Gender Equity in CTE and STEM Education in Illinois Public Schools

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The struggle for gender equity in the U.S. workplace is significant and ongoing (Gioiosa, 2014). In many occupational fields, women receive lower wages than men who hold similar positions and have comparable levels of education and experience (Toglia, 2013). Also, gender equity may be examined relative to the composition of the workforce in certain occupations, career pathways, or career clusters. Some career fields have tended to be male-dominated (e.g., engineering), whereas others (e.g., child care and nursing) have tended to be dominated by females (Lufkin et al., 2007). The underrepresentation of women in Science, Technology, Engineering, and Mathematics (STEM) fields is particularly concerning. Males generally are more likely than females to pursue many STEM careers, particularly those requiring the highest levels of education and commanding the highest wages (Committee on Equal Opportunities in Science and Engineering [CEOSE], 2013; Toglia, 2013). Although females are disproportionately affected by gender inequities, males also can experience negative effects: Both women and men who enter nontraditional fields may be confronted with stereotypes that restrict their access to, and full participation in, their chosen professions (Lufkin et al., 2007).

Preceding most adults' entry into the workforce is a long period of educational preparation via PK-12 and, often, postsecondary systems, which may function to maintain or erode gender inequities. In other words, if the PK-12 education system is successfully preparing more female students for fields that have previously been male-dominated, one can confidently expect gender inequities in career profiles to decrease over time. If, instead, students' academic preparation tends to mirror the existing occupation/gender distribution, appreciable changes are unlikely.

Career and Technical Education (CTE) offerings are of particular interest within the P-12 education system because of their specialized instruction and clear linkages to postsecondary and career options. Are CTE programs of study, for instance, sensitive and responsive to the current and anticipated demands of the U.S. labor market? Do they tend to prepare students for living wage careers? Of equal importance, do student enrollments by gender tend to mirror or disturb the current occupation/gender distribution in STEM fields? These questions are of extra importance in light of the increased focus upon CTE as a positive, or potentially positive, force for disrupting gender inequity patterns by policymakers and laypersons (U.S. Department of Education, 2014). In this report, we focus on the third question, making use of CTE student enrollment and course/program offering data from Illinois from the 2012-13 school year.

Gender Equity in Career and Technical Education: Review of Literature

Title IX of the Education Amendments of 1972 is most widely known for its impact upon athletics, but this legislation also applies to gender equity within CTE (Gioiosa, 2014; Toglia, 2013). Title IX states, "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance."

Although Title IX protections are applicable to both genders, women and girls historically have been confronted with greater barriers to participation. Troublingly, more than 40 years after the enactment of this law, women continue be underrepresented in nontraditional CTE fields and STEM programs (Gioiosa, 2014; National Coalition for Women and Girls in Education [NCWGE], 2012; National Women's Law Center, 2005).

A nontraditional occupation is defined by the U.S. Department of Labor (2009) as one in which women account for 25% or less of those employed. The U.S. Department of Education (2014) has expanded this definition within CTE programming, describing 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). The NCWGE (2012) studied U.S. PK-20 enrollments by females during the 2009-10 school year for selected career cluster areas. As noted in Table 1, females were significantly under-enrolled at both the secondary and postsecondary levels in the career cluster areas of Architecture and Construction; Manufacturing; Science, Technology, Engineering and Mathematics; and Transportation, Distribution and Logistics. Females' STEM postsecondary preparation and workforce participation, according to the Committee on Equal Opportunities in Science and Engineering (CEOSE, 2013), has improved in certain fields. For example, in 1974 only 30% of bachelor's degrees in the combined fields of science and engineering were attained by women, whereas that proportion now stands slightly above 50%. In addition, women represented 45% of total employment in science and engineering fields in 2010 (CEOSE, 2013). However, the CEOSE also noted that females in 2010 were underrepresented in bachelor's degree programs in computer science (18%), physics (19%), and engineering (19%).

Table 1. Female Secondary and Postsecondary Enrollments in Selected Career Clusters, 2009-10

Career Cluster	Female Enrollment, Secondary (percent)	Female Enrollment, Postsecondary (percent)	Male Enrollment, Secondary (percent)	Male Enrollment, Postsecondary (percent)
Architecture and Construction	15	10	85	90
Manufacturing	17	11	83	89
Science, Technology, Engineering and Mathematics	21	24	79	76
Transportation, Distribution and Logistics	8	7	92	93

Source: National Coalition for Women and Girls in Education. (2012).

The majority of published reports examining gender equity in the workforce primarily focus on the negative effects for women. Although progress has been made in thepast three decades in reducing wage disparities (Blau & Kuhn, 2007), women earn only 81% of the median wages of male full-time U.S. workers (U.S. Bureau of Labor Statistics, 2013). Furthermore, female-dominated occupations pay a median hourly wage of $13.80, compared to a median hourly wage of $18.04 in traditionally male fields (Lufkin et al., 2007). These disparities may be unintentionally promoted in our PK-12 school systems, as Lufkin et al. (2007) found that only a small portion of females were enrolled in nontraditional CTE fields in U.S. high schools. Noting that no states reported having more than 25% of females enrolled in nontraditional coursework, Lufkin et al. concluded, "girls are preparing for traditionally female occupations at a disproportionately high rate" (p. 428). Yet, Lufkin et al. noted negative effects of workforce imbalances apply to both genders, explaining that "discrimination and barriers are limiting young men's and women's opportunities to pursue careers that are nontraditional to their gender" (p. 428). They cited eight possible reasons for gender inequities within CTE: (a) a lack of exposure to nontraditional occupational fields and role models; (b) students' attitudes; (c) gender-biased career guidance materials and

practices; (d) lack of encouragement to enroll in math, science, and technology coursework; (e) use of stereotyped curriculum materials and instructional strategies; (f) school and classroom climates that isolate students who enroll in nontraditional CTE coursework; (g) lack of self-efficacy; and (h) the existence of limited individualized student support services.

The purpose of this brief is to highlight current CTE course enrollment data as it relates to gender in Illinois public high schools with comparisons to similar data of the United States. We provide observations of gender disparities that exist with an emphasis on gender disparities in STEM-specific career clusters.

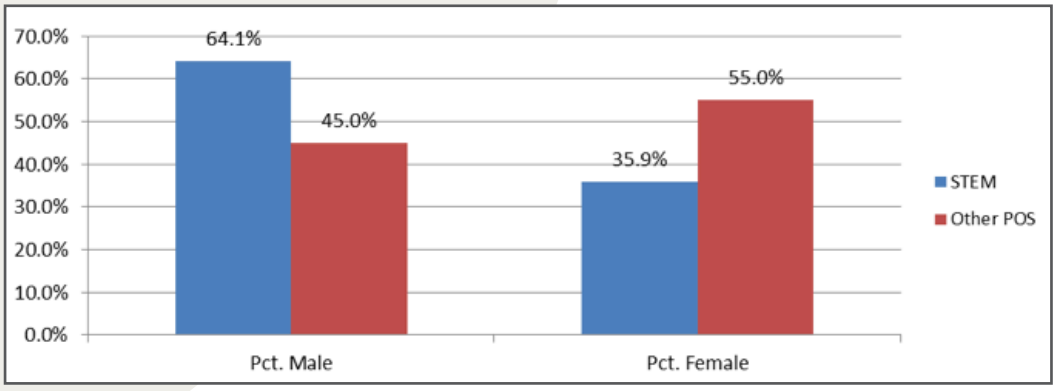
Methods and Data Sources

We obtained a dataset from the Illinois State Board of Education containing duplicated high school student enrollments in Career and Technical Education (CTE) courses for the 2012-13 school year for every public high school and career center in the state of Illinois. Data were aggregated to the career cluster and the career pathways levels. Fifteen of the 16 Illinois Career Cluster areas were represented (Nicholson-Tosh & Bragg, 2013), as were 40 career pathways.[1] Eight of these 15 career clusters and 20 of 40 career pathways are considered to represent STEM cluster areas, as defined by the state of Illinois Race to the Top application (State of Illinois, 2011).[2] In analyzing data for this study, we reviewed the gender distributions of enrollments in the career clusters and selected STEM career pathways. This report focuses only on the career clusters. We also accessed national high school CTE enrollments from the 2011-12 school year (U.S. Department of Education, n.d.), the most recent dataset available, making comparisons between the state of Illinois and national CTE enrollment patterns. Descriptive analyses were conducted and selected results are presented in the following section.

Results

Significant gender-based inequities were found in certain career cluster areas, with more equitable patterns in others. Of concern, and as displayed in Figure 1, student enrollment in courses fitting within STEM career clusters included substantially greater male than female participation (64.1% male, 35.9% female), whereas non-STEM clusters showed the reverse enrollment pattern (55.0% female, 45.0% male). In total, 364,388 enrollments (233,664 male and 94,837 female) were recorded in STEM clusters, and 210,976 enrollments (94,837 male and 116,139 female) were recorded in other career clusters.

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



1 In the state of Illinois, high school CTE courses are not offered in the Government and Public Administration career cluster area.

2 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). (NOTE: The Illinois Race to the Top application renamed the Science, Technology, Engineering and Mathematics career cluster area as Research and Development.)

Table 2 shows the full set of enrollments by career cluster and gender in Illinois. This brief, however, only addresses STEM clusters. Applying the U.S. Department of Education (2014) definition (less than 25% participation of individuals from one gender) within the clusters areas defined within the state of Illinois as STEM fields, females are underrepresented in four areas: Architecture and Construction; Transportation, Distribution, and Logistics; Manufacturing; and Science, Technology, Engineering, and Mathematics.

If gender parity is the goal, then equal proportions of males and females should be enrolled in CTE coursework within each career cluster area. Examining 2012-13 high school CTE enrollment patterns across the United States, several cluster areas are approaching gender parity (Table 2). Acknowledging that exact parity—while ideal—is not pragmatic, we used a 20% range (40-60%), noting that gender parity has 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 show greater gender-based disproportionality in all STEM career cluster areas except Health Science. Using the 40-60% participation range, Illinois approaches gender parity only in Finance.[3]

Table 2. Illinois High School CTE Enrollments by Career Cluster and Gender, 2012-13

Career Cluster	IL CTE Rank	Total Enrollments	Percent of Total Enrollments	Number of Male Enrollments	Number of Female Enrollments	Percent Male	Percent 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 Logistics	8	30,847	5.4	28,608	22,39	92.7	7.3
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

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

3 Additional analyses and results, including by career pathway, are available at http://pathways.illinois.edu/wp-content/uploads/2014/10/CTE_powerpoint_FINAL.pdf

Table 3. Illinois and United States High School CTE Enrollment Percentages, By Career Cluster and Gender

Career Cluster	Illinois Female (Percent)	United States Female (Percent)	Illinois Male (Percent)	United States Male (Percent)
Finance	43.7	48.7	56.3	51.3
Health Science	60.7	66.2	39.3	33.8
Human Services	77.1	71.7	22.9	28.3
Arts, A/V Technology and Communications	34.9	41.5	65.1	58.5
Agriculture, Food and Natural Resources	36.6	41.6	63.4	58.4
Business, Management and Administration	43.2	47.6	56.8	52.4
Architecture and Construction	11.0	18.5	89.0	81.5
Transportation, Distribution and Logistics	7.3	13.5	92.7	86.5
Manufacturing	17.1	18.7	82.9	81.3
Information Technology	30.9	38.9	69.1	61.1
Science, Technology, Engineering and Mathematics	15.4	30.8	84.6	69.2
Hospitality and Tourism	60.7	53.8	39.3	46.2
Marketing	64.7	50.2	35.3	49.8
Education and Training	91.6	69.4	8.4	30.6
Law, Public Safety, Corrections and Security	30.1	42.0	69.9	58.0

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

Recommendations for Policy and Practice in Illinois

Explanations as to why gender inequities exist in high school CTE programs extend beyond the scope of what occurs in schools and often emphasize the role of gender stereotypes and historical beliefs that exist within our culture (Lufkin et al., 2007). These stereotypes can become institutionalized and perpetuated in our public schools if they are not consciously addressed by educators. Yet, school leaders and state and local policymakers have the capacity to influence these CTE STEM inequities by examining and changing equity-hindering practices and policies that may be in place. Building on the findings from this study, the following recommendations to assess and address gender and other inequities within high school CTE programs are presented.

Recommendations for Policy

Recommendation 1: Improve statewide data collection systems. Policymakers in Illinois can ensure that there are uniformly established participation and performance definitions for CTE programs and also should improve statewide data collection systems (U.S. Department of Education, 2012). Expanding school district reporting mechanisms would allow for more comprehensive and transparent statewide review of course enrollments and student performance within CTE courses, allowing for analysis of disproportionality of students in both traditional and nontraditional CTE programs. Although this study focused only on gender, we recommend that data should be disaggregated at the student level by gender, race/ethnicity, disability, socio-economic status, English learner status, and measures of educational performance (e.g., GPA, assessment data), as well as at the district level by various demographic factors (e.g., urban/suburban/rural, per-pupil expenditures) to gain a more comprehensive picture of which students have access to CTE coursework and how they are faring in CTE programs (NCWGE, 2012), with the goal of attaining gender parity.

Recommendation 2: Promote enhanced school district accountability, while also providing incentives to eliminate gender disparities. Both the state and individual school districts share the responsibility to promote and ensure equity in access and participation in CTE STEM programming. Creating financial incentives to promote the development of STEM exploratory programs and experiences, including work-based learning and mentoring programs, may encourage school district officials to develop such programs. Identification of high performing districts that exhibit success in increasing students' access to nontraditional CTE programs, along with positive features of these districts' practices, can be used to encourage other districts to emulate their models.

Recommendation 3: Provide a consistent definition of nontraditional occupations that embraces both genders. Currently, the U.S. Department of Labor (2009) definition of a nontraditional occupation only addresses the participation of females (comprising 25% or less of those employed), while the U.S. Department of Education (2014) description includes both genders. A consistent definition should be developed that embraces both genders, based upon historical workforce patterns within the selected occupational fields. This approach would demonstrate state and federal policymakers' commitments to promoting equal access of both females and males to all career fields.

Recommendations for School Practices

Recommendation 1: Improve school district data collection systems. School and district officials should conduct institution-wide examinations of CTE enrollment trends to identify gender disparities and understand if and how gender equity is promoted (Gioiosa, 2014). Reviewing CTE student enrollment data can be helpful in surfacing persistent gender gaps within individual CTE courses, career pathways, and career cluster areas, particularly in STEM fields. If significant disparities are identified, school leaders should consider developing targeted strategies and programs to recruit and encourage underrepresented students to enroll in STEM CTE coursework.

Recommendation 2: Examine curriculum and promotional materials and provide professional development to address classroom- and school-level inequities. Often, teachers may be unaware that curriculum materials and school documents present gender-biased perspectives that can discourage students from considering careers in fields that have been nontraditional for their gender. School officials should generate awareness among both the teaching force and student body of the array of nontraditional career opportunities in STEM fields for both males and females. One way to accomplish this goal is through the careful selection of educational materials that contain positive images and examples showing both genders engaged in nontraditional occupations. In addition, district materials should contain messages that promote and encourage students' exploration and enrollment in nontraditional CTE programs of study (Gioiosa, 2014; Lufkin et al., 2007). Districts also should provide quality professional development to ensure that school personnel play an active role in promoting and encouraging unbiased course and career selections (Lufkin et al., 2007). Furthermore, teachers should be expected to reflect on their instructional practices, to note the presence of gender bias ensure and work to eliminate it from their classrooms. Equity audits are one way to assess patterns of biases at the classroom or school level and can be used as a starting point to address identified inequities (McKenzie & Skrla, 2011; Skrla, McKenzie, & Scheurich, 2009). Teachers also should ensure that teaching and learning activities promote students' exploration of nontraditional fields.

Recommendation 3: Implement exploratory programs and mentor programs. To increase students' interest and knowledge of STEM careers, school district officials should develop strategies to encourage females to engage in career exploration of STEM opportunities, including such activities as summer camps, bridge programs, and job shadowing opportunities. In addition, school counselors and teacher advisory programs can assist students with career exploration and encourage enrollments in STEM fields. When possible, districts should engage in partnerships with businesses/industries and community colleges to develop these programs. Schools also can provide students with access to nontraditional role models (Gioiosa, 2014) through guest speakers and mentor programs.

References

Blau, F. D., & Kuhn, L. M. (2007). The gender pay gap: Have women come as far as they can? *Academy of Management Perspectives, 21*(1), 7-23.

Committee on Equal Opportunities in Science and Engineering. (2013). *Broadening participation in America's STEM workforce: 2011-2012 biennial report to Congress.* Arlington, VA: National Science Foundation. Retrieved from http://www.nsf.gov/od/iia/activities/ceose/reports/Full_2011-2012_CEOSE_Report_to_Congress_Final_03-04-2014.pdf

Gioiosa, C. (2014). *Gender equity in CTE and STEM education.* Champaign, IL: Office of Community College Research and Leadership. Retrieved from http://occrl.illinois.edu/wp-content/uploads/gender-brief.pdf

Lufkin, M. E., Wiberg, M. M., Jenkins, C. R., Lee Berardi, S. L., Beyer, T., Eardley, E., & Huss, J. (2007). Gender equity in career and technical education. In S. S. Klein (Ed.), H*andbook for achieving gender equity through education* (2nd ed., pp. 421-443). Mahwah, NJ: Lawrence Erlbaum Associates.

Title IX of the Education Amendments of 1972 (discrimination based on sex or blindness), 20 U.S.C.A. §§ 1681-1688 (West Supp. 2006).

McKenzie, K. B, & Skrla, L. (2011). *Using equity audits in the classroom to reach and teach all students.* Thousand Oaks, CA: Corwin Press.

National Coalition for Women and Girls in Education. (2012). *Title IX at 40: Working to ensure gender equity in education.* Washington, DC: Author. Retrieved from http://www.ncwge.org/PDF/TitleIXat40.pdf

National Women's Law Center. (2005). *Tools of the trade: Using the law to address sex segregation in high school career and technical education.* Washington, DC: Author.

Nicholson-Tosh, K., & Bragg, D. (2013). *Illinois career clusters, pathways, and programs of study guide.* Champaign, IL: Office of Community College Research and Leadership, University of Illinois at Urbana-Champaign. Retrieved from http://occrl.illinois.edu/files/Projects/ptr/2013-Career-Cluster-Guide-Final.pdf

Skrla, L., McKenzie, K. B., & Scheurich, J. J. (Eds.). (2009). *Using equity audits to create equitable and excellent schools.* Thousand Oaks, CA: Corwin Press.

State of Illinois. (2011, December 16). *Race to the Top application for phase 3 funding CFDA number: 84.395A.* Retrieved from http://www.isbe.net/racetothetop/PDF/phase3_app.pdf

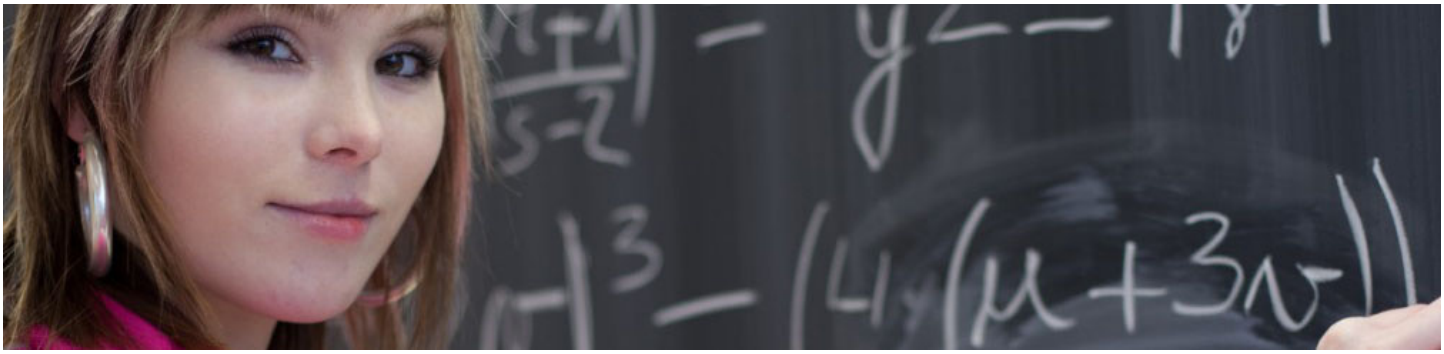
Toglia, T. (2013). Gender equity issues in CTE and STEM education. *Tech Directions, 72*(7), 14-17.

U.S. Bureau of Labor Statistics. (2013). *Highlights of women's earnings in 2012. BLS Reports, Report 1045.* Washington, DC: Author. Retrieved from http://www.bls.gov/cps/cpswom2012.pdf

U.S. Department of Education, Office of Career, Technical, and Adult Education. (n.d.). *Consolidated annual reports.* Retrieved from http://cte.ed.gov/accountability/reports.cfm

U.S. Department of Education, Office of Planning, Evaluation and Policy Development, Policy and Program Studies Service. (2014). *National assessment of career and technical education: Final report to Congress.* Washington, DC: Author. Retrieved from http://www2.ed.gov/rschstat/eval/sectech/nacte/career-technical-education/final-report.pdf

U.S. Department of Labor. (2008). *Quick facts on nontraditional occupations for women. Women's Bureau Report.* Retrieved from http://www.dol.gov/wb/factsheets/nontra2008.htm



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