Racial/Ethnic and Gender Equity Patterns in Illinois High School Career and Technical Education Coursework

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ABSTRACT

This study analyzed high school Career and Technical Education (CTE) enrollments in Illinois, with comparisons to national data when possible, by career cluster and pathway and with respect to gender and racial/ethnic makeup of students. Enrollment patterns in Science, Technology, Engineering, and Math (STEM) CTE programming were emphasized. Gender and ethnicity-based inequities were found in certain areas and more equitable patterns were apparent in others. Of concern, student enrollment in courses fitting within STEM pathways included substantially greater male than female participation (64.1% male vs. 35.9% female), whereas other pathways showed the reverse enrollment pattern (45.0% male and 55.0% female). With respect to ethnicity, all subgroups except White students were underrepresented in CTE programming in general. The underrepresentation was exacerbated for all but Asian students when concerning STEM CTE programming. Considering implications, we recommend heightened focus, support, and goal setting concerning equity of CTE programming.

Introduction

Attaining equitable career pathways for high school students requires educators to engage in honest, reflective discourse concerning data, construct an understanding of the term "equity," and determine how underlying assumptions may influence a school's progress toward providing a rigorous curriculum that prepares every student for college and careers (Welton & LaLonde, 2013). Racial/ethnic and gender inequities existing within Career and Technical Education (CTE) course enrollments restrict students' access to Science, Technology, Engineering, and Mathematics (STEM) fields, not only as they attempt to transition to postsecondary educational experiences but also as they matriculate into STEM occupations (Fletcher, 2012).

As the knowledge-based economy has grown in the U.S., jobs in high-technology fields are expanding but postsecondary institutions are producing insufficient numbers of graduates in these fields (Fletcher, 2012). To maintain our nation's global competitiveness, a focus on equity is critical as all high school graduates strive to gain access to postsecondary career and

educational opportunities. Amid reports that women, non-Hispanic Blacks, and Hispanics have been consistently underrepresented in STEM occupations (Beede, Julian, Khan et al., 2011; Beede, Julian, Langdon et al., 2011), racial and gender compositions within high school CTE STEM programs of study, in particular, require closer examination. Racial and ethnic inequities existing within CTE course enrollments restrict students' access to STEM fields, not only as they attempt to transition to postsecondary educational experiences but also as they matriculate into STEM occupations (Fletcher, 2012). Therefore, the purpose of this study was to examine participation patterns of historically underrepresented students within high school CTE courses in STEM fields. This article begins with an overview of research on participation in career fields by gender and race/ethnicity, with a focus on STEM, and then presents findings from an analysis of public high school CTE enrollments in the state of Illinois. In the discussion and implications section, we integrate our findings with existing literature. We conclude with recommendations for educational leaders and policymakers.

Review of Literature

Career and technical education has evolved in the past two decades from its initial mission to integrate manual vocational training into the secondary curriculum to meet the industrial needs of the nation (Fletcher, 2012). As our knowledge-based economy has shifted, so too have expectations for students' academic preparation. High school practices historically steered students into either academic tracks for college-bound students or vocational tracks for students who were perceived as being more inclined to enter the workforce after high school (Hess, 2010). Vocational coursework has been perceived as being less rigorous and associated with low prestige and low-wage occupations (Fletcher, 2012). Hess (2010) claimed that "vocational education has reinforced social divisions along racial lines, as black students have been far more likely to be enrolled in vocational education than are white students" (p. 119).

One consequence of lowered academic expectations for students is the skills gap in the U.S. workforce, with many young adults lacking essential knowledge and skills to be productive workers in our knowledge-based economy (Symonds, Schwartz, & Ferguson, 2011). This gap is particularly challenging in the state of Illinois, where 80% of jobs within the state require some form of postsecondary training but only 41% of adults have attained industry credentials or earned postsecondary degrees (Advance Illinois, 2012). In recent years, policymakers and educators across the U.S. have acknowledged this gap in expectations. Thirty-five states have joined the American Diploma Project (2004), with a goal of improving secondary preparation so that students are ready for college and work (Achieve, 2014), and college and career readiness standards have been formulated as a result of this project. According to Achieve (2014),

> college and career readiness means that a high school graduate has the knowledge and skills necessary to qualify for and succeed in entry-level, credit-bearing postsecondary coursework without the need for remediation—or to qualify for and succeed in the postsecondary job training and/or education necessary for his or her chosen career. (p. 6)

Achieve further notes: “To be college and career ready, high school graduates must have studied a rigorous and broad curriculum that is grounded in the core academic disciplines but also consists of other subjects that are part of a well-rounded education” (p. 6).

The Carl D. Perkins Career and Technical Education Act of 2006 (Perkins IV) provides funds to each state for CTE programming and has been influential in expanding definitions of CTE beyond traditional concepts of vocational education. Perkins IV requires programs of study to include rigorous academic and career/technical content, with courses sequenced in a coordinated, non-duplicative manner and containing both secondary and postsecondary elements. In addition, programs should lead to an industry-recognized credential, postsecondary certificate, and/or degree and include opportunities for students to earn dual credit or dual enrollment. CTE coursework has the potential not only to prepare students for college and careers but also to disrupt race and gender inequity patterns within STEM professions (U.S. Department of Education, 2014). In recent years, and promoted through Perkins IV, high school educators have made strides in making CTE courses more academically challenging and have focused on preparing students for additional training beyond high school (Fletcher, 2012).

The National Career Clusters Framework (National Association of State Directors of Career Technical Education Consortium, n.d.) has developed 16 career cluster areas: Agriculture, Food and Natural Resources; Architecture and Construction; Arts, Audio/Video, Technology and Communications; Business Management and Administration; Education and Training; Finance; Government and Public Administration; Health Sciences; Hospitality and Tourism; Human Services; Information Technology; Law, Public Safety, Corrections and Security; Manufacturing; Marketing; Science, Technology, Engineering and Mathematics; and Transportation, Distribution and Logistics. The state of Illinois has adopted these 16 career clusters within its state model (Nicholson-Tosh & Bragg, 2013), and Perkins IV funding at the secondary level is provided for CTE coursework in all cluster areas, with the exception of Government and Public Administration. In its federal Race to the Top (RttT) application, the State of Illinois (2011) identified eight career clusters as STEM fields, with a goal to expand CTE programs of study within these clusters in Illinois school districts participating in RttT activities. The Illinois STEM clusters include Agriculture, Food and Natural Resources; Architecture and Construction; Finance; Health Sciences; Information Technology; Manufacturing; Science, Technology, Engineering and Mathematics; and Transportation, Distribution and Logistics. The Illinois RttT application also included a performance measure to increase the enrollments of underrepresented high school students participating in STEM programs of study. Within the state of Illinois, Perkins IV funding is provided to school districts when they obtain approval for specified CTE programs of study within the career cluster areas. CTE educators are required to engage in curriculum development activities, offering courses that meet minimum program of study requirements. Through Illinois RttT activities, funding has been provided for the creation of centers—known as Learning Exchanges—whose function is to develop curriculum materials within the Illinois-defined STEM career cluster areas. In the following sections, we address participation in CTE fields by gender and race/ethnicity; we also address student enrollments in the Illinois-defined STEM fields, when relevant.

Gender Participation

The U.S. Department of Education (2014) defines nontraditional fields as "those in which individuals from one gender comprise less than 25 percent of the individuals employed in the occupation or field of work" (p. 36). It is important to note that this definition encompasses both sexes, although females typically are more likely to experience the negative effects of gender inequities. For example, the U.S. Bureau of Labor Statistics (2013) reported that females earn only 81% of the median wages earned by full-time male workers. Domenico and Jones (2006) also noted that women traditionally have worked within only 20 of 400 job categories, which tend to be lower paying occupations. Females comprise nearly half of the U.S. workforce, yet only about one in five workers in scientific and technological fields are women (Committee on Science, Engineering, and Public Policy, 2007). In addition, females are underrepresented in STEM CTE coursework (National Coalition for Women and Girls in Education [NCWGE], 2012; National Women's Law Center [NWLC], 2007; Toglia, 2013).

Reviewing data from the 1997 National Longitudinal Survey of Youth, Fletcher (2012) found that gender was significantly related to high school students' career choices. Females were nearly twice as likely to select occupations in Health Sciences and Human Services than were males, while males were 20 times more likely to select occupations in Agriculture, Food and Natural Resources and nearly 17 times more likely to select occupations within Transportation. In fiscal year 2012, 47% of students enrolled in high school CTE courses in the U.S. were females (National Alliance for Partnerships in Equity [NAPE], 2014). Examining national CTE enrollment patterns, Lufkin et al. (2007) found that no states reported having more than 25% of females enrolled in nontraditional coursework, leading them to conclude that "girls are preparing for traditionally female occupations at a disproportionately high rate" (p. 428). Reviewing STEM high school course enrollment trends between 1990 and 2005, Laird, Alt, and Wu (2009) reported that both males and females had experienced increases in STEM credits, with females earning slightly more credits in advanced mathematics and science and engineering coursework, and males earning slightly more credits in physics, computer science, engineering, and engineering/science technologies. However, gender differences were not significant.

Although the majority of research tends to focus on the negative effects of gender inequities for women, this issue is also a concern for men in fields in which they are underrepresented. For example, only 6% of registered nurses in the U.S. are males (Lucci, 2007). Both females and males may be confronted with gender stereotypes when they attempt to access coursework within their chosen occupations (Lufkin et al., 2007).

Several factors may contribute to female under-participation within STEM-related career fields, including lack of self-confidence and loss of interest in science and math during middle school (National Science Foundation (2003). Lufkin et al. (2007) cited eight potential reasons for inequities within CTE that may affect both genders: (a) insufficient exposure to nontraditional occupations and role models, (b) students' attitudes regarding certain occupations, (c) gender-

biased career guidance practices and published materials (d) insufficient encouragement to enroll in STEM coursework, (e) use of gender-stereotyped curricula and instructional approaches, (f) school and classroom climates that isolate students who choose to enroll in nontraditional CTE courses, (g) lack of student self-efficacy, and (h) limited individual support services for students.

Race/Ethnicity Participation

Students' racial or ethnic backgrounds may influence their enrollment in rigorous high school programs of study. According to Rojewski and Xing (2013), race/ethnicity potentially affects students' perceptions of career opportunities and barriers, as well as their decisions to enroll in CTE coursework. Of concern, just one fourth of CTE research specifically reports the racial/ethnic composition of the research samples.

Historical influences regarding race/ethnicity play a role in enrollments in high school CTE programs. Compared to those who intend to enroll in postsecondary education, youth who plan to enter the workforce immediately after high school are disproportionately male, from minority backgrounds, and/or exhibiting lower academic performance than their peers (Rojewski & Kim, 2003). Racial discrimination, systemic exposure to less academically rigorous curricula, and unfavorable societal perceptions of persons on the basis of their racial or ethnic backgrounds are factors that contribute to stratification of educational and occupational attainment (Fletcher 2012; Rojewski & Kim, 2003). There has been national support to close the equity gap that exists for minorities in high school CTE programs, and recent research indicates some progress on this front. Analysis of CTE student enrollments across the U.S. by race in fiscal year 2012 disclosed that 52% were White, 23% Hispanic, 16% Black, 4% Asian, 2% two or more races, 1% American Indian or Alaska Native, and 1% Native Hawaiian or Other Pacific Islander (NAPE, 2014); these proportions were in close alignment with overall secondary enrollment data.

Race/ethnicity still remains a critical factor in STEM occupational fields and course enrollments. Data from the 1997 National Longitudinal Survey of Youth determined that Whites were 2.4 times more likely than were African Americans and 4.5 times more likely than Hispanics to be employed in STEM occupations (Fletcher, 2012). Reviewing STEM high school course enrollments between 1990 and 2005, Laird et al. (2009) found that all racial/ethnic groups had experienced increases in STEM credits, but White and Asian/Pacific Islander students earned more credits than Black and Hispanic students. Many children begin reaching decisions about career fields at an early age, which may serve to restrict access into STEM fields for students of color. Riegle-Crumb, Moore, and Ramos-Wada (2010) reported that racial/ethnic disparities exist in math and science career aspirations well before students enter into high school, with students of color less likely to identify these fields. Dynamics such as one's attitude toward certain occupations may contribute to reduced participation of non-White females in math and science fields and can influence occupational choices later in life.

Tracking enrollment patterns into postsecondary settings also can provide insights into STEM participation, and research confirms that women and minorities exhibit higher rates of

leaving STEM fields of study than do their peers (Shaw & Barbuti, 2010). Following a cohort of undergraduate students majoring in STEM fields between 2003-2006, Chen (2013) observed that approximately 28% of entering students pursuing bachelor's degrees and 20% pursuing associate's degrees were enrolled in STEM fields, which Chen identified as mathematics, physical sciences, biological/life sciences, computer and information sciences, engineering and engineering technologies, and science technologies. However, 48% of those enrolled in bachelor's degree programs and 69% enrolled in associate's degree program had left these STEM fields by spring 2009. Attrition rates for Black and Hispanic students were higher than those for other racial/ethnic groups, and females were more likely to transfer than were males Focusing on female and minority students at the high school level may affect the likelihood that they will remain within STEM fields of study throughout college and into the workforce.

Conceptual Framework

This study was motivated and framed by cultural reproduction theory (Bourdieu & Wacquant, 1992). Cultural reproduction has been defined as "the complex ideological and cultural processes that reproduce social forms such as racism, gender bias, authority structures, attitudes, values, and norms" (Zacharakis & Flora, 2005, p. 293). These processes help to explain how and why group-based inequalities, once established, tend to be highly resistant to change. In large part, this tendency toward reproduction is supported by dominant groups' efforts to preserve their advantages (Bourdieu & Wacquant; Giroux, 1983), for instance by securing access to better funded or higher quality schools. Although the education system is positioned as a central mechanism for cultural reproduction (Sullivan, 2002), arguably, it is the responsibility of educators to establish practices within their schools to counter it (e.g., to promote social mobility by opening up new opportunities to members of historically oppressed groups; Marshall & Oliva, 2006). Nevertheless, even in the midst of significant reform efforts, such as those previously described and intended to increase non-traditional students' participation in CTE programs of study, large-scale improvements may not come about easily. Powerful psychological and institutional counterforces may serve to buttress the status quo.

Given the focus of this study, most pertinent are cultural reproduction processes related to gender and race/ethnicity with respect to CTE enrollments. A large body of literature supports the historical and continued salience in the U.S. of individuals' race/ethnicity and gender; these features affect students' daily experiences and may influence their real or perceived access to, or suitability for, a variety of socially-valued opportunities (Darling-Hammond, 2010; Lufkin et al., 2007; Rojewski & Kim, 2015). In terms of education, and specifically regarding the provision of CTE, there are several structural and psychological reasons why inequities of access or participation might arise and persist. Structurally, the decentralized schooling system in the U.S. invariably fosters wide differences in terms of available resources (and, therefore, the types and qualities of school counseling services and programmatic offerings) by school district (Ladson-Billings, 2014; Malin, 2015). The state of Illinois is no exception, as its funding inequities across school districts are persistent and sizeable (Baker, Sciarra, & Farrie, 2014; Malin & Noppe, 2015). Too, in the face of resource limitations, schools and districts have been shown to ration

their "high-quality curriculum through tracking and interschool disparities" (Darling-Hammond, 2010, p. 30). Closely related are individuals' (e.g., students, parents, teachers, or counselors) beliefs and attitudes, which too often incorporate deficit thinking and serve to reinforce the status quo (Valencia, 2012). For instance, a teacher or counselor who perceives nursing as a field that is better suited for women may be more likely to encourage female students to enroll in CTE courses in the health sciences field (Lufkin et al., 2007). Likewise, a student might internalize that certain career fields or courses of study are not for them based upon negative messages, both implicit and explicit, that they have received from their peers, educators, and parents. Altogether, these factors would help to explain an underrepresentation of females (NCWGE, 2012; NWLC, 2005; Toglia, 2013) and minorities (Rojewski & Kim, 2013) in STEM CTE coursework. Therefore, guided by our understanding of cultural reproduction theory as it applies to U.S. public schooling systems, we were motivated to examine Illinois students' participation, by gender and race/ethnicity, in different types of CTE programming.

Our research center has been involved throughout the past three years in supporting the implementation of STEM CTE programs of study in Illinois school districts that are participating in the federal Race to the Top initiative. As part of our district supports and to discern any state-related issues involving students' access to CTE programming, we were interested in examining differences in Illinois CTE enrollments for both STEM and non-STEM programming. Guided by our understanding of cultural reproduction theory as it applies to United States public schooling systems, our study addressed the following research questions:

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

Research Methods

We requested and obtained a dataset from the Illinois State Board of Education containing duplicated high school enrollments in CTE programs of study for the 2012-13 school year for every Illinois public high school and career center. First, we performed exploratory data analysis techniques (Tukey, 1977) to the dataset, looking especially for unusual data patterns (e.g., unusually high enrollments given the size of a particular high school, etc.) that might suggest data corruption. Uncovering no such issues, we proceeded to modify the dataset in a manner that would permit us to analyze our research questions. Namely, we added data elements, associating each program of study with the career pathway and the career cluster to which it belonged, and tagging each with a "0" to represent a non-STEM area or a "1" to represent a STEM area, based upon state of Illinois definitions of STEM career cluster areas in the Race to the Top application (State of Illinois, 2011).[1] Fifteen of the 16 Illinois Career Cluster areas were

[1] The STEM career clusters, with rankings showing popularity (Illinois duplicated student enrollments) in parentheses, are as follows: Finance (1); Health Science (2); Agriculture, Food, and Natural Resources (5); Architecture and Construction (7); Transportation, Distribution, and Logistics (8); Manufacturing (9); Information Technology (10); and Science, Technology, Engineering, and Mathematics (11).

represented, as were 40 career pathways. Eight of these 15 career clusters and 20 of 40 career pathways are considered to represent STEM cluster areas. As part of our research center activities, we were interested in noting participation of Illinois high school students in both STEM and non-STEM fields, to determine if differences existed by gender and race/ethnicity.

In analyzing data for this study, we aggregated program of study enrollments by gender and race/ethnicity to the career cluster and pathways (limited to STEM cluster areas) levels. We also analyzed national high school CTE enrollments from the 2011-12 school year (U.S. Department of Education, n.d.), which was the most recent CTE dataset available, so comparisons could be made between the state of Illinois and national enrollment patterns. This national dataset represented a compilation of states' 2011-12 annual reports to the U.S. Department of Education (per Perkins IV requirements); although we could not confirm the accuracy of the data, we chose to employ it given the source and our desire to make a nation-wide comparison to contextualize the Illinois gender data.

Because we were able to access secondary CTE enrollment data from all school districts in Illinois, we considered our data set as representing population-level data. We were not working with sample data, so it was unnecessary to conduct inferential statistical analyses. Our findings, based upon descriptive data analyses, represent the full context of Illinois high school CTE enrollments in 2012-13. To address our research questions, we cross-tabulated information and calculated enrollment percentages in different CTE programs and clusters by gender and race/ethnicity, respectively. We then aspired to assess the proportionality or disproportionality of enrollments and employed the following reasoning to aid our interpretations. With respect to gender, we assumed that parity, reflected by equally proportioned (50% male, 50% female) participation in CTE programming, is ideal. Because this ideal of exact equality in gender participation in each cluster area is mathematically improbable, we employed a 20% range (40-60% female participation) as our working definition of gender parity for the purposes of this study. Therefore, we considered that gender parity had been approached when participation fit this pattern. With respect to race/ethnicity, to assess the extent of parity, we compared CTE participation rates by race/ethnicity to the racial/ethnic distribution of the total Illinois public high school student population.

Findings

Illinois CTE Participation Rates, by Gender

Gender and career cluster. Substantial gender-based inequities were found in certain career cluster areas. Illinois public high school CTE student enrollments in courses fitting within the Illinois-defined STEM career clusters included substantially greater male (64.1%) than female (35.9%) participation, whereas non-STEM clusters showed the reverse participation pattern. In total, 364,388 enrollments (233,664 male and 94,837 female) were recorded in STEM clusters, and 210,976 enrollments (116,139 female and 94,837 male) were recorded in other career clusters.

Table 1 shows the full set of Illinois CTE enrollments by career cluster and gender in Illinois. Applying the U.S. Department of Education (2014) definition (25% or less participation) of a nontraditional occupation to CTE enrollments across genders, females were substantially underrepresented in four career cluster areas, which are defined within the state of Illinois as STEM fields: Architecture and Construction; Transportation, Distribution, and Logistics; Manufacturing; and Science, Technology, Engineering, and Mathematics. Males were substantially underrepresented in two career cluster areas, which are not Illinois-identified STEM fields: Human Services, and Education and Training.

If gender parity is the goal, then relatively similar proportions of males and females should be enrolled in CTE coursework within each career cluster area. Examining CTE enrollment patterns across the United States, several cluster areas approached gender parity (Table 2). Using our working definition of 40-60% female participation as gender parity, we noted parity had been approached in U.S. CTE enrollments for two STEM clusters: Finance, and Agriculture, Food and Natural Resources. Comparing state of Illinois high school student CTE enrollments to national enrollments in the STEM fields, Illinois enrollments showed greater gender-based disproportionality in all Illinois-defined STEM career cluster areas except Health Science. Applying the 40-60% participation range for females in the Illinois STEM clusters, Illinois approaches parity only in Finance.

Table 1. Illinois High School CTE Enrollments by Career Cluster and Gender, 2012-13

Career Cluster	IL CTE Rank	Total Enrollment	Percent of Total Enrollment	Male Enrollment (N)	Female Enrollment (N)	Male (%)	Female (%)
Finance	1	98,619	17.1	55,565	43,054	56.3	43.7
Health Science	2	80,526	14.0	31,619	48,907	39.3	60.7
Human Services	3	66,950	11.6	15,343	51,607	22.9	77.1
Arts, A/V Technology and Communications	4	61,592	10.7	40,113	21,479	65.1	34.9
Agriculture, Food and Natural Resources	5	48,826	8.5	30,963	17,863	63.4	36.6
Business, Management and Administration	6	43,679	7.6	24,806	18,873	56.8	43.2
Architecture and Construction	7	36,488	6.3	32,471	4,017	89.0	11.0
Transportation, Distribution and	8	30,847	5.4	28,608	22,39	92.7	7.3

Logistics							
Manufacturing	9	27,798	4.8	23,047	4,751	82.9	17.1
Information Technology	10	22,820	4.0	15,775	7,045	69.1	30.9
Science, Technology, Engineering and Mathematics	11	18,464	3.2	15,616	2,848	84.6	15.4
Hospitality and Tourism	12	16,221	2.8	6,378	9,843	39.3	60.7
Marketing	13	14,089	2.4	4,971	9,118	35.3	64.7
Education and Training	14	4,351	0.8	366	3,985	8.4	91.6
Law, Public Safety, Corrections and Security	15	4,094	0.7	2,860	1,234	69.9	30.1

Table 2. Illinois and U.S. High School CTE Enrollment Percentages by Career Cluster and Gender

Career Cluster	Illinois Female (%)	United States Female (%)
Finance	43.7	48.7
Health Science	60.7	66.2
Human Services	77.1	71.7
Arts, A/V Technology and Communications	34.9	41.5
Agriculture, Food and Natural Resources	36.6	41.6
Business, Management and Administration	43.2	47.6
Architecture and Construction	11.0	18.5
Transportation, Distribution and Logistics	7.3	13.5
Manufacturing	17.1	18.7
Information Technology	30.9	38.9
Science, Technology, Engineering and Mathematics	15.4	30.8
Hospitality and Tourism	60.7	53.8
Marketing	64.7	50.2
Education and Training	91.6	69.4
Law, Public Safety, Corrections and Security	30.1	42.0

Source: U.S. Department of Education, Office of Career, Technical, and Adult Education. (n.d.)

Gender and career pathway. We also analyzed participation in Illinois high school CTE courses by gender and career pathway, limiting our focus to career pathways that fall within

STEM clusters. As expected, we found gender participation patterns by pathway within Illinois-defined STEM clusters to be quite variable, and prima facie these patterns appeared to mirror occupational data that we have reviewed. For instance, male participation within the Health Science career cluster ranged from 13.0% and 16.3% in the health informatics and therapeutic pathways, respectively, to 46.5% in the diagnostic services pathway (Table 3).

Table 3. Illinois High School CTE Enrollments by STEM Career Pathway and Gender, 2012-13

Cluster	Pathway	Male (N)	Female (N)	Male (%)	Female (%)
Agriculture, Food and Natural Resources	Plant Systems	11,648	9,476	55.1	44.9
	Power Structure and Technical Systems	11,168	3,693	75.1	24.9
	Natural Resources Systems	8,147	4,694	63.4	36.6
Architecture and Construction	Construction	18,172	1,678	91.5	8.5
	Design/Pre-Construction	13,869	2,220	86.2	13.8
	Maintenance/Operations	430	119	78.3	21.7
Finance	Financial and Investment Planning	55,565	43,054	56.3	43.7
Health Science	Support Services	28,181	33,360	45.8	54.2
	Therapeutic Services	2,839	14,566	16.3	83.7
	Diagnostic Services	410	472	46.5	53.5
	Biotechnology	186	489	27.6	72.4
	Health Informatics	3	20	13.0	87.0
Information Technology	Network Systems	10,886	5,674	65.7	34.3
	Programming and Software Development	4,889	1,371	78.1	21.9
Manufacturing	Production	17,054	1,391	92.5	7.5
	Maintenance, Installation and Repair	5,813	1,743	76.9	23.1
	Manufacturing Production Process Development	180	1,617	10.0	90.0
Science, Technology, Engineering, and Mathematics	Engineering and Technology	15,616	2,848	84.6	15.4
Transportation, Distribution and Logistics	Facility and Mobile Equipment Maintenance	24,495	1,768	93.3	6.7
	Transportation Operations	4,113	471	89.7	10.3

Illinois CTE Participation Rates, by Race/Ethnicity

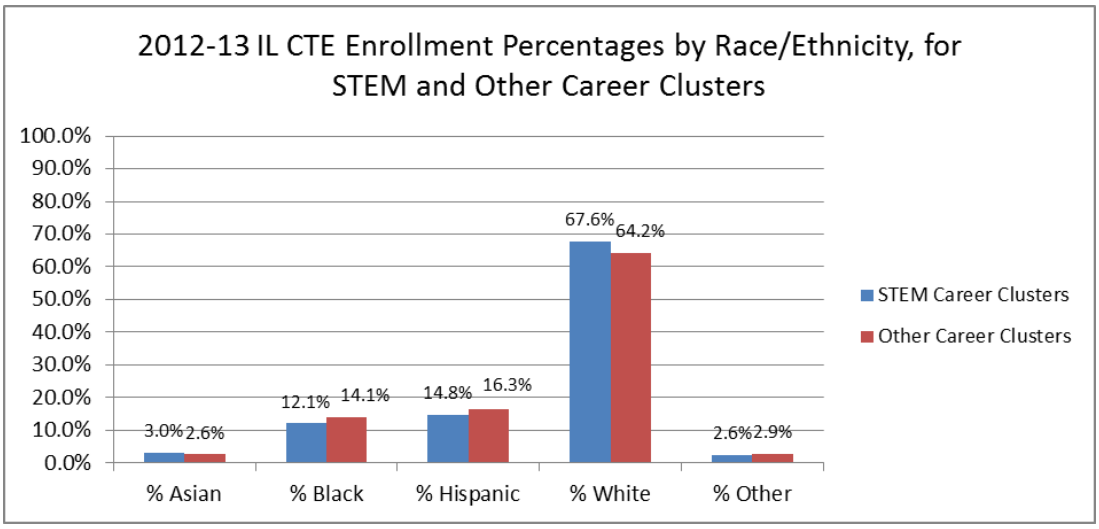
Race/ethnicity and career cluster. Conspicuous racial/ethnic participation differences in Illinois CTE enrollments were found in several career cluster areas (Table 4). For instance, Asian students' participation in the Science, Technology, Engineering, and Math career cluster, representing 9.7% of enrollments while comprising 4.3% of the overall population, was striking. Black students' participation in all but one career cluster area (Hospitality and Tourism; 22.7%) was lower than what would have been expected based upon their 18.0% makeup of the total Illinois public high school population. Likewise, Hispanic students, who comprise 21.5% of the Illinois public high school population, were underrepresented in all areas except Transportation, Distribution, and Logistics (23.6%). White students were overrepresented in every career cluster area. Because nationwide CTE data disaggregated by race/ethnicity were not reported, we were unable to compare the state of Illinois to national CTE enrollments on this factor.

Table 4. Illinois High School CTE Enrollments by Career Cluster and Race/Ethnicity, 2012-13

Career Cluster	Asian (%)	Black (%)	Hispanic (%)	White (%)	Other (%)
State Enrollment Data, FY 2013	*4.3*	*18.0*	*21.5*	*53.4*	*2.9*
Finance	3.4	15.7	15.5	62.7	2.7
Health Science	3.5	16.6	17.7	59.5	2.8
Human Services	2.0	11.2	15.1	68.8	3.0
Arts, A/V Technology and Communications	2.4	15.2	18.7	60.9	2.7
Agriculture, Food and Natural Resources	0.4	4.0	3.8	90.2	1.6
Business, Management and Administration	3.6	14.6	13.6	65.3	2.9
Architecture and Construction	2.0	9.3	14.7	71.4	2.6
Transportation, Distribution and Logistics	2.1	11.6	23.6	60.2	2.4
Manufacturing	1.6	9.4	13.5	72.9	2.5
Information Technology	4.7	10.1	14.8	67.7	2.9
Science, Technology, Engineering and Mathematics	9.7	7.2	14.2	65.9	3.1
Hospitality and Tourism	1.7	22.7	18.9	53.9	2.8
Marketing	3.3	14.3	15.8	63.7	2.9
Education and Training	5.4	7.8	17.6	65.8	3.4
Law, Public Safety, Corrections and Security	0.8	8.4	19.2	68.8	2.8

Interesting patterns also were evident when data were analyzed in terms of participation rates in Illinois CTE courses by race/ethnicity for Illinois-defined STEM clusters and other career clusters (Figure 1). White (67.6% STEM, 64.2% other) and Asian (3.0% STEM, 2.6% other) students' proportional participation rates were greater in STEM than other career clusters, whereas the reverse pattern was found for Black (12.1% STEM, 14.1% other), Hispanic (14.8% STEM, 16.3% other), and "other" racial/ethnic groups (2.6% STEM, 2.9% other).

Figure 1. Illinois CTE Enrollments by Race/Ethnicity, for STEM and Other Career Clusters, 2012-13



Race/ethnicity and career pathway. We also analyzed participation in Illinois CTE courses by race/ethnicity and career pathway, limiting our focus to career pathways within Illinois-defined STEM clusters. We found racial/ethnic participation patterns by STEM pathways to be quite variable. For instance, within Information Technology, Black student participation ranged from 7.8% in the Network Systems Pathway to 16.0% in the Programming and Software Development Pathway. Hispanic students' participation in Information Technology showed a reverse pattern: Hispanic students comprised 13.8% of the enrollments in Network Systems and 17.2% of the enrollment in Programming and Software Development. The pattern of findings underscores the importance of viewing the data at this level of detail, in addition to the career cluster and individual course levels.

Table 5. Illinois High School CTE Enrollments by STEM Career Pathway and Race/Ethnicity, 2012-13

Career Cluster	Pathway Title	Asian (%)	Black (%)	Hispanic (%)	White (%)	Other (%)
Agriculture, Food and Natural Resources	Plant Systems	0.5	5.5	4.7	87.6	1.7
	Power Structure and Technical Systems	0.3	3.2	3.2	91.8	1.5
	Natural Resources Systems	0.3	2.5	3.0	92.7	1.6
Architecture and Construction	Construction	1.2	10.8	14.3	70.8	2.8
	Design/Pre-Construction	3.1	7.4	14.4	72.7	2.4
	Maintenance/Operations	1.5	11.3	32.8	53.0	1.5

Finance	Financial and Investment Planning	3.4	15.7	15.5	62.7	2.7
Health Science	Support Services	2.6	15.3	16.7	62.6	2.8
	Therapeutic Services	6.8	20.4	21.6	48.6	2.6
	Diagnostic Services	2.0	5.0	12.4	78.0	2.6
	Biotechnology	4.1	48.9	10.2	35.0	1.8
	Health Informatics	8.7	26.1	17.4	47.8	0.0
Information Technology	Network Systems	3.6	7.8	13.8	72.0	2.8
	Programming and Software Development	7.6	16.0	17.2	56.2	3.0
Manufacturing	Production	0.7	6.1	11.0	79.5	2.7
	Maintenance, Installation and Repair	3.3	16.1	19.3	59.3	2.0
	Manufacturing Production Process Development	4.2	14.8	15.0	62.6	3.4
Science, Technology, Engineering, and Mathematics	Engineering and Technology	9.7	7.2	14.2	65.9	3.1
Transportation, Distribution and Logistics	Facility and Mobile Equipment Maintenance	2.2	11.8	23.3	60.3	2.5
	Transportation Operations	2.0	10.6	25.5	59.8	2.2

Discussion and Implications

We analyzed the distribution of Illinois high school CTE enrollments by career pathway and career cluster, paying special attention to STEM programming due to its current policy emphasis in the U.S. and nationally. There were pronounced gender and ethnicity-based inequities in certain pathways and clusters. Enrollments in courses fitting within Illinois-defined STEM pathways included substantially greater male than female participation (64.1% male, 35.9% female), whereas non-STEM pathways showed the reverse (45.0% male, 55.0% female). With respect to race/ethnicity, all subgroups except White students were underrepresented in CTE programming in general. Moreover, when we limited our focus to STEM CTE programming, underrepresentation was exacerbated for all but Asian students. Comparing Illinois CTE enrollments to nationwide enrollment statistics, there were greater gender disparities in Illinois in nearly all career cluster areas, which is particularly troubling and reinforces the urgency of Illinois policymakers' RttT focus on STEM programming within the state's high schools. The findings from our study provide support for cultural reproduction theory, as these inequalities by gender and race/ethnicity appear to be persistent in the state of Illinois and highly resistant to change.

Our findings also are consistent with national data indicating underrepresentation of females in STEM CTE coursework (NCWGE, 2012; NWLC, 2007; Toglia, 2013). Under-enrollments appear to be commonplace in the state of Illinois, despite Perkins IV goals to

achieve more equitable outcomes in CTE coursework. These results are concerning, because students' identification of career pathways and course selections during their high school years can serve to restrict their future career and earning prospects. Female students, for example, are more likely to enroll in career cluster areas that have lower mean salaries (U.S. Department of Labor, n.d.), which likely perpetuates ongoing issues regarding wage inequities for females in the U.S. workforce. In this discussion section, we address our findings as they relate to gender and race/ethnicity equity within CTE programming.

Gender

Illinois CTE enrollment data reflected a large discrepancy in male and female participation within many career cluster areas that have been defined as STEM-related within the state of Illinois. These disparities are particularly pronounced for females in the career cluster areas of Transportation, Distribution and Logistics (7.3% female enrollments); Architecture and Construction (11.0% female); Science, Technology, Engineering and Mathematics (15.4% female); and Manufacturing (17.1% female). Greater male enrollments in STEM clusters and greater female participation in non-STEM clusters within Illinois are consistent with the disproportionality in national workforce trends citing the lack of female employment in STEM fields (Committee on Science, Engineering, and Public Policy, 2007).

Both males and females were underrepresented in Illinois CTE enrollments in numerous cluster areas. Males were substantially underrepresented in two cluster areas; females were substantially underrepresented in four cluster areas that are identified within the state of Illinois as STEM fields. With respect to gender parity, applying our working definition of 40-60% female participation range, Illinois approached parity only in one of the eight Illinois-defined STEM cluster areas (Finance). Illinois enrollments demonstrated greater gender-based disproportionality in all STEM career cluster areas except Health Sciences. While we conducted relatively limited analysis career pathways, we did find that pathways within STEM clusters had varied participation patterns by gender, but these generally mirrored occupational data (U.S. Department of Labor, n.d.).

It was especially concerning, when comparing enrollments by gender, to note that Illinois fell below national CTE enrollment patterns in nearly every cluster area. Some differences were particularly striking. For example, in Illinois only 7.3% of students enrolled in Transportation, Distribution and Logistics were female, compared to 13.5% nationally; in Science, Technology, Engineering and Mathematics, 15.4% of enrolled students were female compared to 30.8% nationally. Only 8.4% of those enrolled in Education and Training are male, compared to 30.6% nationally (U.S. Department of Education, n.d.). These data underscore the urgency of the state's goal within the Race to the Top initiative to increase female students' participation in STEM CTE coursework. These data also reflect the potential existence of gender bias within Illinois CTE programming—again reinforced by cultural reproduction theory—which subsequently may contribute to the overall national workforce data that shows limited female representation in scientific and technological fields (Committee on Science, Engineering and Public Policy, 2007).

Equally important are the reduced enrollments by gender in cluster areas that may be considered as nontraditional fields for both male and female high school students.

Race/Ethnicity

Racial/ethnic participation differences in Illinois CTE enrollments were found in several career clusters and career pathways. Disparities existed in the overall population representation versus the enrollment representation for Asians, Black, and Hispanic students in particular. White students were overrepresented in every career cluster area. Participation rates in Illinois CTE courses by race/ethnicity for STEM and other career clusters showed greater STEM participation by White and Asian students, but the reverse pattern emerged for African-American, Hispanic and other racial/ethnic groups.

These findings run counter to claims that Black students are overrepresented in CTE coursework (Hess, 2010)—at least, within in the state of Illinois. Black students were underrepresented in every career cluster area, except for Hospitality and Tourism. Under-enrollments for Black students were particularly noticeable in Agriculture, Food and Natural Resources; Science, Technology, Engineering and Mathematics; Law, Public Safety, Corrections and Security; Education and Training; and Architecture and Construction. Hispanic students also were under-enrolled in every cluster area, with the exception of Transportation, Distribution and Logistics. These STEM enrollment patterns are consistent with research indicating that Blacks and Hispanics are less likely to be employed in STEM fields, (Fletcher, 2012).

Asian students were highly overrepresented in CTE coursework in the Science, Technology and Engineering career cluster and also slightly overrepresented in the Illinois CTE fields. This finding aligns with research (Laird et al. 2009) indicating that Asian students are more likely to earn STEM credits in high school.

Our study did not include an analysis of CTE course offerings based upon high school demographic settings (urban, rural, and suburban), as that was beyond the scope of our research. Yet, it was not unexpected that Asian, Black, and Hispanic students were underrepresented in Agriculture, Food and Natural Resources. In the state of Illinois agriculture education courses typically are offered in rural school districts and are infrequently provided in urban and suburban high schools. Clearly, students can only gain access to CTE coursework if it is made available to them, either within their local school or at a regional career center. Thus, it is possible that racial/ethnic participation within some career cluster areas may speak more to their school demographics than to students' interests in selected career fields. For example, nearly one fourth of students enrolled in Transportation, Distribution and Logistics CTE courses were Hispanic; additional research is needed to determine whether courses in this cluster area are more frequently offered in schools and communities with large Hispanic populations.

Our study also did not investigate whether schools were offering CTE programs of study based upon labor market analyses within their regions and/or whether students may be selecting

CTE coursework based upon perceived labor needs within their local communities; this is an important area for future research. Differences were noted by race/ethnicity and gender in students' enrollments for cluster areas and career pathways. Additional research is needed to determine whether Illinois school districts are offering CTE coursework and encouraging students to enroll in career areas that are not in high demand or that are offering high wages within the regions.

We also did not examine whether CTE courses—and in particular, STEM CTE courses—were more prevalent in Illinois school districts with higher per-pupil student expenditures. As noted earlier, Illinois has significant funding disparities across school districts (Baker et al., 2014; Malin & Noppe, 2015). Limits on school district financial resources can hamper educators' efforts to expand CTE programming for their students, particularly for those students of color who attend schools in communities with fewer resources.

Limitations

Although this study reveals important and useful information concerning participation rates in high school CTE programs, it does have some limitations. The student enrollment counts for this study were reported for the 2012- 2013 school year, which was the most recent data that we could obtain from the state. The dataset contained information provided by Illinois public school district personnel and is subject to reporting errors that may have occurred when compiling and transmitting this information. In addition, as was noted previously, the study did not review CTE enrollment patterns based upon school district demographics and funding levels.

Recommendations for Policy and Practice

Based upon our research, we provide recommendations to policymakers and school practitioners to strengthen equity efforts within CTE programs. The federal government has outlined expectations through the No Child Left Behind Act for reducing education gaps, and the Illinois Race to the Top initiative includes a goal to increase underrepresented students' participation in CTE STEM coursework. State policymakers and school district educators are jointly accountable for ensuring that CTE programming is equitable and accessible to all students regardless of gender and race/ethnicity. By critically reviewing equity-conscious practices in relationship to gender and race/ethnicity, policymakers and educational leaders and may help produce better outcomes for all CTE participants. We offer the following suggestions as initial steps toward creating better educational outcomes for all students within CTE programs.

Recommendations for Policymakers

One suggestion as policymakers strive to monitor and improve equity is to ensure that statewide data reporting systems include comprehensive information regarding the profiles of students enrolled in CTE coursework. Information such as socio-economic status, assessment data, race/ethnicity, and gender can assist in better understanding issues of access. Further, collecting data on the postsecondary decisions of CTE students can provide information on how to address and improve equity efforts within high schools. For example, it would be helpful to

discern whether students transition into higher education, obtain postsecondary training, or immediately obtain employment in CTE fields, and whether they are adequately prepared for these transitions. It is also essential that statewide data systems are accessible to educators, researchers, and policymakers. If this information is unavailable for policy analysis and/or it is not in user-friendly formats, dialogue and change are unlikely.

Policymakers have a responsibility to ensure that school district officials are accountable in ensuring access and equitable outcomes for all CTE students with respect to race/ethnicity and gender. Offering financial incentives for increasing underrepresented student enrollments in STEM CTE programming, as well as selecting schools as exemplars or models, demonstrates to educators that ensuring equity is a priority. Providing incentives and public recognition can encourage school and district officials to concentrate their efforts on the array of CTE programs that can be offered in their schools, to fully address students' career interests. In addition, featuring CTE students who have obtained desired employment and/or successfully transitioned to postsecondary experiences can provide tangible examples of student success.

State legislators could enact legislation requiring all school districts to develop Individualized Learning Plan (ILP) processes, with each student creating an ILP aligned to her/his career interests. ILPs are plans generated by students, in consultation with teachers, counselors, and parents, which align high school coursework with their intended career goals. ILPs help guide students in their academic planning and assist them in their college and career readiness by providing an understanding of relevant coursework to career and college plans, as well as their short- and long-term goals (Fox, 2014). ILPs also should incorporate students' post-graduation planning, indicating how high school coursework connects with high education courses, military, and/or workforce employment. Currently, over 20 states mandate ILPs for all high school students (Solberg, Phelps, Haakenson, Durham, & Timmons, 2012); within the state of Illinois, school districts that are voluntarily participating in the Race to the Top initiative must implement an ILP process that commences in the seventh grade. However, only 32 of Illinois' 850+ public school districts are involved in RttT. Thus, only a small portion of the state's students are engaged with ILPs. Through the ILP process and associated school supports, students can discern which coursework, including CTE courses, align with their career interests and ensure that they are adequately prepared for postsecondary success.

Policymakers also can encourage school districts to develop robust CTE programs of study that permit students to attain industry-recognized credentials or certificates. Such credentials certify to potential employers that the applicant has attained the necessary skills to meet entry-level standards of employment (Castellano, Stone & Stringfield, 2005). Students also can obtain additional credentials as they enroll in postsecondary educational opportunities. Credentials can facilitate advancement of students within a particular pathway and provide for more versatility in the skills they acquire.

Recommendations for Practitioners

School leaders can influence race/ethnicity and gender patterns within CTE programs by performing equity audits, examining access and availability of opportunities within CTE programs, and encouraging all educators to actively adopt and advance an equity agenda. By employing the following recommendations, practitioners can begin to systemically address processes that have reinforced inequitable practices in their schools, rather than a means of simple adherence to state, local, or federal policies.

Through data examination, practitioners can begin to uncover patterns that exist within their CTE programs, possibly revealing gender and/or race/ethnicity inequities. School leaders and teachers also can learn about cultural reproduction theory (Bourdieu & Wacquant, 1992), to assist in understanding how they may be maintaining school cultures that tend to reinforce the status quo. Additionally, through the use of equity audits (Skrla, McKenzie, & Scheurich, 2009), educators can analyze CTE assignments to gain insight on how students choose to enroll in and participate in CTE courses. They then can lead their faculties in discourse centered on the enrollment patterns and begin to identify factors that may contribute to any inequities found. The most critical aspect of engaging in equity audits is responding to the data and insights in a way that contributes to changing or reforming practices. In other words, it is not enough to merely identify the issues contributing to inequities within CTE programming: Educators also must take actionable steps toward remedying any identified problems. Possible areas for exploration may include district practices related to students' exposure to career exploration materials and activities, efforts to encourage students to consider fields that may be nontraditional for them, examination of curriculum materials for potential race or gender bias, and the continuing refinement of teaching and learning practices.

Data examination also may expose inequities within CTE programs. Not only is it critical to understand who is participating in CTE programming but it also is important to understand any circumstances surrounding the lack of participation by gender and race/ethnicity. Sharing and promoting positive aspects of CTE programs to all students may promote interest from a wider, more diverse audience. School officials also may wish to examine potential barriers that may restrict students' access to program participation. For example, some students may be unable to obtain transportation to business/industry sites or may not be able to afford professional attire for work-based learning opportunities that are available in their career fields.

School leaders also can work with their faculty to implement Individualized Learning Plan processes for their students, irrespective of whether they are mandated by state policy. School leaders will need to provide professional development, ensuring that school counselors and teachers are trained in supporting students' ILP activities and can assist students with career exploration and the development of course plans that extend through high school and into postsecondary settings. School officials also can review course selections contained in their students' projected programs of study, as a mechanism to identify changing career interests of the student body and plan for future course needs.

Lastly, we encourage educational leaders to adopt and advance an equity agenda within their schools and districts. The adoption of such an agenda requires school leaders to critically inspect practices and policies to ensure that they encompass all students fairly and justly. Focusing on equity requires educators to continually examine their beliefs and perceptions about students and/or student groups. Education leaders have the capacity to create the vision toward reaching the equity goal and set goals to achieve this vision.

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