of Applied Arts [AAS]); however, some FCS colleges offer four-year baccalaureate degrees.[3,4]

3 The FCS institutions are distinct from the 12 public four-year universities in Florida.

4 All FCS institutions offer at least one baccalaureate degree starting Fall 2022.

The dataset includes college transcript data for students including course enrollment, credit hours earned, major declaration, and degree awarded. The dataset also includes demographic data such as gender, age, and race/ethnicity. A unique identifier is provided for each student and community college institution for tracking across data files and academic years.

Because we strive to center equity in this report, it is important that we describe the student background categories available to us to create this report. The demographic groups included in this report were self-identified by students and reported by the community colleges to the state of Florida for reporting purposes. Categories were defined by the Florida Department of Education, and students self-reported through the institution where they enrolled in college. Gender is reported as "the gender of the student, as reported by the student" and includes the following categories: male, female, and not reported. Due to small sample sizes, we do not provide results from the "not reported" category, which accounted for 1% of the total student sample. Race is reported as "Yes," "No," or "Unknown" for the following race or ethnicity categories: White, Black or African American, Asian, American Indian/Alaskan Native, and Native Hawaiian/Pacific Islander. Students had the option to select more than one racial category, which we coded as multiracial. There was a separate reporting category for ethnicity, which included "Yes," "No," and "Unknown" for Hispanic/Latino. We report Hispanic in our report for students who select "Yes." We explore variation in race within the Hispanic category in Appendix D. We acknowledge that these categories do not represent the full spectrum of identities that a student can have, and our goal is that this study will only be the beginning of a review of how students with different social and academic identities interact with STEM majors and STEM WBL experiences.

Findings

This section summarizes the key findings of the study presenting descriptive analyses by research question.

Who participates in WBL? How does participation vary by STEM versus non-STEM majors?

Non-STEM students are more likely to participate in WBL than STEM students.

Among the sample of 103,363 students, 3,420 (3%) participated in at least one internship or co-op while enrolled in a FCS institution between fall 2013 and spring 2019 (see Table

1). A slightly larger number of students participated in an internship (2,307 students, 2% overall) compared to a co-op (1,197 students, 1% overall). In addition, 872 students who at some point majored in a STEM program participated in a WBL opportunity (6%) compared to 2,548 non-STEM majors (3%). The mean number of internship courses that students took was 1.4, and the mean number of cooperative education courses students took was 1.2.

Table 1: Number of Students Who Participated in Work-Based Learning

	STEM	Non-STEM	All Majors
Internship	539 (3%)	1,768 (2%)	2,307 (2%)
Cooperative Education	357 (2%)	840 (1%)	1,197 (1%)
Total Work-Based Learning	872 (6%)	2,548 (3%)	3,420 (3%)
Total Student Sample	15,532 (15%)	87,831 (85%)	103,363 (100%)

Source: Florida Department of Education's Education Data

Notes: The sample is 3,420 students who were first-time-in-college students in 2013–2014 and participated in a WBL opportunity at any point during their enrollment in a FCS institution. This table provides descriptive analysis for students who participated in a WBL opportunity and declared a STEM or non-STEM program major. Cells may not add up to the totals because 84 students took both a co-op and an internship and 39 students took a WBL course but did not declare a major.

Work-based learning participation is clustered among schools located in or around Florida's metro areas.

WBL coursetaking was clustered among colleges located in Florida's metro areas including Jacksonville, Orlando, Tampa Bay, Gainesville, and Miami (see Figure 1). The top five colleges with the most students who enrolled in credit-based internships and cooperative education opportunities with any program major included Eastern Florida State College (14%), Miami Dade College (12%), St. Petersburg College (11%), Florida State College at Jacksonville (8%), and Valencia College (7%). Across these colleges, the majority of WBL occurred within the Liberal Arts and Sciences/General Studies (23%); Health Professions

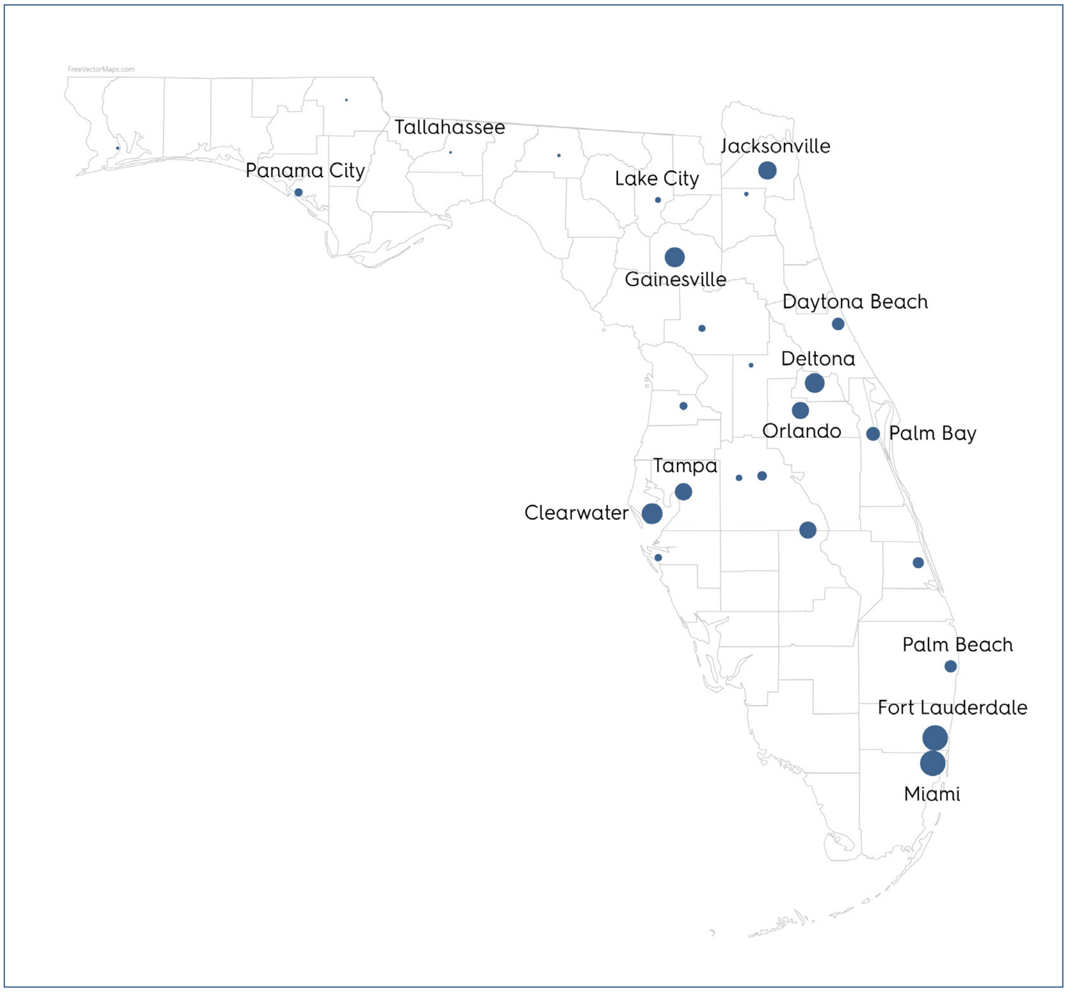
(20%); Business, Management, and Marketing (10%); Education (9%); and Culinary and Entertainment (6%) Classification Instruction Program (CIP) codes.[5]

Similarly, WBL coursetaking for STEM students occured in and around Florida's metro areas, where the population was also the highest (see Figure 1). The top five colleges with students enrolled in WBL opportunities while also enrolled in a STEM program major included Miami Dade College (12%), Broward College (11%), St. Petersburg College (10%), Santa Fe College (9%), and Seminole State College (8%). The majority of the WBL opportunities for students enrolled in these colleges were for programs in Computer and Information Sciences and Support Services (37%), Engineering/Engineering-Related Sciences (20%), Mechanic and Repair Technologies (17%), Liberal Arts and Sciences/General Studies (8%), and Communications Technologies/Technicians and Services (6%).[6]

5 We utilized the two-digit CIP code to identify the program areas.

6 As noted in Appendix C, we coded some programs as "STEM" that were part of the Liberal Arts and Sciences/General Studies CIP code. Appendix C lists the program titles in that CIP code that were labeled as STEM.

Figure 1: STEM Work-Based Learning Course Participation in Florida



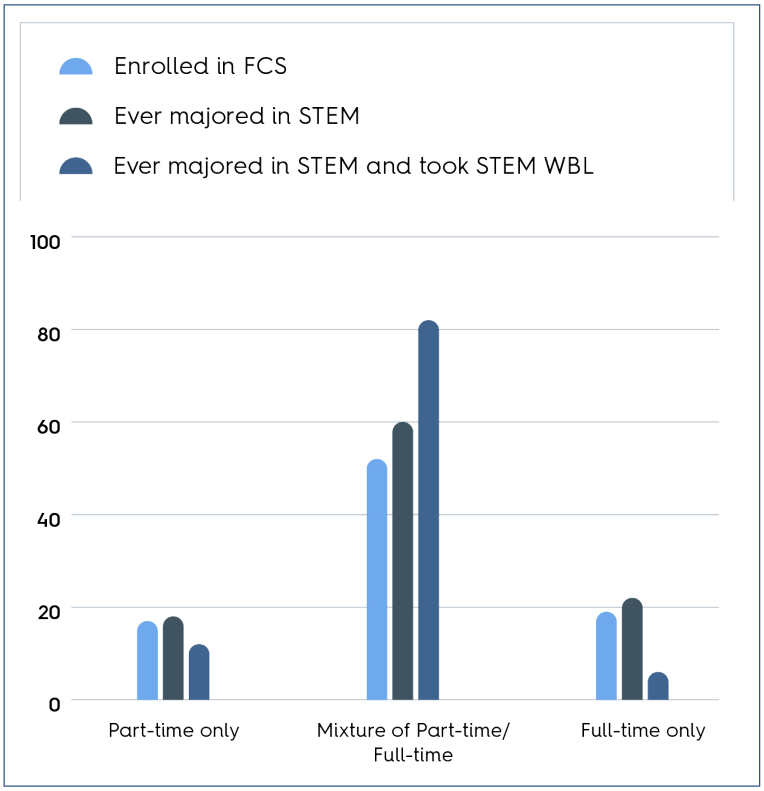
How does participation in STEM work-based learning experiences in Florida community colleges dIffer by student gender, student race/ethnicity, and other student characteristics?

Most STEM and STEM work-based learning students enrolled as both part-time and full-time students.

Students who alternated between part-time and full-time enrollment status were more likely to participate in STEM and were also more likely to participate in STEM WBL experience than students who enrolled as part time or full time only during their college experience (see Figure 2). Students who were full time only were more likely than students who were part time only to major in STEM;

however, students who were only part-time students were slightly more likely than students who were only full-time students to participate in a STEM WBL experience. Since WBL experiences often require students to have more flexible schedules to accomodate both their course load and employers' schedules, it is not surprising that students who alternate between part- and full-time status were more likely to participate in a STEM WBL experience.

Figure 2: STEM Work-Based Learning Participation Compared to the Overall STEM and Student Sample by Part-Time/Full-Time Status

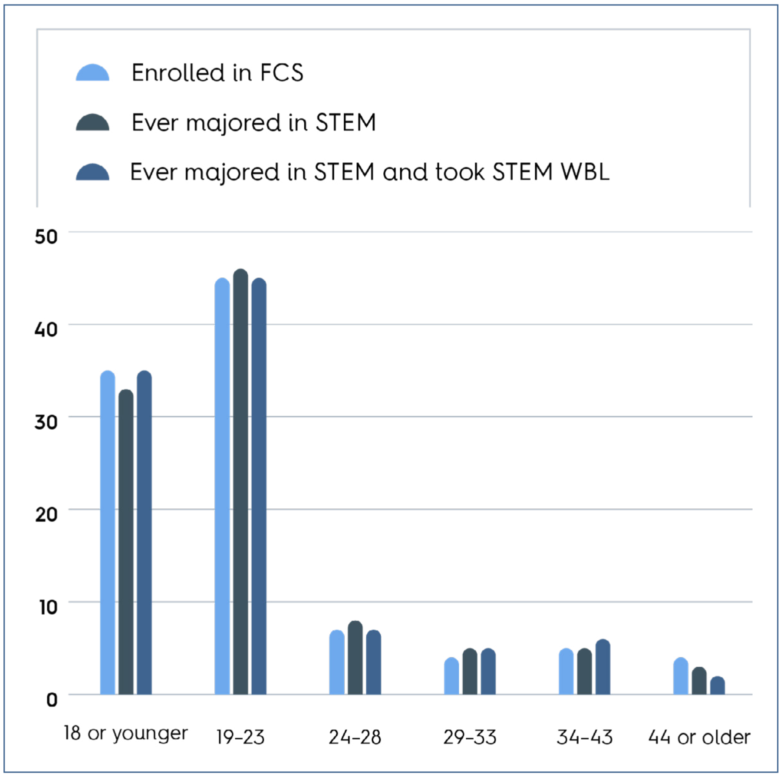


Notes: Based on author's analysis of the Florida Department of Education's Florida College System data.

Although most STEM work-based learning students were younger than 24, students ages 29 to 43 who majored in STEM were just as likely as their younger counterparts to participate in a work-based learning experience.

Of the STEM WBL students, 36% were 18 or younger, and 45% were aged 19 to 23 years. The age representation in STEM WBL is consistent with that in STEM majors overall (see Figure 3). However, students aged 29 to 43 were just as likely or more likely to participate in STEM WBL compared to their representation in STEM majors and the entire college system.

Figure 3: STEM Work-Based Learning Participation Compared to the Overall STEM and Student Sample by Age Group

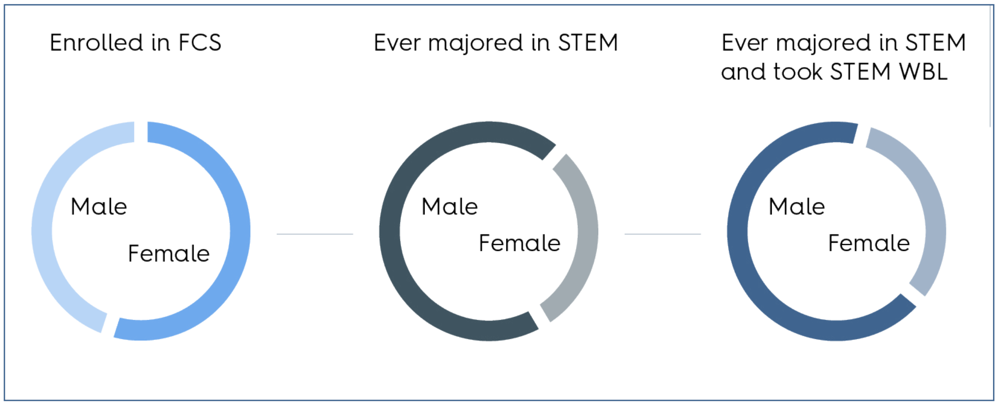


Notes: Based on author's analysis of the Florida Department of Education's Florida College System data.

Female students were less likely to major in STEM but appeared to be just as likely as males to participate in work-based learning opportunities once they majored in STEM.

Male students made up 46% of the overall student sample, yet they represented most of the STEM students and STEM WBL students (see Figure 4). In contrast, female students made up more than half of the overall student sample, but fewer than 30% majored in STEM, and slightly more than 30% participated in a STEM WBL opportunity (Marco-Bujosa et al., 2020).

Figure 4: STEM Work-Based Learning Participation Compared to the Overall Student Sample by Gender and Program



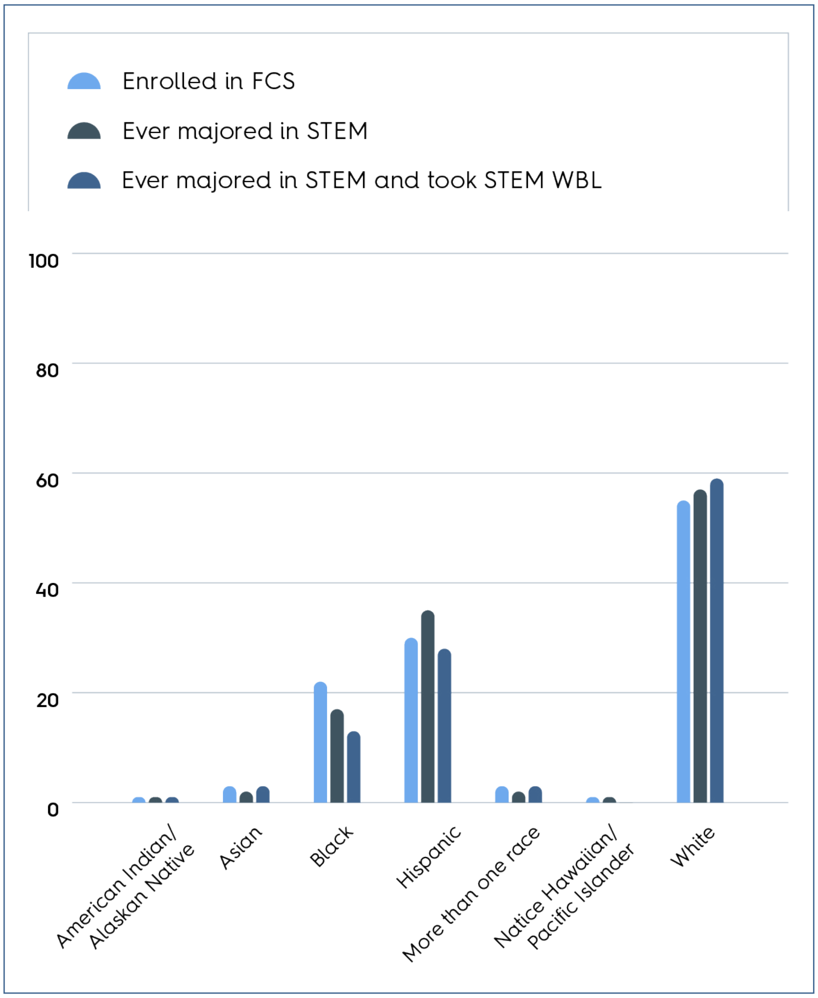
Notes: Based on author's analysis of the Florida Department of Education's Florida College System data.

Disparities in STEM major and STEM work-based learning exist among students of different racial and ethnic backgrounds.

Few students who identified as American Indian/Alaskan Native or Native Hawaiian/Pacific Islander majored in STEM and participated in a WBL experience. Black students were underrepresented in both STEM majors and STEM WBL opportunities compared to their enrollment in the FCS (see Figure 4). Twenty-one percent of students enrolled in the community college system identified as Black, but 18% of the students who had ever majored in a STEM degree were Black, and 15% of those who majored in a STEM degree and participated in WBL were Black. Hispanic students were slightly overrepresented in STEM majors (34%) compared to their enrollment in the FCS (30%), but Hispanic students were less likely to participate in STEM WBL (29%). Students who selected more than one race participated in STEM WBL and majored in STEM degrees at rates comparable to their enrollment in the FCS.

Both White and Asian students participated in STEM majors and STEM WBL opportunities at higher rates than their enrollment in the FCS. For example, 55% of students in the FCS identified as White, 58% majored in STEM, and 59% participated in a STEM WBL opportunity. Similarly, 3% of Asian students majored in STEM, and slightly more than 3% participated in STEM WBL compared to 2% of the student sample.

Figure 5: Work-Based Learning Participation Compared to the Overall Student Sample by Race/Ethnicity and Program

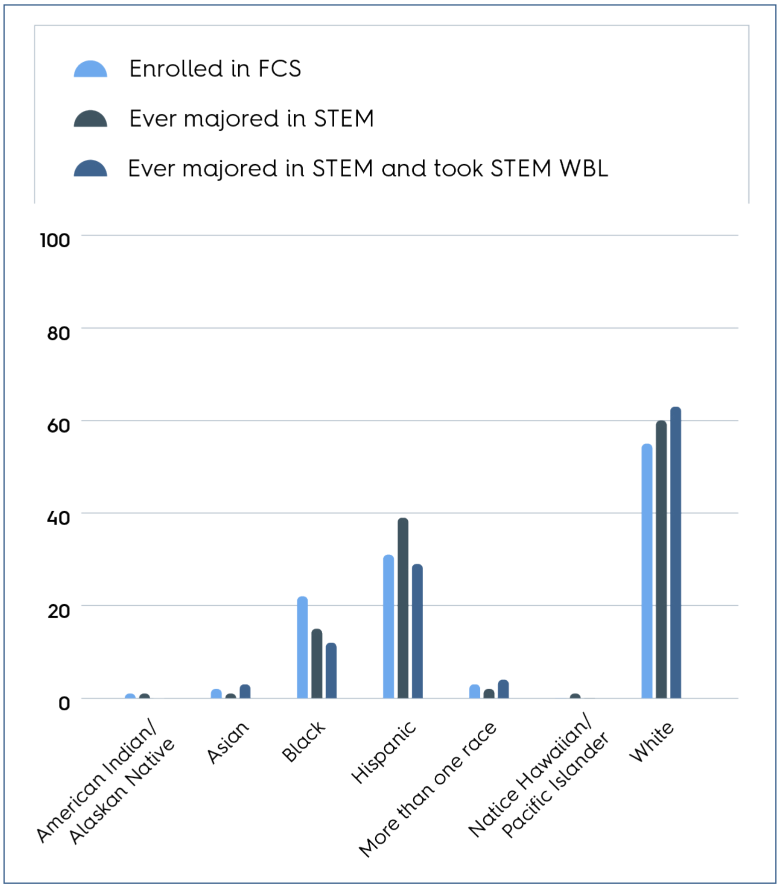


Notes: Based on author's analysis of the Florida Department of Education's Florida College System data.

White, Multiracial, and Asian females are more likely to participate in STEM WBL opportunities than females of color.

Overall, female students who identified as Asian, Hispanic, multi-racial, and/or White majored in STEM fields at comparable or higher rates than their enrollment in the FCS, but only White, Asian, and multiracial females participated in STEM WBL at higher rates than their enrollment (see Figure 5). Furthermore, Hispanic women majored in STEM at higher rates than their enrollment in the FCS, but they were less likely to participate in a STEM WBL opportunity. Black female students were less likely than their peers from other racial and ethnic groups to have both majored in STEM and participated in a STEM WBL opportunity.

Figure 6: Female Work-Based Learning Participation Compared to the Overall Student Sample by Race/Ethnicity

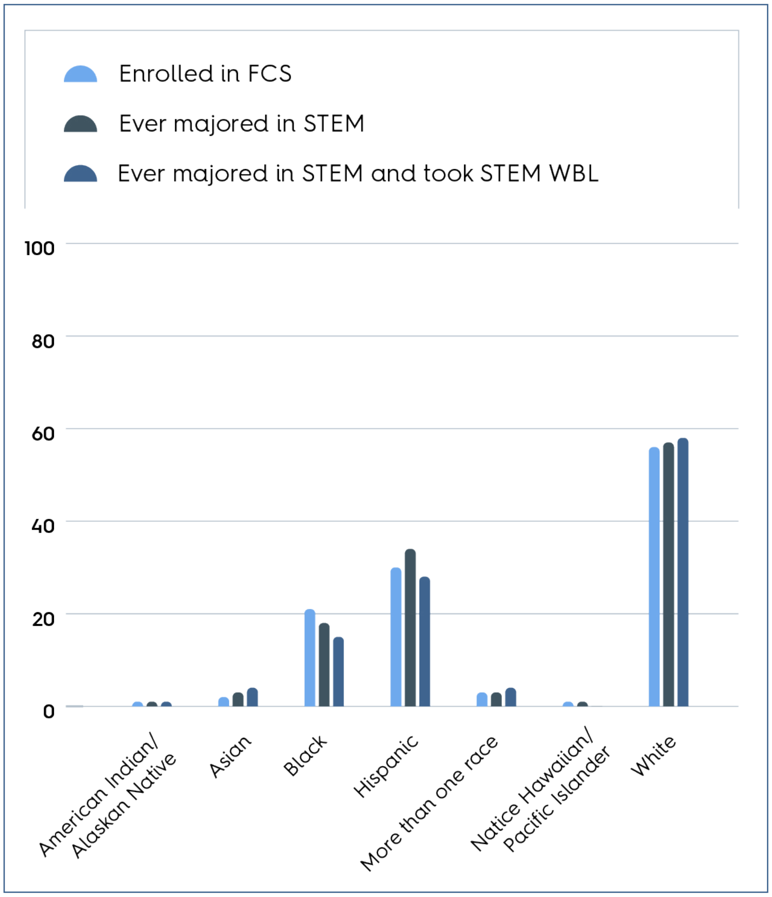


Notes: Based on author's analysis of the Florida Department of Education's Florida College System data.

Male STEM WBL participation is driven by White, Asian, and Multiracial males.

Compared to other racial and ethnic groups, White, Asian, and multiracial males major in STEM and participate in STEM WBL at higher rates than their enrollment in the FCS. Similar to Hispanic females, Hispanic males major in STEM at higher rates than their enrollment in the FCS but still participate in STEM WBL at lower rates. Furthermore, Black males major in STEM and participate in STEM WBL at lower rates than their enrollment in the FCS.

Figure 7: Male Work-Based Learning Participation Compared to the Overall Student Sample by Race/Ethnicity



Notes: Based on author's analysis of the Florida Department of Education's Florida College System data.

How is work-based learning participation associated with credential attainment? To what extent is there variation among demographic groups?

Most work-based learning students completed at least one credential by their sixth year, and most STEM work-based learning students completed a STEM credential within four years.

Eighty-one percent of all WBL students and 87% of STEM WBL students completed at least one credential by their sixth year (or after 12 semesters, not including summer).[7] Most STEM students (76%) completed an AA or AS degree,

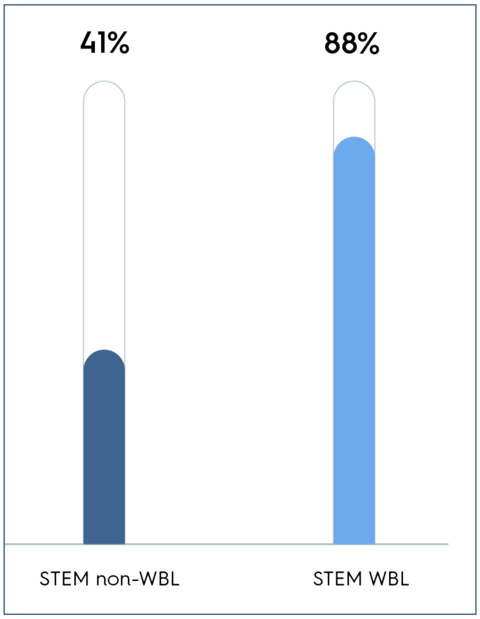
7 We define a credential as any AA, AS, or AAS degree or certificate earned by a student.

54% completed a certificate, and 5% completed an AAS degree. The majority of STEM students (80%) completed at least one credential (AA/AS/AAS/certificate) within four years, and 71% of students who ever majored in a STEM program and participated in WBL graduated with a STEM degree.

STEM students who participated in work-based learning completed a credential at higher rates than other STEM students who did not complete work-based learning, though this is likely due to the timing of their work-based learning experience.

Many STEM WBL students completed more than one credential through a short-term certificate or Associates degree. Ninety-two percent of STEM WBL students completed more than one credential compared to 76% of STEM non-WBL students (see Figure 7). Students most often participated in WBL toward the end of their degree program. For example, the mean number of semesters after which students participated in any WBL is 6.5, and the mean number of semesters after which students earned a credential was 6.9. For STEM students, the mean number of semesters before WBL participation was 6.1, and the mean number of semesters before credential attainment was 7.1. Thus, WBL students were likely to have higher completion rates due to the timing of their WBL participation. A recent case study analysis of two Florida community college technology programs conducted in parallel to this analysis confirmed that most students who participate in WBL do so in their last semester of college (Joy, 2022).

Figure 8: Credential Attainment Rates by Spring 2019



Notes: Based on analysis of the Florida Department of Education's Florida College System data. Attainment refers to any credential earned during a student's enrollment in the Florida College System from 2013–2014 until spring semester 2019. STEM WBL refers to any student who declared a STEM major and participated in WBL. STEM non-WBL refers to any student who majored in STEM but did not participate in WBL.

There were few differences in completion rates across demographic groups.

STEM WBL students attained a credential at higher rates than non-STEM WBL or STEM non-WBL students (see Table 42. While some STEM WBL student groups had higher attainment rates than others (i.e., female students, Asian students, and students who were enrolled in a mixture of part time and full time). STEM non-WBL students had the lowest attainment rates, though as mentioned above, this is likely due to the timing of when students participate in WBL, which is often at the end of a student's degree program.

Table 2: Attainment by STEM Work-Based Learning Status and Demographic Group

	STEM Work-Based Learning Attainment: Attained at least one credential	STEM non-Work-Based Learning Attainment: Attained at least one credential
Total	87%	41%
Female	91%	47%
Male	86%	39%
AI/AN	-	36%
Asian	93%	57%
Black	88%	31%
Hispanic	88%	42%
Multiple races	73%	38%
NH/PI	-	37%
White	89%	44%
Hispanic only	89%	44%
Always part-time	90%	43%
Part-time and full-time	88%	52%
Always full-time	78%	16%
Age 18 or younger	88%	49%

	STEM Work-Based Learning Attainment: Attained at least one credential	STEM non-Work-Based Learning Attainment: Attained at least one credential
Age 19 to 23	86%	39%
Age 24 to 28	88%	32%
Age 29 to 33	90%	36%
Age 34 to 43	91%	33%
Age 44 to 53	-	34%
Age 54 and older	-	39%

Source: Our analysis of data from the Florida Department of Education's Florida College System Database.

Notes: Attainment is considered to have occcurred if a student earned at least one credential through a short-term certificate or Associate's degree by spring 2019 (six-year graduation rate). Students who did not attain a degree or leave remained enrolled in the Florida College System but did not receive a credential. Cells without observations or observations below 10 are noted with a hyphen and not included in the reporting.

Discussion

WBL has promise for creating a streamlined approach for students to enter into the labor force following degree attainment. High-quality WBL can provide students with hands-on knowledge and skills as well professional skills and social capital. This approach could be especially promising for occupations in STEM fields and for demographic groups that have faced structural barriers to employment in STEM occupations. However, there is a lack of research about who participates in WBL and how participation is distributed among important demographic groups and across certain programs of study. This report found that WBL remains an underutilized strategy for community college students in Florida. Only 3% of students enrolled in the FCS participated in a WBL opportunity. Most WBL opportunities, both STEM and non-STEM, occured in metropolitan areas where there are more businesses to offer WBL and where a higher number of students are enrolled. Additionally, some program majors (Liberal Arts and Sciences, Business, Marketing, and Education) were drivers of WBL participation across all majors. Since we only observed WBL uptake in the data, we cannot know whether institutional differences in WBL participation are due to student choice or internship structure and offerings. Our case study research of two Florida college technology programs that ran parallel to this analysis revealed that student participation in technology internships was largely dependent on whether or not the internship was required for graduation. In those programs where the internship was offered as an elective credit, very few students participated (Joy, 2022). In those schools where WBL uptake is high, then, the data do not allow us to discern whether this is due to more students selecting into internships or internships being required for graduation.

There appear to be clear differences between student identities in who participates in STEM WBL. Most of the students who participated in WBL and majored in STEM enrolled at a mixture of part-time and full-time status and were younger than 24; however, STEM students aged 29 to 43 were just as likely to participate in a WBL experience. This distinction in age is important since older students are more likely to be employed and be caretakers with dependents. This finding further necessitates a better understanding of how these STEM WBL opportunities are structured and whether these students are paid for their participation.

Compared to the overall community college sample, fewer females majored in STEM and participated in WBL. However, once female students majored in STEM, they were just as likely to participate in WBL as male students were. Students of color were also underrepresented in WBL opportunities overall as compared with their college enrollment. When we considered the intersectionality of race and gender, we began to uncover some of the nuances with respect to participation in STEM WBL. For example, Hispanic male and female students majored in STEM at rates comparable to their overall enrollment in the FCS, but they had lower STEM WBL participation rates compared to their representation in STEM and in the FCS. Additionally, while Asian students had higher participation in STEM and STEM WBL compared to their FCS enrollment, further analysis showed that this was largely driven by Asian males. These findings corroborate many existing studies that conclude that female students and students from racial and ethnic minoritized groups are less likely to major in STEM and participate in WBL. These findings also show promise to help us understand the gender and racial divide in STEM and WBL. For example, the analysis revealed that females who major in STEM are more likely to participate in WBL, but this was driven by participation for White women rather than women of color. These findings also corroborate the gender/racial divide that exists in the STEM workforce.

Most students who participated in STEM WBL completed at least one credential within six years, and over 90% of those who completed a credential completed more than one.[8] The high attainment rates for STEM WBL students is likely due to the timing in which most students completed their STEM WBL opportunity or requirements for graduation since most did so before they finished their credential. However, we also cannot rule out that participation in a WBL experience for some students may also connect students to the workforce and potential careers, thereby increasing the likelihood of attainment.

Recommendations for Researchers and Practitioners

The goal of this report was to use a statewide data system as a case study to empirically describe patterns of participation in STEM majors and STEM WBL. If WBL is to be used as a tool to streamline and equalize pathways to middle- and high-wage occupations, a better understanding of who participates in WBL is necessary. We hope that the findings of

8 Either resulting in several short-term certificates or a mixture of both degrees and short-term certificates.

this report will help policymakers and practitioners develop essential recommendations and actions to increase participation in WBL, improve the experiences of STEM students who participate in WBL, and continue to refine data collection to make reporting more efficient and accurate.

Practitioner Recommendation: Standardize Definitions and Requirements for the Different Types of Work-Based Learning

At present, there is no standardized definition of the different types of WBL, such as internships and co-ops across industries or government agencies. Additionally, there are varying definitions and requirements of these WBL opportunities across institutions and programs in Florida and nationwide. This includes whether or not students receive academic credit or payment for their participation and whether the WBL is required for graduation or is an optional course. Without a standard definition of WBL that is consistent across state data systems and program majors, it is difficult to track participation, understand why participation may be low for some students and not others, and understand the quality of the students' experiences. Additionally, standardizing the definition could be helpful for employers to know what is required from them in order to offer the most high-quality experience for students.

Researcher and Practitioner Recommendation: Ensure Consistent Data to Capture Work-Based Learning Across the Florida College System (and Other State and National Datasets)

The ability to track student participation in WBL in Florida for this study was dependent on using course codes in the Statewide Course Numbering System (SCNS; see Appendix A: Methodology for more details about how we identified internships and co-ops). This approach is limiting because all of the course codes in the SCNS must be associated with WBL opportunities for which course credit was offered. Standardizing separate course codes for different WBL types (e.g., internships, co-ops, apprenticeships, practicums, etc.) would also help future researchers and practitioners understand which types of WBL opportunities are expanding for certain programs and student types. Researcher–practitioner partnerships to remedy this challenge could bolster the state-specific data needs with accurate and reliable data collection. Furthermore, understanding whether a WBL opportunity is paid, whether it is required for graduation, and whether the opportunity is in the same sector as a student's program of study is important for tracking the alignment and quality of the WBL experience and student outcomes. Finally, tracking access to WBL opportunities by location and geography can ensure equitable geographic opportunities.

Researcher and Practitioner Recommendation: Better Understanding of STEM Work-Based Learning Participation Barriers and Facilitators

Differences in STEM WBL participation by gender and race/ethnicity emerged in the descriptive analysis of this report. Some student demographic groups were underrepresented in both STEM majors and STEM WBL, such as students who identified as Black males and Black females. Other student demographic groups had more complicated stories. For example, males and females who identified as Hispanic were well represented in STEM majors compared to their overall enrollment, but they were less likely to participate in STEM WBL. A better understanding of the experiences of people of color and their barriers to participation in STEM WBL is necessary to increase their participation. At the same time, understanding what facilitates the students' STEM WBL participation may also be informative. It is well known that many non-White students and/or students from low-income families face structural barriers to participation in STEM fields and employment in those fields and that those barriers are often linked to systemic racism. Yet, knowing where barriers emerge for students during the WBL recruitment to completion pipeline is important to addressing those barriers. As more research is conducted to recognize the experiences of traditionally marginalized communities, we can target and allocate resources to support more high-quality participation.

In a case study research of two Florida technology programs, Joy (2022) found that participation in technology internships depended on whether or not the internship was required for graduation. This requirement removed gender and racial/ethnic differences in participation. Furthermore, women of all races/ethnicities and learners of color expressed high satisfaction with the internship experiences in terms of helping them gain important hands-on learning experiences and furthering their career and educational goals. Where the internship was not required, few students from all gender and racial/ethnic groups participated in the internship. This was due to the difficulty students had in securing internships. The case study research suggests that unless internships are required, only those students who face the fewest barriers to entering Information Technology careers will participate (Joy, 2022).

In addition to minoritized student voices, more research is needed to understand college and employer perspectives regarding providing high-quality and inclusive STEM WBL for a diverse student population. This research could investigate whether or not colleges have funding and infrastructure to support WBL placement, the extent to which employers' recruitment process can recruit from a diverse pool of students, and the perspectives of colleges and employers about providing meaningful WBL opportunities and providing payment to students for WBL. Closing the gaps in the research would require conducting qualitative research studies with these stakeholders to understand their experiences. In addition, quantitative analyses of WBL and students' labor market outcomes would provide additional insights into the effectiveness of STEM WBL. As previously described, such research is dependent on new or supplemental data collection for large samples across time.

Understanding barriers and contributors to successful WBL experiences as well as impacts on student outcomes will help community colleges allocate resources efficiently, including refining efforts to increase student access to WBL opportunities, supporting students' success in their experiences, and partnering with employers to standardize training and requirements for WBL sites. Only by understanding and addressing these barriers and facilitators can community colleges ensure that STEM WBL is effectively used as a strategy for improving employment outcomes for all students.

Author Positionality Statements

First Author:

The first author of this study is a white, middle class, cisgender woman. I have studied STEM education and barriers to participation in STEM for almost 10 years. As a female, I am motivated to examine inequities in access and participation in STEM education because I faced barriers in STEM throughout my experiences in the public education system in the US and some of those barriers were a result of gender discrimination. At the same time, I recognize that I was awarded several privileges - including access to STEM internships because of my other identities, which I don't often think about because I don't experience challenges directly related to them. I hope that by understanding the inequities that exist for students, we can address the barriers to improve participation for students of all identities.

Second Author:

As a Hispanic (Latina), middle-class, cisgender woman with a background in science, I aim for objectivity and prefer clear definitions and quantitative analysis. As I learn more about barriers to STEM education I realized that being one of the few females in my science classes was a problem. Additionally, as an immigrant in the US, I often struggle with choosing the right identity for myself in terms of race and ethnicity. These realizations and struggles inform how I analyze data while working on STEM education projects, mostly by being aware and attentive to the meanings and categories that others may used more mechanical. Although on paper I am considered a minority that should have faced multiple barriers, I have enjoyed privileges thanks to my consistent support system, my educational background, and a documented immigration. My motivation is to understand the inequities and barriers that students face so one day everyone has the same chance to participate in STEM and higher education.

Third Author:

I identify as a cisgender woman of color and the daughter of immigrants. I am motivated to study inequities in access to, readiness for, and success in post-secondary training and education due to my own life experiences. Although I always recognized my middle-class privileges and opportunities, I also faced barriers in the educational system and in my career due to racial and gender discrimination and bias. I have found personal value from internships, participating in four vastly different, unpaid internships while working part-time and attending college full-time. I often reflect on the uneven access to internship opportunities and the inconsistent quality of those experiences. Most importantly, I attribute my career trajectory to these internships, especially identifying the careers I did not want to pursue.

Fourth Author:

I am the first woman in my family to go to college. My father, the first person in my extended Italian-American family to go to college, was able to do so with support from the Veterans Affairs education bill. I participated in an internship for my undergraduate education, an experience that was instrumental in helping me obtain my first professional job after college, but that was also difficult to obtain. I have had a long interest in understanding and making visible the structural barriers to education and high opportunity careers that women and people of color face. I became interested in studying work-based-learning as a unique intersection of education and workplace factors to see if the barriers that women and people of color experience in the labor market translate into the educational setting through the vector of work-based-learning. I am a white woman who came of age during and was significantly impacted by the second wave feminist movements of the 1970s. Educational and labor market opportunities available to me because of these movements were not available to my mother, aunts, and grandmothers.

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Appendix A: Methodology

Analyzing Work-Based Learning Opportunities

In this study, WBL includes opportunities for hands-on experiential learning that is credit based through internships and cooperative education courses. We identified internship courses using student transcript data. In Florida, the SCNS allowed us to identify a common course number for WBL opportunities.Using the SCNS, we found that course numbers with "94" as the fifth and sixth character of the course abbreviation have a course name of "internships/practicums/clinical practice." We used this information to identify students who participated in an internship. To identify the cooperative education courses, we requested the binary data element from PERA that flags cooperative education courses. In this report, students who ever took a WBL opportunity through internships or cooperative education courses were considered in our treatment sample. We used this approach because some students enroll in WBL opportunities in multiple semesters.

Identifying STEM Majors

We used the CIP code to identify STEM majors in the dataset. We used the STEM Designated Degree Program CIP codes provided by the U.S. Department of Homeland Security. These programs have been recognized by the federal government as designated STEM degrees and jobs. These are also used by the National Science Foundation's "Classification of fields of study." Although these resources provided us with a foundation for identifying STEM majors, they were developed for four-year college degrees. Two-year programs often have a career and technical focus and may not be traditionally categorized as "STEM." These programs include career paths for electricians, line workers, pipefitters, plumbers, mechanics, repair technicians, et cetera. We followed Kuehn and Jones' (2018)methodology and included these programs of study in our STEM designation for community colleges, which we term "STEM" throughout the report (see Appendix B for the full list of CIP codes and corresponding fields of study). One of the most common CIPs in the data was 240101, which corresponds to liberal arts studies/ liberal studies and is defined as a program that combines arts, biological and physical sciences, social science, and humanities.[9]

9 https://nces.ed.gov/ipeds/cipcode/cipdetail.aspx?y=56&cipid=90665

For cases where the CIP was 240101, we used the program name to identify STEM students who aligned with STEM CIP codes (see Appendix B).

Data Limitations

Part of this study's significance and relevancy for Florida is to understand how to identify credit-bearing internship opportunities. Unlike cooperative education courses, which are already identified and flagged as a separate binary indicator in the EDW, internships are more difficult to identify for several reasons. First, institutions and even programs of study within institutions may have different requirements and definitions for what an internship entails. This means that we cannot assess the quality of the internship or whether the structure of the internship is consistent across institutions or programs of study. The course description label also includes "practicum and clinical practices"; thus, we cannot completely disentangle other types of WBL opportunities by using this method. Second, reporting is often inconsistent from one institution to the next; for example, "Education: Exceptional Child" has the course description "Internship: Special Education," but the course number does not include "94." However, other education course descriptions labeled "internship" have a "94" course number. Third, we found that some cooperative education courses in the data have a "94" course number and a course description labeled as "internship," but others do not. In such cases, we deferred to the "cooperative education" label.

Appendix B: List of STEM CIP Codes

2010 STEM CIP Code	STEM CIP Code Title
01.0308	Agroecology and Sustainable Agriculture
01.0901	Animal Sciences, General
01.0902	Agricultural Animal Breeding
01.0903	Animal Health
01.0904	Animal Nutrition
01.0905	Dairy Science
01.0906	Livestock Management
01.0907	Poultry Science
01.0999	Animal Sciences, Other
01.1001	Food Science
01.1002	Food Technology and Processing
01.1099	Food Science and Technology, Other
01.1101	Plant Sciences, General
01.1102	Agronomy and Crop Science
01.1103	Horticultural Science
01.1104	Agricultural and Horticultural Plant Breeding
01.1105	Plant Protection and Integrated Pest Management
01.1106	Range Science and Management
01.1199	Plant Sciences, Other
01.1201	Soil Science and Agronomy, General
01.1202	Soil Chemistry and Physics

2010 STEM CIP Code	STEM CIP Code Title
01.1203	Soil Microbiology
01.1299	Soil Sciences, Other
03.0101	Natural Resources/Conservation, General
03.0103	Environmental Studies
03.0104	Environmental Science
03.0199	Natural Resources Conservation and Research, Other
03.0205	Water, Wetlands, and Marine Resources Management
03.0502	Forest Sciences and Biology
03.0508	Urban Forestry
03.0509	Wood Science and Wood Products/Pulp and Paper Technology
03.0601	Wildlife, Fish and Wildlands Science and Management
04.0902	Architectural and Building Sciences/Technology
09.0702	Digital Communication and Media/Multimedia
10.0304	Animation, Interactive Technology, Video Graphics and Special Effects
11.0101	Computer and Information Sciences, General
11.0102	Artificial Intelligence
11.0103	Information Technology
11.0104	Informatics
11.0199	Computer and Information Sciences, Other
11.0201	Computer Programming/Programmer, General

2010 STEM CIP Code	STEM CIP Code Title
11.0202	Computer Programming, Specific Applications
11.0203	Computer Programming, Vendor/Product Certification
11.0299	Computer Programming, Other
11.0301	Data Processing and Data Processing Technology/ Technician
11.0401	Information Science/Studies
11.0501	Computer Systems Analysis/Analyst
11.0701	Computer Science
11.0801	Web Page, Digital/Multimedia and Information Resources Design
11.0802	Data Modeling/Warehousing and Database Administration
11.0803	Computer Graphics
11.0804	Modeling, Virtual Environments and Simulation
11.0899	Computer Software and Media Applications, Other
11.0901	Computer Systems Networking and Telecommunications
11.1001	Network and System Administration/Administrator
11.1002	System, Networking, and LAN/WAN Management/ Manager
11.1003	Computer and Information Systems Security/ Information Assurance
11.1004	Web/Multimedia Management and Webmaster
11.1005	Information Technology Project Management
11.1006	Computer Support Specialist

2010 STEM CIP Code	STEM CIP Code Title
11.1099	Computer/Information Technology Services Administration and Management, Other
13.0501	Educational/Instructional Technology
13.0601	Educational Evaluation and Research
13.0603	Educational Statistics and Research Methods
14.XXXX	Engineering
15.0000	Engineering Technology, General
15.0101	Architectural Engineering Technology/Technician
15.0201	Civil Engineering Technology/Technician
15.0303	Electrical, Electronic and Communications Engineering Technology/Technician
15.0304	Laser and Optical Technology/Technician
15.0305	Telecommunications Technology/Technician
15.0306	Integrated Circuit Design
15.0399	Electrical and Electronic Engineering Technologies/Technicians, Other
15.0401	Biomedical Technology/Technician
15.0403	Electromechanical Technology/Electromechanical Engineering Technology
15.0404	Instrumentation Technology/Technician
15.0405	Robotics Technology/Technician
15.0406	Automation Engineer Technology/Technician
15.0499	Electromechanical and Instrumentation and Maintenance Technologies/Technicians, Other

2010 STEM CIP Code	STEM CIP Code Title
15.0501	Heating, Ventilation, Air Conditioning and Refrigeration Engineering Technology/Technician
15.0503	Energy Management and Systems Technology/ Technician
15.0503	Energy Management and Systems Technology/ Technician
15.0505	Solar Energy Technology/Technician
15.0506	Water Quality and Wastewater Treatment Management and Recycling Technology/ Technician
15.0507	Environmental Engineering Technology/ Environmental Technology
15.0508	Hazardous Materials Management and Waste Technology/Technician
15.0599	Environmental Control Technologies/Technicians, Other
15.0607	Plastics and Polymer Engineering Technology/ Technician
15.0611	Metallurgical Technology/Technician
15.0612	Industrial Technology/Technician
15.0613	Manufacturing Engineering Technology/Technician
15.0614	Welding Engineering Technology/Technician
15.0615	Chemical Engineering Technology/Technician
15.0616	Semiconductor Manufacturing Technology
15.0699	Industrial Production Technologies/Technicians, Other
15.0701	Occupational Safety and Health Technology/ Technician

2010 STEM CIP Code	STEM CIP Code Title
15.0702	Quality Control Technology/Technician
15.0703	Industrial Safety Technology/Technician
15.0704	Hazardous Materials Information Systems Technology/Technician
15.0799	Quality Control and Safety Technologies/Technicians, Other
15.0801	Aeronautical/Aerospace Engineering Technology/Technician
15.0803	Automotive Engineering Technology/Technician
15.0805	Mechanical Engineering/Mechanical Technology/Technician
15.0899	Mechanical Engineering Related Technologies/Technicians, Other
15.0901	Mining Technology/Technician
15.0903	Petroleum Technology/Technician
15.0999	Mining and Petroleum Technologies/Technicians, Other
15.1001	Construction Engineering Technology/Technician
15.1102	Surveying Technology/Surveying
15.1103	Hydraulics and Fluid Power Technology/Technician
15.1199	Engineering-Related Technologies, Other
15.1201	Computer Engineering Technology/Technician
15.1202	Computer Technology/Computer Systems Technology
15.1203	Computer Hardware Technology/Technician
15.1204	Computer Software Technology/Technician

2010 STEM CIP Code	STEM CIP Code Title
15.1299	Computer Engineering Technologies/Technicians, Other
15.1301	Drafting and Design Technology/Technician, General
15.1302	CAD/CADD Drafting and/or Design Technology/ Technician
15.1303	Architectural Drafting and Architectural CAD/ CADD
15.1304	Civil Drafting and Civil Engineering CAD/CADD
15.1305	Electrical/Electronics Drafting and Electrical/ Electronics CAD/CADD
15.1306	Mechanical Drafting and Mechanical Drafting CAD/ CADD
15.1399	Drafting/Design Engineering Technologies/ Technicians, Other
15.1401	Nuclear Engineering Technology/Technician
15.1501	Engineering/Industrial Management
15.1502	Engineering Design
15.1503	Packaging Science
15.1599	Engineering-Related Fields, Other
15.1601	Nanotechnology
15.9999	Engineering Technologies and Engineering-Related Fields, Other
26.XXXX	Biological and Biomedical Sciences
27.XXXX	Mathematics and Statistics
28.0501	Air Science/Airpower Studies

2010 STEM CIP Code	STEM CIP Code Title
28.0502	Air and Space Operational Art and Science
28.0505	Naval Science and Operational Studies
29.0201	Intelligence, General
29.0202	Strategic Intelligence
29.0203	Signal/Geospatial Intelligence
29.0204	Command & Control (C3, C4I) Systems and Operations
29.0205	Information Operations/Joint Information Operations
29.0206	Information/Psychological Warfare and Military Media Relations
29.0207	Cyber/Electronic Operations and Warfare
29.0299	Intelligence, Command Control and Information Operations, Other
29.0301	Combat Systems Engineering
29.0302	Directed Energy Systems
29.0303	Engineering Acoustics
29.0304	Low-Observables and Stealth Technology
29.0305	Space Systems Operations
29.0306	Operational Oceanography
29.0307	Undersea Warfare
29.0399	Military Applied Sciences, Other
29.0401	Aerospace Ground Equipment Technology
29.0402	Air and Space Operations Technology

2010 STEM CIP Code	STEM CIP Code Title
29.0403	Aircraft Armament Systems Technology
29.0404	Explosive Ordinance/Bomb Disposal
29.0405	Joint Command/Task Force (C3, C4I) Systems
29.0406	Military Information Systems Technology
29.0407	Missile and Space Systems Technology
29.0408	Munitions Systems/Ordinance Technology
29.0409	Radar Communications and Systems Technology
29.0499	Military Systems and Maintenance Technology, Other
29.9999	Military Technologies and Applied Sciences, Other
30.0101	Biological and Physical Sciences
30.0601	Systems Science and Theory
30.0801	Mathematics and Computer Science
30.1001	Biopsychology
30.1701	Behavioral Sciences
30.1801	Natural Sciences
30.1901	Nutrition Sciences
30.2501	Cognitive Science
30.2701	Human Biology
30.3001	Computational Science
30.3101	Human Computer Interaction
30.3201	Marine Sciences
30.3301	Sustainability Studies

2010 STEM CIP Code	STEM CIP Code Title
40.XXXX	Physical Sciences
41.0000	Science Technologies/Technicians, General
41.0101	Biology Technician/Biotechnology Laboratory Technician
41.0204	Industrial Radiologic Technology/Technician
41.0205	Nuclear/Nuclear Power Technology/Technician
41.0299	Nuclear and Industrial Radiologic Technologies/ Technicians, Other
41.0301	Chemical Technology/Technician
41.0303	Chemical Process Technology
41.0399	Physical Science Technologies/Technicians, Other
41.9999	Science Technologies/Technicians, Other
42.2701	Cognitive Psychology and Psycholinguistics
42.2702	Comparative Psychology
42.2703	Developmental and Child Psychology
42.2704	Experimental Psychology
42.2705	Personality Psychology
42.2706	Physiological Psychology/Psychobiology
42.2707	Social Psychology
42.2708	Psychometrics and Quantitative Psychology
42.2709	Psychopharmacology
42.2799	Research and Experimental Psychology, Other
43.0106	Forensic Science and Technology

2010 STEM CIP Code	STEM CIP Code Title
43.0116	Cyber/Computer Forensics and Counterterrorism
45.0301	Archeology
45.0603	Econometrics and Quantitative Economics
45.0702	Geographic Information Science and Cartography
49.0101	Aeronautics/Aviation/Aerospace Science and Technology, General
51.1002	Cytotechnology/Cytotechnologist
51.1005	Clinical Laboratory Science/Medical Technology/ Technologist
51.1401	Medical Scientist
51.2003	Pharmaceutics and Drug Design
51.2004	Medicinal and Pharmaceutical Chemistry
51.2005	Natural Products Chemistry and Pharmacognosy
51.2006	Clinical and Industrial Drug Development
51.2007	Pharmacoeconomics/Pharmaceutical Economics
51.2009	Industrial and Physical Pharmacy and Cosmetic Sciences
51.2010	Pharmaceutical Sciences
51.2202	Environmental Health
51.2205	Health/Medical Physics
51.2502	Veterinary Anatomy
51.2503	Veterinary Physiology
51.2504	Veterinary Microbiology and Immunobiology
51.2505	Veterinary Pathology and Pathobiology

2010 STEM CIP Code	STEM CIP Code Title
51.2506	Veterinary Toxicology and Pharmacology
51.2510	Veterinary Preventive Medicine, Epidemiology, and Public Health
51.2511	Veterinary Infectious Diseases
51.2706	Medical Informatics
52.1301	Management Science
52.1302	Business Statistics
52.1304	Actuarial Science
52.1399	Management Science and Quantitative Methods, Other
40.901	Architect Technology/Technician
10.0105	Communication Technology/ Technician
10.0202	Radio and TV Broadcasting Technology Technician
46.0302	Electritian
46.0303	Lineworkers
46.0502	Pipefitting
46.0503	Plumbing
48.0508	Welding Technology/Welder.
15.XXXX	Engineering/Engineering Related Technologies/ Technicians
47.XXXX	Mechanic and Repair Technologies / Technicians

Notes: CIP Codes with ".XXXX" indicate that all programs in the CIP Code are labeled STEM

Appendix C: List of Liberal Arts Programs Labeled STEM

Agricultural Science

Animal Sciences

Architectural Engineering

Associate of Arts Focus Radiologic Technology

Associate of Arts Pathway to a Major in Biology

Associate of Arts Pathway to a Major in Biotechnology

Associate of Arts Pathway to a Major in Chemistry

Associate of Arts Pathway to a Major in Computer Science

Associate of Arts Pathway to a Major in Engineering

Associate of Arts Pathway to a Major in Environmental Science

Associate of Arts Pathway to a Major in Geology

Associate of Arts Pathway to a Major in Mathematics

Associate of Arts Pathway to a Major in Pharmacy

Associate of Arts Pathway to a Major in Physics

Associate of Arts Transfer Plan to Biology

Associate of Arts Transfer Plan to Engineering

Associate of Arts Transfer Plan to Mathematics

Associate of Arts-Astronomy

Associate of Arts-Biological Sciences Genetics

Associate of Arts-Biology

Associate of Arts-Chemistry

Associate of Arts-Computer Information Systems

Associate of Arts-Computer Science

Associate of Arts-Computer Science

Associate of Arts-Earth/Space Science

Associate of Arts-Engineering

Associate of Arts-Engineering Emphasis

Associate of Arts-Engineering Technology

Associate of Arts-Engineering Transfer

Associate of Arts-Environmental Science

Associate of Arts-Environmental Studies

Associate of Arts-Forestry

Associate of Arts-Forestry/Conservation

Associate of Arts-Marine Biology

Associate of Arts-Marine Science

Associate of Arts-Math/Technology

Associate of Arts-Mathematics

Associate of Arts-Ocean Engineering

Associate of Arts-Pharmacy Emphasis

Associate of Arts-Pharmacy Transfer Track

Associate of Arts-Physics

Associate of Arts-Science-General

Astronomy

Atmospheric Science & Meteorology

Biochemistry
Biological Science
Biological Sciences
Biology
Biology General Track
Biology, Pre-Bacc
Biomedical Science
Biotechnology
Botany
Chemistry
Chemistry Track
Chemistry, Pre-Bacc
Civil Engineering Technology
Computer and Information Science
Computer Engineering Associate of Arts-Statistics
Computer Information Systems
Computer Science
Enengineering Track
Engineering
Engineering-Chemical
Engineering-Civil
Engineering-Electrical
Engineering-Industrial
Engineering-Mechanical
Engineering-Ocean
Engineering-Science
Engineering, Pre-Bacc
Environmental Biology
Exploring Science
Forestry
General Construction Engineering Technology
General Science
General Science and Engineering
General Biology
General Engineering
General Pharmacy
Geology
Horticultural Science
Information Technology Management
Marine Biology
Marine Science
Marine/Aquatic Biology Track
Mathematics
Mathematics Track
Microbiology and Cell Science
Natural and Physical Sciences
Natural Resource Conservation
Pharmacy
Pharmacy Track
Pharmacy, Pre-Bacc
Pre-Engineering
Pre-Pharmacy
Wildlife Ecology
Wildlife Ecology/Conservation
Zoology

Appendix D: Descriptive Statistics for Student Sample

	Student Sample		Ever Majored in STEM		Attained any Credential		Attained a Certificate		Attained an AA Degree		Attained an AS Degree	
All Students	103,363	100%	15,532	15%	37,946	37%	10,450	10%	28,503	28%	3,869	4%
Female	54,360	53%	4,636	30%	21,046	56%	4,940	48%	16,834	59%	2,339	61%
Male	47,687	46%	10,726	69%	46,330	43%	5,293	51%	11,300	40%	1,475	38%
American Indian/ Alaskan Native	535	1%	80	1%	164	0%	43	0%	122	0%	15	0%
Asian	2,424	3%	429	3%	1,292	3%	285	7%	1,085	4%	132	3%
Black	22,157	21%	2,725	18%	5,976	16%	1,845	18%	4,372	15%	562	15%
Native	930	1%	125	1%	299	1%	82	1%	228	1%	27	1%
Hispanic	31,204	30%	5,320	34%	11,336	30%	3,054	30%	8,880	31%	978	25%
More than one race	2,950	3%	425	3%	991	3%	272	3%	763	3%	103	3%
Native Hawaiian/ Pacific Islander	395	0%	45	0%	135	0%	39	0%	106	0%	12	0%

	Student Sample		Ever Majored in STEM		Attained any Credential		Attained a Certificate		Attained an AA Degree		Attained an AS Degree	
White	56,854	55%	8,936	58%	22,529	60%	6,103	59%	16,835	59%	2,425	63%
Only Part-Time Student	18,508	18%	2,794	18%	6,562	17%	1,201	12%	5,254	18%	257	7%
Mixture of Part-time and full-time	54,114	52%	9,285	60%	26,892	71%	6,779	66%	21,346	75%	3,282	85%
Only Full-time	30,584	30%	3,453	22%	4,335	11%	2,369	23%	1,835	6%	322	8%
Age 18 or younger	37,194	36%	5,444	35%	16,726	44%	3,248	31%	14,332	50%	1,450	38%
Age 19-23	46,350	45%	7,084	46%	15,653	41%	4,143	40%	12,091	43%	1,433	37%
Age 24-28	7,729	7%	1,237	8%	4,990	5%	944	9%	898	3%	328	9%
Age 29-33	3,881	4%	652	4%	1,118	3%	577	6%	444	2%	210	5%
Age 34-43	4,603	4%	672	4%	1,318	3%	772	7%	449	2%	262	7%
Age 44 or older	3,449	3%	443	3%	984	3%	665	6%	665	78%	665	77%