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Exploring Ethnic and Gender Equity Enrollment and Achievement Patterns in High School CTE Career Pathways in Mississippi

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ABSTRACT

This study, a post hoc observational one, attempted to understand how to continue promoting equitable opportunities in career and technical education (CTE) for the state of Mississippi. We explored the enrollment patterns of Mississippi secondary CTE students by career cluster and career pathways associated with STEM careers over the last five years. Additionally, the enrollment patterns were compared to statewide enrollment patterns by gender and ethnicity. Also, we examined the proficiency results of students on the statewide CTE assessment by gender and ethnicity. Our secondary CTE student enrollment results are like previous reports of underrepresentation of nontraditional students in STEM-related career fields. Additionally, similar results were found when looking at the statewide CTE assessment data. However, there is an indication that CTE and non-CTE leaders effectively recruit underrepresented populations to STEM-related career pathways in the state of Mississippi, but more work is needed to allow access to all students.

Keywords: Career and Technical Education, STEM, Equity, Assessment, Recruitment, Gender, Ethnicity

Introduction

Equality in education has long been a focus of concern in the United States. Since the days of school segregation, there have been studies, articles, and ongoing debates about inequalities that existed in the American system. In the early days of the civil rights movement, cases like *Brown v Board of Education* called into question the great schism that existed among resources for minority students in the segregated school system. These disparities at first were the result of systematic efforts to curtail or deny access to various groups based on the racial biases that had long been entrenched in American society. As progress occurred (at least superficially) in terms of resources, the nature of these battles gradually evolved. Soon the goal of addressing inequalities become one more about ensuring equity so that diverse groups of students had specifically what they needed to achieve equal outcomes as their peers (Shankar-Brown, 2015). Even as these disparities have been addressed, there likely remain inherent issues of inequality and equity in the educational system due to the nature of how the education system was originally envisioned. Santos et al. (2020) claim the system was not designed to create outcomes around equity or equality; rather, the education system was designed to specifically foster methods that met the overall goal of creating workforces that fulfilled business and industry needs.

Although these problems of inequity in regular academic subjects have been the primary focus of advocates and activists for years, lesser-known disparities, such as those in career and technical education (CTE), have been (and continue to be) areas of concern.

Early examples of these concerns can be seen in the writings of 19th-century educational advocate John Dewey. Among some of his most pointed criticisms, Dewey took note of glaring disparities in the early vocational educational system nearly 100 years ago. He believed these early methods for vocational education reinforced inequality by placing some students on paths for more prestigious leadership and higher-

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paying careers at the expense of their lower socioeconomic peers (DeFalco, 2016).

Dewey might view today's educational landscape as one that has made some advancements toward a system that has more equity for students, but he could also likely easily point out continued discrepancies between policies and desired outcomes. While this more recent focus on historically marginalized students has been welcomed as a potential opportunity to address these concerns, there remain some potential roadblocks to understanding and addressing these issues. The federal government's leadership role in examining and addressing these issues of concern in an organized manner is one of these issues. Since the federal government has not intentionally addressed some of these issues, problem-solving has chiefly fallen to the states. The lack of federal intervention results in the development of remedies originating in the individual states. Because these state responses vary widely in both effort and solutions, truly equitable outcomes are limited (Duff & Wohlstetter, 2019). There is a clear need to better understand possible disparities by specifically examining certain state-level data.

Theoretical Framework

The growth in career fields like science, technology, engineering, and mathematics (STEM) has presented problems in the labor market in the United States (U.S.). The biggest problem is having an inadequate number of educated workers to fill these roles (Carnevale et al., 2010; Carnevale et al., 2013; Curnow & Calderon; 2021; Fletcher, 2012). One report states that 65% of the future jobs available in the U.S. labor market will require some postsecondary education experience by 2020, and will continue to grow beyond (Carnevale et al., 2013). Therefore, there has been a recent push to better educate students in K-12 education to accommodate this lack of workers in these fields. Subsequently, there has been a gradual reform of the United States education system over the past 20 years to educate students focusing on CTE and postsecondary education.

Before this reform occurred, educators tracked students into one of two pathway choices during high school. The two pathway choices were a college preparatory curriculum or a vocational and job training curriculum (Dougherty, 2016, Fletcher, 2012; Hamilton et al., 2015). These two pathways led to issues that included placing students based on social constructs (e.g., students' gender, students' income status, students' race, and students with disabilities) that were potentially biased and may have suppressed enrollment in both these pathways (Fletcher, 2012; Hamilton et al., 2015; Hess, 2010). The intention to place students in these pathways was not nefarious; however, because of educators' use of this strategy, gaps were created in specific career pathways. For example, educators often find the most glaring disparities in STEM career pathways. As of 2017, women only represented 35% of participants in postsecondary STEM-related degree programs worldwide (Chavatzia, 2017). As a result of this apparent gender inequity, policymakers began to develop policies to address this disparity and others in STEM pathways to get more students involved in these careers.

Legislatures began reforming the educational system from the typical one of two pathway choices for high school students to address present inequities in the workforce. Initially, a curriculum in high school for vocational and job training, educators believed this type of curriculum was best for the students who are more interested in entering the workforce after high school (Advance CTE, 2018). Typically, educators perceived this curriculum as less rigorous because they unintentionally associated it with low prestige and low-wage occupations (Fletcher, 2012; Hamilton et al., 2015; Rosen & Molina, 2019). Due to this perception of vocational and job training, some pathways have reinforced the social disparities that researchers see in some career pathways (Fletcher, 2012; Hess, 2010; Landers, 2019). For example, Hess (2010) reports that more African American students participate in vocational and job training curricula than White students. Due to this higher participation rate and the negative association of this pathway, one could falsely assume that African American students do not have the same academic expectations as White students. As a result, African American students may be hindered from gaining the appropriate skills for the current labor market.

The growing gender and racial inequities discussed thus far prompted legislators to enact the Carl D. Perkins Career and Technical Education Act of 2006 (Perkins IV). The goal was to solve any problems that could exacerbate these disparities among students' gender, race, socioeconomic status, and those with disabilities. Also, legislators enacted this due to the U.S. shift in providing a more rigorous education in coursework that focuses on academic and career/technical content, encompassing both secondary and postsecondary elements (Dougherty, 2016). Plasman et al. (2020) found that STEM-related CTE courses offer one route for low-income students to reach the middle class. The education provided is more rigorous than past vocational curricula and allows students to develop skills for the current U.S. labor market. In addition, many CTE pathways include opportunities for students to receive dual credit or dual enrollment from a postsecondary institution, leading to a possible certificate or degree from the institution. The belief is that having these CTE programs will help resolve these disparities that educators see in career pathways like STEM professions (Hamilton et al., 2015). High school educators can then provide more academically challenging coursework and prepare students for more training beyond high school (Dougherty, 2016; Fletcher, 2012). The overall goal of the reform provided by Perkins IV was to better educate the students for the U.S. workforce and eliminate some of the inequities present in career pathways.

Perkins IV allowed states to fund CTE programs to better educate and prepare students for success in the

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workforce; however, equity in career pathways has continued to be a problem. Hamilton et al. (2015) investigated the participation patterns of historically underrepresented students in Illinois high school CTE courses in STEM fields. They specifically looked at the 2012-2013 school year from all school districts for CTE enrollment and compared their data to the national data for the 2011-2012 school year. Their data indicated more male participation (64%) than female participation (35.8%) in the STEM career clusters. In addition, there was a disproportion of male to female participation in almost all STEM career clusters; however, the data indicated that there was more female participation in the Health Sciences career cluster. Also, the proportion of male to female participation in non-STEM career clusters was reversed, with more females participating in these career clusters than male participation. As far as racial disparities, the data in STEM career clusters demonstrated an overrepresentation of White students in all career clusters. The data reported in Hamilton et al.'s study is more than eight years old, but CTE legislation and equity improvements are known to be a slow change (Kim et al., 2021); therefore, it is plausible that some of these inequities within STEM-related career clusters and other CTE clusters, although improving, are ongoing in other states beyond Illinois.

Every Student Succeeds Act (ESSA, 2015) was enacted to ensure that all students in the U.S. are held to a high academic standard and that educators, families, students, and communities are receiving information through statewide assessments on students' progress toward achieving these standards. In addition, the ESSA further advances equity for the learning opportunities required to develop skills in the 21st-century labor market (Cook-Harvey et al., 2016). The predecessor to ESSA, the No Child Left Behind Act of 2006 (NCLB, 2002), was intended to advance equity in traditional education, but the NCLB legislation neglected to address equity in CTE as well; therefore, Fletcher and Zirkle (2009) concluded that equity in CTE was left behind. Furthermore, the ESSA addresses this lack of focus on CTE by the NCLB and includes language that defines CTE as a component of a well-rounded education (Kim et al., 2021). In addition to the ESSA attempting to address equity in CTE, Perkins V (Perry, 2019) further builds on CTE ideals. One core indicator performance requirement in Perkins V is that all states must report on CTE participation rates and report data based on federally defined subgroups (Advance CTE, 2019). With these two pieces of legislation, the United States can further promote a more equitably skilled labor workforce.

These disparities remain a hindrance to more significant workforce issues impacting the United States (Leu & Arbeit, 2020). A lack of a qualified skill-based workforce in many areas is a concern and impediment to progress not only for gender equity but also for economic stability and growth. The majority of the U.S. population graduates high school now; however, not enough students graduate with the proper credentials required by specific employment opportunities that provide a livable-wage job (AIR, 2021). In addition, populations like students of color and lower SES represent a large and growing proportion of the U.S. population, and there is still a problem with keeping these populations enrolled and attaining postsecondary education (AIR, 2021). The problem is concerning because these populations are growing and will be the future labor workforce that the U.S. relies on to fulfill future jobs that require some postsecondary education.

The overarching goal of U.S. legislators is to cultivate an educated labor workforce so that all citizens have an equitable opportunity to participate in future jobs. As researchers in the state of Mississippi, we are interested in understanding how we can continue promoting equitable CTE opportunities for the state. Therefore, our study addresses the following research questions:

1.What are Mississippi students' CTE enrollment patterns, by gender, in both STEM and non-STEM career cluster areas?

2.What are Mississippi students' CTE enrollment patterns, by race/ethnicity, in both STEM and non-STEM career cluster areas?

3.What are Mississippi students' CTE statewide assessment proficiency patterns, by gender, in both STEM and non-STEM career cluster areas?

4.What are Mississippi students' CTE statewide assessment proficiency patterns, by race/ethnicity, in both STEM and non-STEM career cluster areas?

In addition to understanding these patterns in Mississippi, there is also a critical goal to understand why students select specific CTE clusters. Social cognitive career theory (SCCT; Lent et al., 1994; Lent & Brown, 2019) uses Bandura's (1986) triadic reciprocal causation framework with the emphasis being that career and educational development are shaped by contextual, personal, and behavioral factors (e.g., self-efficacy, social supports, goal setting). Additionally, SCCT was formed to understand better how certain aspects of persons (e.g., gender, culture, SES) may make particular career and learning experiences more or less available to individuals. The original SSCT work consisted of models focused on interest development, choice-making, and performance and persistence in educational and vocational domains (Lent et al., 1994). Although it is not the authors' goal to extend or apply SCCT, the framework is believed to be helpful when looking at the CTE enrollment patterns for gender and race and assessment of proficiency in CTE clusters in the state of Mississippi, with the goal being to give recommendations and future directions that will help all Mississippi students access an equitable educational opportunity.

Methodology

As previously discussed, it is not only a statewide but national movement toward providing more equitable opportunities to secondary students in STEM-related CTE pathways. The Research and Curriculum is the organization in

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the state of Mississippi responsible for helping the Mississippi Department of Education provide quality CTE experiences in public school districts as well as conduct educational research around CTE to continuously improve overall program quality. In this study, the authors used a post hoc observational research design using existing statewide secondary CTE assessment data captured during the period from 2015 to the present. This type of research is designed to explore what is currently occurring without any treatment. It is not intended to examine cause-and-effect relationships but to inform future research that is more causal or inferential in research design (Leedy & Omrod, 2018).

Population and Method of Data Collection

The Research and Curriculum Unit (RCU) requested and obtained data from the Mississippi Department of Education containing secondary enrollment numbers for all students in CTE programs for the 2015-2021 school years. The population of this study was 132,476 students who were enrolled in secondary CTE pathways. In Mississippi, 15 of the 16 national Career Cluster areas were represented, as well as 58 distinct career pathways (Advance CTE, 2021). Seven of these 15 career clusters and 21 of 58 career pathways are STEM cluster areas.

Method of Analysis

The researchers disaggregated the dataset to analyze the research questions. For this study, the researchers were interested in identifying patterns in the enrollment of Mississippi high school CTE students in both STEM and non-STEM fields to determine if certain trends existed by gender and race/ethnicity. Researchers gathered data for this study using career cluster and pathways' program of study enrollments by gender and race/ethnicity (separating STEM and non-STEM cluster areas). Data emerging from the research instruments were processed using the Statistical Package for Social Sciences software (SPSS 28.0) for relevant and adequate statistical analysis to generate the required statistical evidence (IBM Corp.,2021). The descriptive analysis used in this study included means and percentages. CTE enrollment patterns and statewide assessment proficiencies were also compared to statewide enrollment demographics and national science assessment proficiency patterns, respectively.

RESULTS AND DISCUSSION

Results

The presentation of the research results focuses on the research questions of the study: (1) what are Mississippi students' CTE enrollment patterns, by gender, in both STEM and non-STEM career cluster areas? (2) what are Mississippi students' CTE enrollment patterns, by race/ethnicity, in both STEM and non-STEM career cluster areas? (3) what are Mississippi students' CTE statewide assessment proficiency patterns, by gender, in both STEM and non-STEM career cluster areas? and (4) what are Mississippi students' CTE statewide assessment proficiency patterns, by race/ethnicity, in both STEM and non-STEM career cluster areas? For context, the researchers collected the high school enrollment data from the Mississippi Department of Education for the 2020-2021 school year. This data, shown in Table 1, allows the researchers to draw comparisons between enrollment patterns of CTE and non-CTE high school students.

Table 1. Mississippi High School Student Enrollment, by grade, gender, and ethnicity

Grade Level	Black (%)	White (%)	Hispanic (%)	Asian (%)	Other (%)	Male (%)	Female (%)
9^{th} – 12^{th}	47.72%	43.13%	4.39%	1.15%	3.61%	51.00%	49.00%

Source: MDE secondary CTE enrollment data, 2020-2021 (Mississippi Department of Education, 2021)

Statistical evidence from Table 2 indicates that a higher percentage of males enrolled in Agriculture Food and Natural Resources, Arts, Audio-Video Technology, and Communications, Information Technology, Manufacturing, and STEM career pathways. A higher percentage of females enrolled in the STEM-related career pathways in the Health Science career cluster. When comparing the secondary CTE enrollment with the state enrollment, there are 17.32% more females than males in STEM-related CTE clusters. This difference is largely due to the large enrollment of females in the Health Science career cluster. Using the U.S. Department of Education (2021) Perkins V 4S1: Non-traditional Program Concentration Core Indicator of Performance definition (25% or less participation) of a nontraditional occupation to CTE enrollment for gender equity, the Information Technology, and Manufacturing career clusters were below the threshold.

Table 2. Mississippi HS student enrollment in STEM-related CTE clusters, by gender

Career Cluster	Male (*n*)	Female (*n*)	Male (%)	Female (%)
Agriculture, Food, and Natural Resources	11,505	7,242	61.4%	38.6%
Arts, Audio-Video Technology, and Communications	2,200	1,510	59.3%	40.7%
Health Science	3,442	21,984	13.5%	86.5%
Information Technology	235	77	75.3%	24.7%
Manufacturing	153	12	92.7%	7.3%
Science, Technology, Engineering, and Mathematics	7,253	2,866	71.7%	28.3%
Summary Data	**24,788**	**33,691**	**42.39%**	**57.61%**

Source: MDE secondary CTE enrollment data, 2015-2021

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The statistics in Table 3 show that the same pattern of enrollment for males and females remained the same in the career clusters that were present in Table 2 and Table 3. It is interesting to note that the patterns of enrollment by gender in career clusters mimic the stereotypical female- or male-dominated roles in certain career sectors (Blau et al., 2013). The non-STEM CTE student enrollment is closer to the overall high school enrollment in the state (Mississippi Department of Education, 2021). The Architecture and Construction career cluster did not meet the threshold for the Perkins V 4S1: Non-traditional Program Concentration Core Indicator of Performance (United States Department of Education, 2021).

Table 3. Mississippi HS student enrollment in non-STEM CTE clusters, by gender

Career Cluster	Male (*n*)	Female (*n*)	Male (%)	Female (%)
Agriculture, Food, and Natural Resources	6,190	2,135	74.4%	25.6%
Architecture and Construction	6,624	1,371	82.9%	17.1%
Business Management and Administration	3,233	6,070	34.8%	65.2%
Education and Training	992	6,624	13.0%	87.0%
Finance	49	114	30.1%	69.9%
Health Science	54	234	18.8%	81.2%
Hospitality and Tourism	2,394	5,546	30.2%	69.8%
Human Services	388	6,574	5.6%	94.4%
Law, Public Safety, Corrections, and Security	2,465	2,431	50.3%	49.7%
Manufacturing	5,531	575	90.6%	9.4%
Marketing	1,052	2,017	34.3%	65.7%
Transportation, Distribution, and Logistics	10,227	1,107	90.2%	9.8%
Summary Data	**39,199**	**34,798**	**52.97%**	**47.03%**

Source: MDE secondary CTE enrollment data, 2015-2021

Globally, there was an equitable distribution of African American students and white students in STEM CTE clusters in Table 4. The reader may notice there is a disparity in most of the clusters apart from the Health Science career cluster due to the larger statewide enrollment of students (*n*=25,426). Except for the Manufacturing career cluster, all STEM-related career clusters met the Perkins V 4S1: Non-traditional Program Concentration Core Indicator of Performance (United States Department of Education, 2021).

Table 4. Mississippi HS student enrollment in STEM-related CTE clusters, by ethnicity

Career Cluster	White (%)	Black (%)	Hispanic (%)	Other (%)
Agriculture, Food, and Natural Resources	65.8%	30.3%	3.5%	0.4%
Arts, Audio-Video Technology, and Communications	43.0%	54.1%	2.5%	0.4%
Health Science	49.5%	46.4%	2.6%	1.5%
Information Technology	63.9%	30.3%	3.5%	2.3%
Manufacturing	78.7%	14.0%	6.7%	0.6%
Science, Technology, Engineering, and Mathematics	53.5%	40.0%	4.3%	2.2%
Summary Data	**55.3%**	**40.4%**	**3.1%**	**1.2%**

Source: MDE secondary CTE enrollment data, 2015-2021

For non-STEM CTE cluster enrollments as shown in Table 5, Agriculture Food and Natural Resources (20.4%), Manufacturing (38.5%), and the Transportation, Distribution, and Logistics (45.1%) career clusters were the only clusters that did not contain a majority-minority student enrollment. All non-STEM CTE clusters meet the Perkins V 4S1: Non-traditional Program Concentration Core Indicator of Performance (United States Department of Education, 2021) for student enrollments by ethnicity except the Agriculture Food and Natural Resources career cluster (20.4%).

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Table 5. Mississippi HS student enrollment in non-STEM CTE clusters, by ethnicity

Career Cluster	White (%)	Black (%)	Hispanic (%)	Other (%)
Agriculture, Food, and Natural Resources	77.6%	20.4%	1.7%	0.3%
Architecture and Construction	43.7%	52.1%	3.7%	0.5%
Business Management and Administration	38.6%	58.1%	2.4%	0.9%
Education and Training	46.4%	50.7%	2.3%	0.6%
Finance	28.9%	69.3%	1.8%	0%
Health Science	45.5%	50.0%	3.5%	1.0%
Hospitality and Tourism	36.8%	59.5%	2.7%	1.0%
Human Services	29.5%	67.1%	2.4%	1.0%
Law, Public Safety, Corrections, and Security	40.5%	55.2%	3.4%	0.9%
Manufacturing	58.5%	38.5%	2.6%	0.4%
Marketing	38.7%	57.4%	3.1%	0.8%
Transportation, Distribution, and Logistics	50.3%	45.1%	3.7%	0.9%
Summary Data	**47.0%**	**49.4%**	**3.0%**	**1.0%**

Source: MDE secondary CTE enrollment data, 2015-2021

For STEM career cluster enrollment as shown in Table 5, Agriculture, Food, and Natural Resources (20.4%), Manufacturing (38.5%), and the Transportation, Distribution, and Logistics (45.1%) career clusters were the only clusters that did not contain a majority-minority student enrollment. All non-STEM CTE clusters meet the Perkins V 4S1: Non-traditional Program Concentration Core Indicator of Performance (United States Department of Education, 2021) for student enrollment by ethnicity.

Table 6. Mississippi HS student enrollment in STEM CTE clusters, by ethnicity

Career Cluster	White (%)	Black (%)	Hispanic (%)	Other (%)
Agriculture, Food, and Natural Resources	65.8%	30.3%	3.4%	0.4%
Arts, Audio-Video Technology, and Communications	43.0%	54.1%	2.5%	0.5%
Health Science	49.5%	46.4%	2.6%	1.5%
Information Technology	63.9%	30.3%	3.5%	2.3%
Manufacturing	78.7%	14.0%	6.7%	0.6%
Science, Technology, Engineering, and Mathematics	53.5%	40.0%	4.3%	2.2%
Summary Data	**55.3%**	**40.4%**	**3.1%**	**1.2%**

Source: MDE secondary CTE enrollment data, 2015-2021

For non-STEM career cluster enrolment's shown in Table 6, Agriculture, Food, and Natural Resources (30.3%), Information Technology (30.3%), and the Manufacturing (14.0%) career clusters were the only clusters that did not contain a majority-minority student enrollment. The Manufacturing career cluster was the only non-STEM career cluster to meet the Perkins V 4S1: Non-traditional Program Concentration Core Indicator of Performance (United States Department of Education, 2021) for student enrollment by ethnicity.

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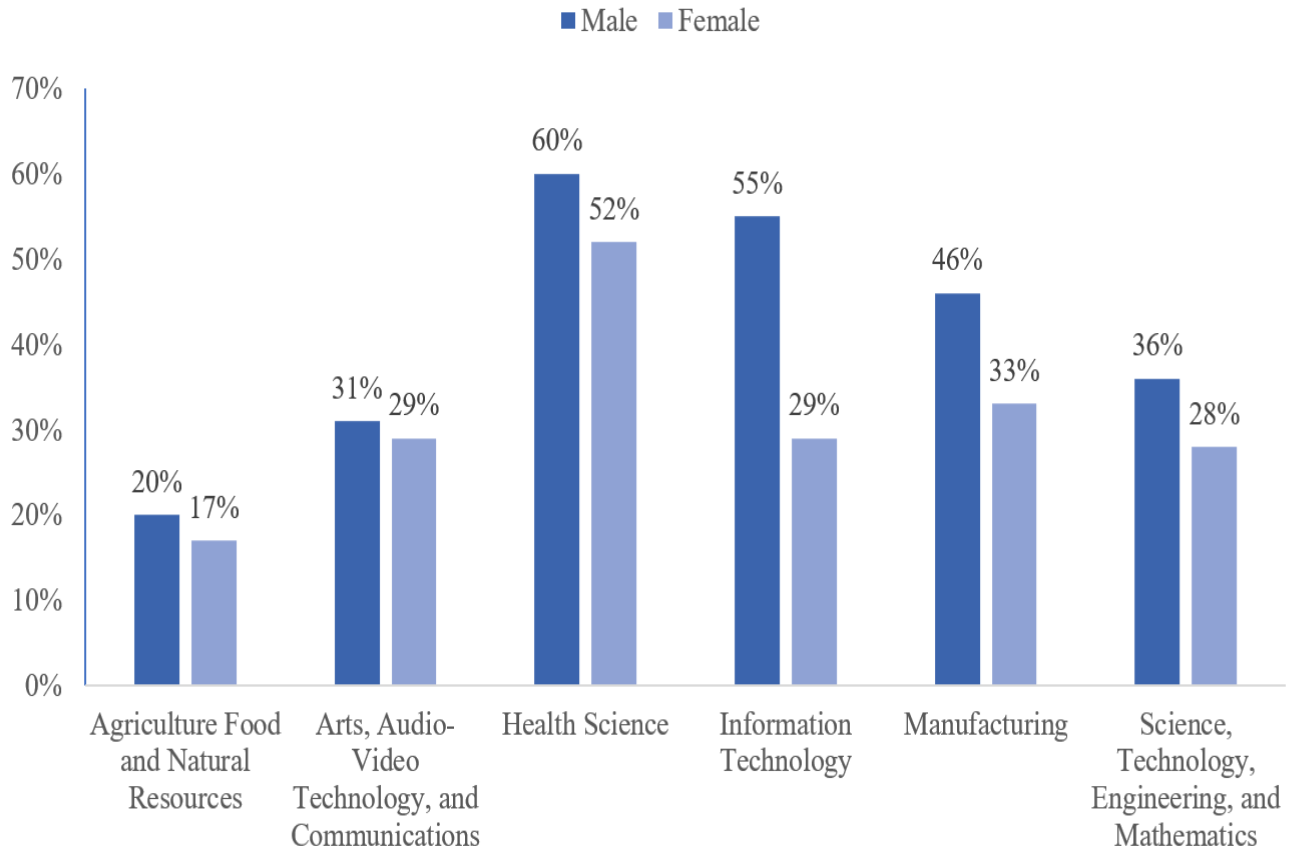
Figure 1. STEM CTE Students Scoring Proficient or Greater on Statewide Assessment, by gender



Source: MS-CPAS Assessment Data, 2015-2021

The graph displays, by STEM-related career cluster, what percentage of students by gender scored proficient on the MS-CPAS (Mississippi's state-level end of the year assessment for CTE). As Figure 1 shows, males scored proficient or higher on the statewide assessment for every career cluster grouping of courses. These results mimic the results displayed in a National Center for Education Statistics report (2017) that showed that males scored proficient or higher than females on the National Assessment of Educational Progress administered to students in 4th grade, 8th grade, and 12th grade.

In Figure 2, statistics were calculated for students enrolled in non-STEM-related career clusters who scored proficient or higher on the MS-CPAS by gender. Males scored proficient or higher on the statewide assessment for every career cluster grouping of courses. These results were also consistent with a report that showed that the summary of National Assessment of Educational Progress results for students in the 4th grade, 8th grade, and 12th grades where males scored proficient or higher than females (National Center for Education Statistics, 2017).

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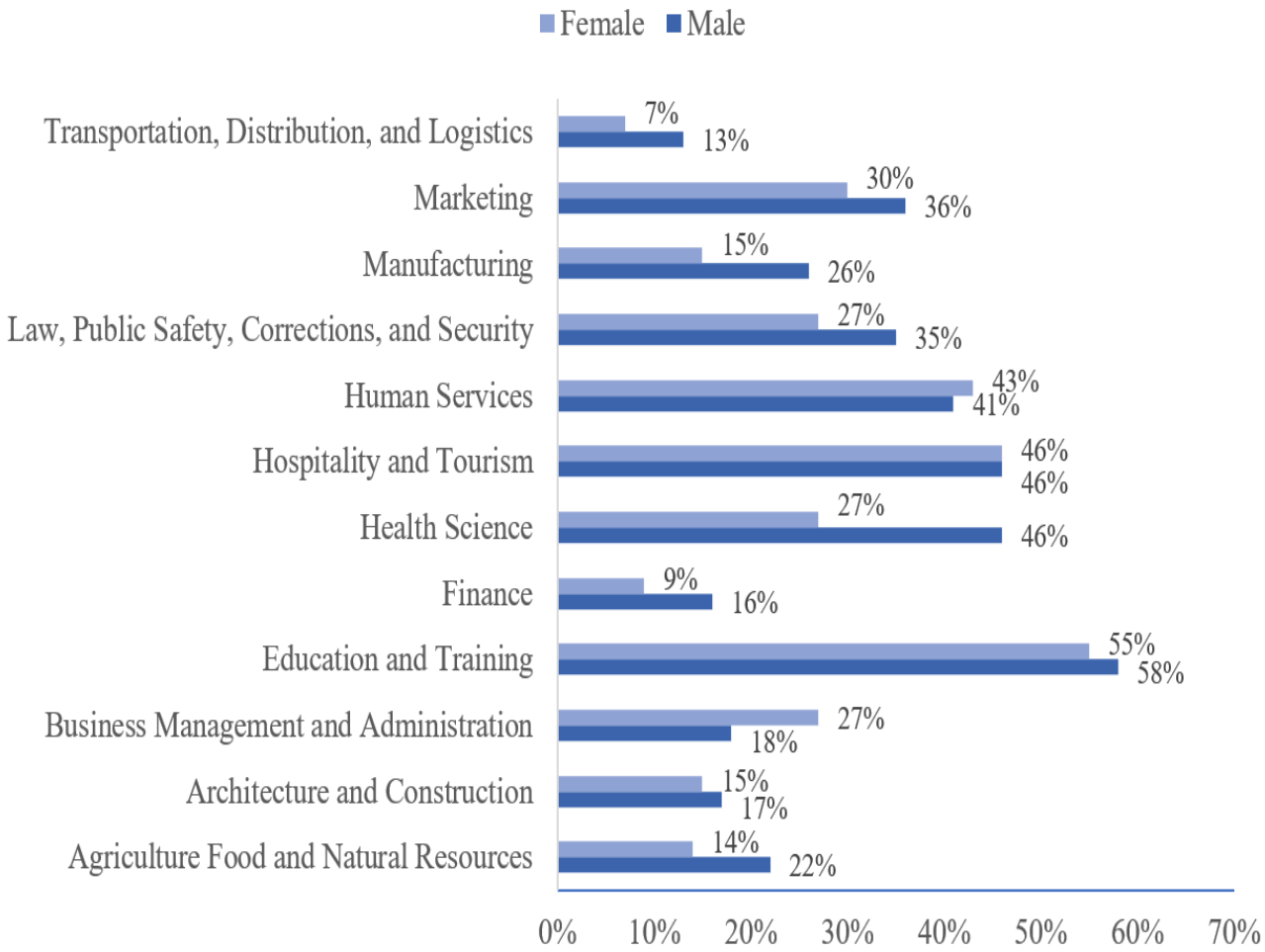
Figure 2. non-STEM Students Scoring Proficient or Greater on Statewide Assessment, by gender



Source: MS-CPAS Assessment Data, 2015-2021

Non-traditional students who enrolled in STEM-related career clusters had lower proficiency rates on the MS-CPAS assessment for each career cluster. These results were analogous to recent National Assessment of Educational Progress results where minority students had a lower percentage of proficiency for all levels of the science NAEP assessments at each grade level it is administered (National Center for Education Statistics, 2017). Students enrolled in the Arts, Audio-Video Technology, and Communications had the least percentage difference (16%) between white students and African American students as compared to other career cluster differences on the CTE statewide assessments.

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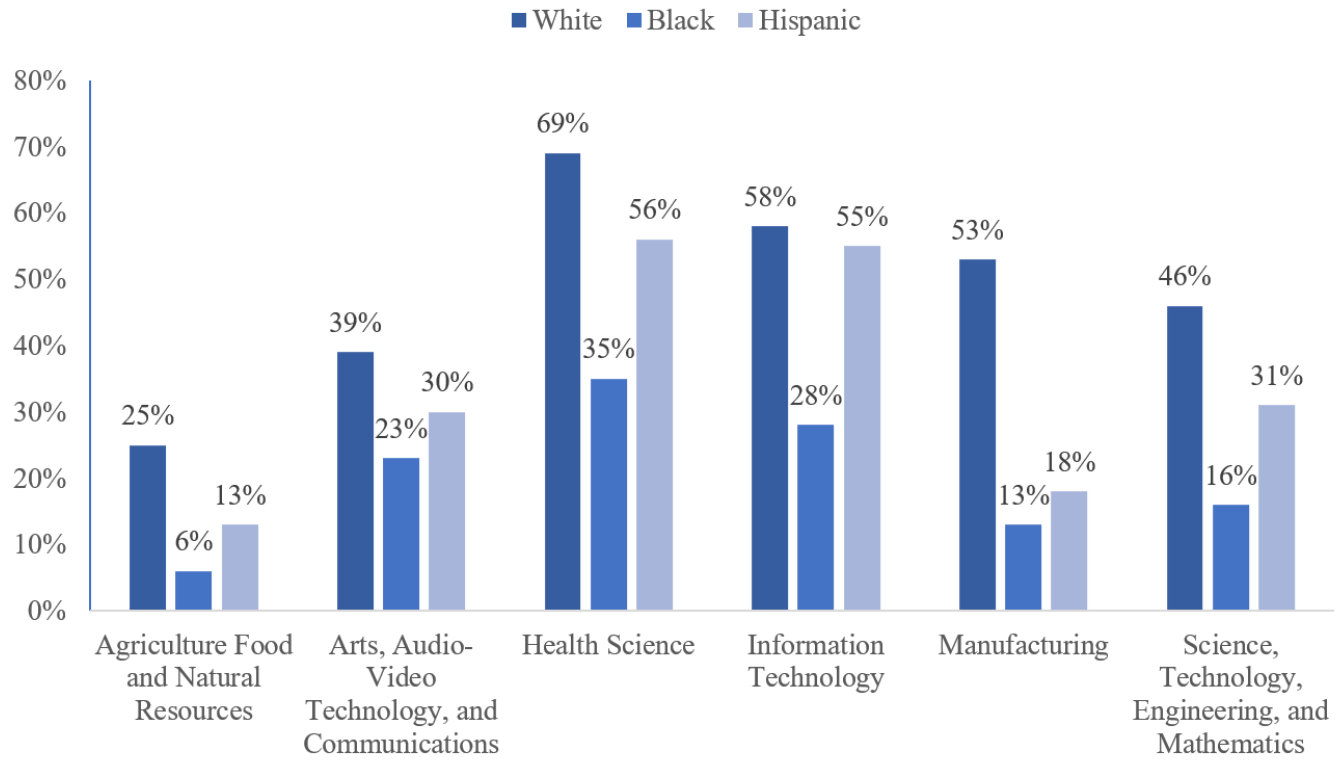
Figure 3. STEM CTE Students Scoring Proficient or Greater on Statewide Assessment, by ethnicity



Source: MS-CPAS Assessment Data, 2015-2021

The proficiency patterns in statewide CTE assessment results for students enrolled in non-STEM-related career clusters were like students enrolled in STEM-related career clusters. Students enrolled in the Finance career pathway had the least percentage difference (14%) between white students and African American students as compared to other career cluster differences on the CTE statewide assessments. The average percentage difference between traditional students and non-traditional students for all non-STEM-related career clusters was 25.08% as compared to the average percentage difference for STEM-related career clusters was 28.17%. The statewide assessment proficiency results are summarized in Figures 3 and 4.

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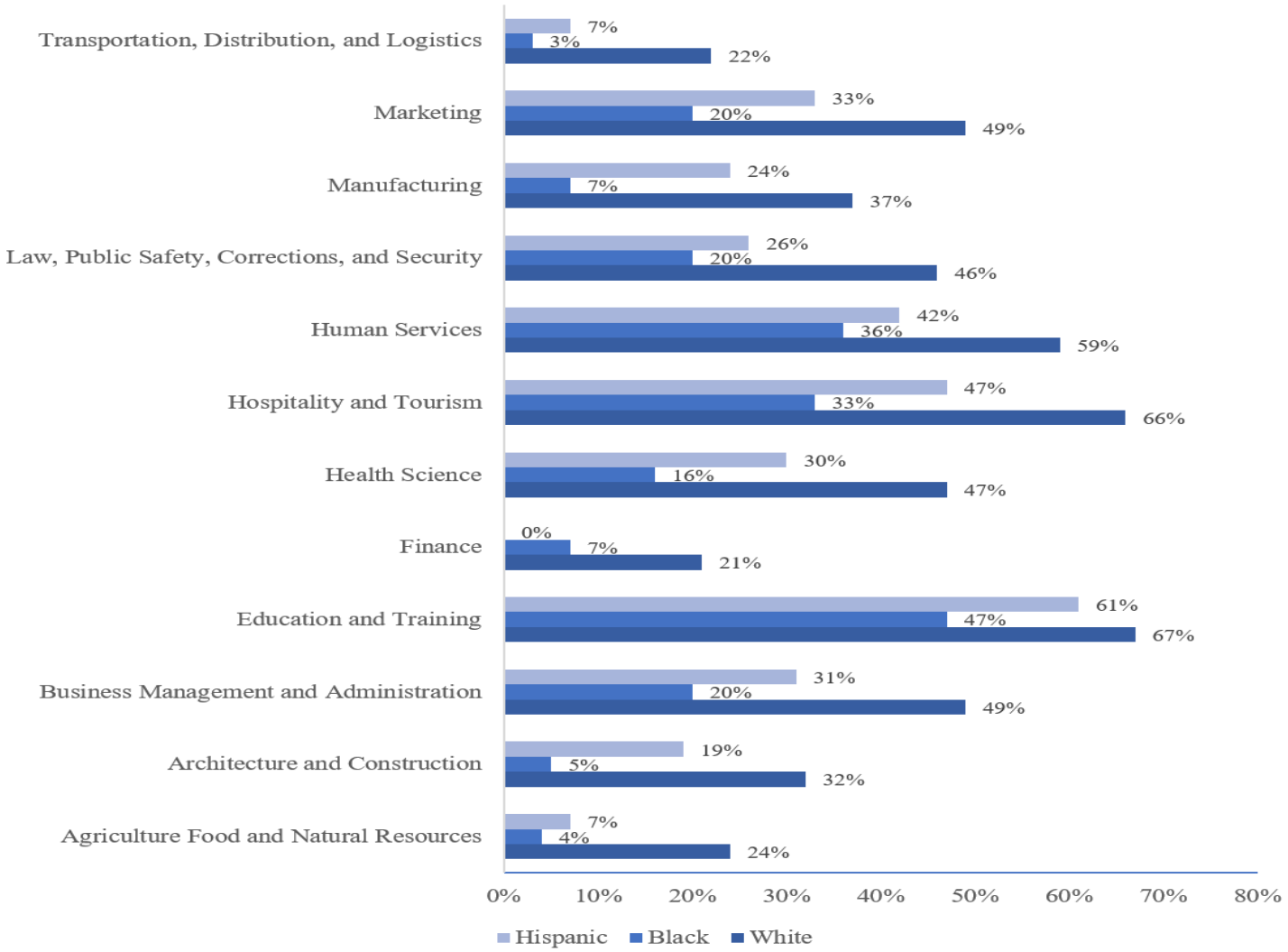
Figure 4. non-STEM Students Scoring Proficient or Greater on Statewide Assessment, by ethnicity



Source: MS-CPAS Assessment Data, 2015-2021

Discussion

In this study, we explored the enrollment patterns of Mississippi secondary CTE students by career cluster, as well as by career pathways that are associated with STEM careers over the last five years. Enrollment patterns were also compared to statewide enrollment patterns by gender and ethnicity. In STEM-related career clusters, female student enrollment was larger than male participation (42.39% male, 57.61% female), due to the pronounced gender disparity in the Health Science career cluster (13.50% male, 86.50% female). Student enrollment in non-STEM-related CTE clusters was the reverse over the last five years (52.97% male, 47.03% female), but was closer to the state's enrollment by gender. Regarding ethnicity, all nontraditional student groups were underrepresented in STEM-related CTE programming (40.4% African American, 55.3% White), whereas African American students were enrolled at more equitable rates than their White counterparts in none-STEM career clusters (47.0% African American, 49.4% White).

These secondary CTE student enrollment results somewhat mimic the patterns of underrepresentation of nontraditional students in STEM-related career fields (National Science Foundation, 2019); however, the enrollment patterns for most STEM career pathways are above 25%, which is the threshold for Perkins V non-traditional program concentration core indicator of performance for 4S1 (United States Department of Education, 2021). These results suggest that the CTE and non-CTE leaders in the state and school districts have been more effective in recruiting females and minority students to enroll in STEM-related career pathways. More work is needed in this area to ensure that this high-demand, high-wage career pathways are accessible to all students (Burbank et al., 2021).

As we explored the proficiency results of students on the statewide CTE assessments, we found similar outcomes as in the enrollment patterns. Males scored higher than females regardless of whether or not the career pathway was a STEM-related pathway. The Business Management and Administration

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career cluster was the only outlier of this result. This disparity between students scoring proficient or higher was even more marked when disaggregating by ethnicity (M=28.17%) in STEM-related CTE pathways. Unfortunately, these results also mimic the patterns of proficiency female and minority students earned on science statewide and national examinations over the past five years.

CONCLUSION

This study was unique because it explored the impact that career technical education may have on nontraditional students' enrollment in STEM-related coursework during high school (Dalton et al., 2013; Fletcher, 2012) and their performance on statewide STEM assessments (Plasman et al., 2020; Usher et al., 2019). As discussed in other studies, there is a gap in the research related to CTE in general. Likewise, more research is needed when exploring equitable access in CTE as school systems try to align more closely to workforce demands in the 21st century (Dougherty, 2016; Kim et al., 2021). This study supports the findings of Byars-Winston et al. (2015), Alonso-Villar & del Río (2017), and Leu and Arbeit (2020) that school systems are not building a robust enough pipeline for female and minority students in STEM-related careers based on current state enrollment patterns. However, in Mississippi, it is promising to see that there is less disparity in nontraditional student enrollment in STEM-related career pathways than on the national scale in high school coursework or labor market patterns (Plasman et al., 2020; United States Bureau of Labor Statistics, 2019). The results of the study also show that the disparity in student performance on statewide, science-based assessments still exists, indicating that more preparation is needed in this area for these subgroups of students (Gottfried et al., 2016; National Alliance for Partnerships in Equity, 2018). States should work toward tightening the connection between academic coursework and CTE coursework to promote more student achievement. One vehicle that has proven effective in recent years is the use of career academies, which integrate CTE coursework and academic coursework while tracking students' paths to labor market outcomes (Lanford & Maruco, 2019; Plasman et al., 2020).

Since this study focused on high school students solely from CTE programs in Mississippi, caution should be taken when inferring that these results generalize to other states. Based on the results of this study, it does seem reasonable to assume that implementing core performance indicators like 4S1 in the Perkins V Act promotes more equitable student enrollment. States should consider implementing similar measures connected to school systems' accountability, which has been shown that this has been an effective mechanism for progressive educational change (Estes & McCain, 2019; Estrada et al., 2016). As suggested earlier, more research is needed in this area from not only a qualitative approach but also a student-centered approach to further explore why certain demographics may or may not enroll in STEM-related coursework. School systems and society are finally in visible agreement concerning the desire to equip the future workforce for high-skill, high-demand jobs (Burbank et al., 2021; Kell et al., 2020). It is up to CTE practitioners and researchers alike to help policymakers discover the most effective mechanisms for all.

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