Strategies for Increasing Female Participation in Technology-Based CTE Courses

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Abstract

This paper details the history of female participation in science, technology, engineering, and mathematics (STEM) related career and technical education (CTE) courses, and reviews relevant peer-reviewed literature on the subject of increasing female participation at the secondary level. Despite females enrolling in STEM-focused college programs and securing STEM-based employment in ever-increasing numbers over the previous two decades, female enrollment in secondary CTE programs remains high primarily in cosmetology, nursing, dental assisting, and early childhood education programs. This research considers why this trend continues, whether females in middle school are interested in pursuing STEM-based careers, and what strategies might be implemented in guidance, recruiting, and instructional practices to reverse the trend.

Introduction

The issue of diversity within the evolving demographics of modern education spans concerns over student achievement to needs for special services to the goal establishing equitable balances for course enrollment and career preparation. Race equity, gender equity, and opportunities for exceptional learners as well as students with special needs are just a few of the facets in the matter of diversity. This article focuses on the problem of female enrollment in career and technical education (CTE) programs centered around science, technology, engineering, and mathematics (STEM).

In particular, the low female enrollment in technology-based CTE courses continues to be a trend at the secondary level. In fact, females "continue to be a disadvantaged group compared to their male peers" (Aldridge & Goldman, 2007, p. 40) in developing various interests and areas of giftedness that have been identified in primary and elementary school. Although societal influences, such as preconceptions about gender roles within the CTE community, have an influence on program demographics, current trends appear to stand at odds with areas of interest and aptitude that are observed in the middle school female population. In other words, females within this generation of digital natives are not only more comfortable with emerging technologies that drive institutions of industry, commerce, medicine, education, and even recreation than those from previous generations, but they are in fact seeking opportunities for technology-based training prior to commencing college studies and securing entry-level jobs within their chosen careers (Garcea, et al, 2012).

If a greater percentage of females are interested in technology-based CTE courses, an increasing percentage of females are enrolling in college and university level STEM-based programs, and the percentage of female workers within the information technology field is growing, it may well be worth investigating reasons why secondary CTE programs have not seen a similar increase in female enrollment for technology-based CTE programs (Lester, 2010). CTE recruitment

strategies, high school guidance counselor training and expectations, and instructional methods currently used in CTE programs in general are three areas worthy of reflection and review.

Word of mouth can be one of the most effective recruitment strategies resulting in program growth, whether it be for a given strand of instruction or increasing interest in an athletics program. This "buzz" can be the result of exceptional program effectiveness, awards or public acknowledgement of a program's achievement, or simply participants who enjoy a program leader's methods or program content spreading the word to their peers with similar interests. This strategy may just not be enough, however, if one factors in the influence of gender-based preconceptions. Thus, CTE centers may need to engage in a strategy of targeted program recruitment.

While CTE programs of the past, which were referred to in the previous generation as "vocational centers," were typically populated by students who were not pursuing advanced diplomas or formal college training, this is no longer the norm. In fact, the effectiveness of the hands-on nature of CTE training and problem based learning (PBL) strategies which have been implemented into many CTE programs now generally map to entry-level industry training certifications and the opportunity to bypass or secure dual enrollment credits for first-year college courses (Tillman & Tillman, 2008). Guidance counselors concerned that "they may suffer in their professional evaluations if they fail to meet quotas for advanced diplomas and college enrollment" (Malik, 2005, p.82) might find an unexpected ally within emerging models of CTE implementation. Perhaps, once this hurdle is overcome, guidance departments will be more willing to yield in their pattern of almost exclusively placing females in traditional programs of career preparation such as cosmetology, nursing, early childhood development, and dental assisting.

Although hands-on, PBL environments abound within CTE learning communities; instructors are often hired from within the ranks of the professions and industries upon which the programs of study focus. As a result, these instructors are just beginners when it comes to the craft of teaching, developing units of instruction, and facilitating learning in such a way as to avoid reflecting traditional gender bias from within that particular profession or industry. Although their experience working within their professional and industrial fields is important, educator training for those making the transition from industry to the classroom ought to focus on the idea that "teachers now need to teach higher-order thinking skills and use a learner-centered constructivist approach which necessitates changing the mindset of teachers and adding skills such as instructional technology and sustainable development" (Manley & Zinser, 2012, p.490). It is worth considering that sustainability is more likely to be achieved through an acknowledgement of the trends within college STEM programs and STEM-centric careers. Over the last three decades in the United States, these trends have shown an increase in female interest and participation (Baruch, 2014).

Literature Review
Before identifying strategies for increasing female participation in technology-based CTE courses, it is important to confirm that a need exists. This need can be confirmed through first assessing that females have an interest and aptitude for enrolling in the courses, and then consulting enrollment statistics to evaluate whether an impropriety exists. Emine Demiray

performed a study of 1100 individuals (550 males and 550 females between the ages of 16 and 64) in which the participants completed a 25-question survey about their use and perceptions of information technology. Residents of Turkey, the questionnaire's participants all had cell phones. Many also owned multimedia devices, digital cameras, and desktop and laptop computers. No significant difference was found between male and female ownership of technology products, according to the study. However, "women's computer use tended to be for communication (MSN, e-mail, chat), work purposes, research, surfing on the Net, and typing, while men used computers mostly for surfing on the Internet, communication (MSN, e-mail, chat), work purposes, playing computer games, and research" (Demiray, 2010, p.14).

The author of the study concludes there is "no difference" between male and female possession of technology, but survey results show that 70% of the females own a personal computer compared to 80% of the males. Likewise, 34% of female respondents owned a laptop, which was 13% less than the males. Discrepancies in ownership such as this would seem to indicate that there is a difference in technology possession and use between male and female populations.

Knowing what trends exist in female ownership and use of consumer information technology (IT) products can be a valid predictor of female interest in IT in general (Sexton, et al, 1999). This interest and aptitude with IT is the same indicator that is used by guidance counselors and others involved in the process of selecting programs of study for CTE placement. It is therefore important to know what kinds of technologies are owned and utilized by females, as well as their perceptions of this usage, in order to determine strategies for steering females into technology-based CTE programs of study.

Based upon data collected through interviews with adult women gamers in the UK, and female teenage participants in digital media workshops organized by the BBC, Thornham and McFarlane researched what it means to claim to be technologically competent in relation to gender (2011). More intimate in its research design than Demiray's survey format, the researchers spent up to five days accumulating anecdotal evidence on each subject while observing and interviewing the gamers and workshop participants. The study concluded that women quickly move beyond the stereotype of the traditional feminine "position of incompetence cover story for not engaging technology" (Thornham & McFarlane, 2011, p.81) when they are embedded in a technology-rich environment such as that which one would expect to find in a hands-on, technology-based CTE program.

While the article includes descriptions of the participants' daily living habits and technology use, it also incorporates quotes from interviews to support its position. A rich picture of how technology is used in the daily professional and recreational lives of the female participants is presented when one reads anecdotal feedback from Chloe, an interview respondent, who holds a professional position as a computer programmer and enjoys gaming, and yet steers clear of *Grand Theft Auto* because "'it's a boy thing' and therefore not for her" (Thornham & McFarlane, 2011, p.71). Such feedback is typical throughout the results presented in the study, indicating a wild mix between females in terms of affinity for technology as well as willingness to engage technology that has content which might speak to traditional issues of gender bias.

While stereotypes suggest that certain technology is for men, this research indicates that when a female's work (or play) involve technology use, women are just as likely as men to learn the most effective ways to apply given technologies within the appropriate settings. Most female participants also indicated a desire to problem-solve and troubleshoot technology by applying resources such as online forums, message boards, and embedded technical support rather than merely 'consulting the nearest male to find a solution.' Therefore, the results of this study are revealing in terms of what can happen *on the other side* of securing increased female IT usage and engaging females in the nuts and bolts of a hands-on, technology-based CTE program.

As with any program of instruction beyond the core curriculum, school divisions and colleges are constantly working to improve student persistence, which is the measure of how likely a program participant is to complete the required courses and earn the relevant credentials. In evaluating statistics from the National Center for Educational Statistics (NCES), it has been determined that students with CTE backgrounds completed credential programs almost 7% more often that those without (Hirschy, et al, 2011). Given that more females participate in college-level CTE programs leading to industry certification than males, and considering the value of a CTE background in terms of persistence, there does appear to be incentive for stakeholders to prioritize female participation in technology-based high school CTE programs.

CTE administrators have sought data on gender equity within certain occupations and occupational training opportunities for at least the last fifty years (Thornham & McFarlane, 2011). For decades, students have progressed through a system that seems to define the male/female role stereotype, despite adoption of Title IX of the Education Amendments of 1972, which intended to address this very kind of discrimination. In CTE training programs for such careers as cosmetology and nursing, female enrollment has remained steadily high perhaps because these are fields that are predominantly staffed by women. With all of this data available to confirm the value of female enrollment in technology-based CTE programs, could it be that school counselors are reluctant to place females in such programs? The dissertation titled *School Counselors' Perceptions about Female Participation in Non-traditional Secondary Career and Technical Education Programs* (Malik, 2005) attempts to answer that question. This research focused on the following questions (Malik, 2005):

1. What are the high school counselors' perceptions toward female participation in nontraditional secondary CTE programs?
2. What are some of the underlying beliefs that affect school counselors' perceptions toward female participation in nontraditional secondary CTE programs?
3. Does difference in gender, age, level of education, years of experience in   education, years of experience in counseling and school size affect school counselors' perception of female participation in nontraditional CTE programs? (pp. 8-9)

280 Counselors across the state of Michigan responded to a 25-item quantitative survey, including questions related to demographics, counselors' beliefs about counseling female students into CTE programs, and counselors' beliefs about female participation in non-traditional CTE programs. Survey feedback regarding female participation in non-traditional programs was positive, although 66.4% of the counselors who responded were female themselves. As an example, 63.1% of counselors in the study strongly disagreed with the statement "some [CTE] programs, like electronics technology, automotive, or manufacturing technology should

primarily enroll males" (Malik, 2005). Counselors strongly agreed that career training opportunities should not be gender specific, and also that females should be allowed to enroll in any CTE programs in which they are interested and likely to complete (based upon course pre-requisites). Additional responses revealed conflicts in counselors' perceptions of job availability for females in IT and STEM-related careers, whether counselors ought to invest special efforts in directing females to non-traditional CTE courses, and whether funds ought to be available to specifically promote female participation in such courses.

Current Issues
When technology functions as designed, it can allow for a more efficient workplace, improve resources for recreation and education, and provide dynamic opportunities for employment. When technology fails to function as designed, the very troubleshooting and problem solving skills required to "get the boxes functioning" can still provide dynamic employment potential. Historically, men designed technologies in order to improve their lives and the lives of those around them at home, on campus, and in the workplace. Women benefited from the explosion of the technology age, but were kept from interacting with technologies beyond the front door of the home by social conventions of the time (McLeod & Allard, 2013).

Generations have passed, and there is a degree to which this is still occurring, regardless of whether the women of today have an aptitude or interest in getting their hands dirty with the design, testing, production, maintenance, and utilization of emerging technologies in the workplace and in other practical applications. Despite this, females have taken to the "faceless" avenues of technology implementation at a higher rate than their male counterparts. For instance, during the first decade of the new millennium not only did females take online courses 7% more often than males, they also completed online programs of study 11% more often than males (Tempelaar, 2012). Many online learning opportunities are looking for basic qualifications to be met for acceptance. A formal interview and application process is not required. Thus, females need not concern themselves with whether a stereotype will be applied to their acceptance or denial into a program of study. Additionally, these universities can use the enrollment and persistence numbers for gender and ethnicity to bolster their general enrollment data, thereby complying with Title IX of the Education Amendments without making substantial changes to existing admissions policies.

Be that as it may, the new millennium has begun to yield a balance at the university level for female participation in STEM and IT-focused degree programs (Tseng, 2013). The market place has been slow to catch on to this trend, particularly in management roles and for salaries in positions of comparable responsibility, but things are improving in these areas as well. A recent study indicated that while the percentage of female enrollees in dual enrollment and advanced STEM courses is roughly equivalent to the male-to-female population ratios in the United States in general, the top 20 technology corporations listed in *Forbes* for 2001-2010 employed women in management positions at a rate less than 20% that of the general population ratio (Watson, et al, 2011).

> "Women's opportunities of using recent information technologies are limited compared to men. Besides, if women use these technologies, they use them in order to do jobs that are considered suitable for their feminine roles, such as entering data and typing text. In

short, computers are presented as advanced typewriters for women; in this way, the uses of a new technology are restrained" (Demiray, 2010, p.1)."

IT courses in the 1980s and early 90s were very general in their content and were generally taken as "exploratory" courses by most of the students at the middle and early high school level. Keyboarding, data processing, and basic computer design were topics implemented into such courses. However, as these general courses evolved into more specific topics such as computer maintenance, networking, computer assisted design, advertising design and graphics, audio and video production and editing, and network security the schools turned more and more to the professionals from the IT field to assist in curriculum development and in many cases instruction itself. The more specialized the course, the more likely it was to wind up in a magnet school or CTE center, and staffed by retired IT professionals or career switchers who were making a transition after the dotcom bubble burst in the late 90s (Association for Career and Technical Education Website, 2014).

The concern that soon emerged from this trend was that employees from within organizations that had been primarily staffed by males for a generation would bring their perceptions, language, and stereotypes from the corporate workplace into the classroom environment. This being the case, even when females were placed in a technology-based CTE course, the instructors would teach the course in such a way as to superimpose upon instruction the same kind of habits of mind that were prevalent in their prior place of employment. While a boy sitting in a networking course might not be personally offended when the instructor describes the network interface cable as being the "male end" of a connection and the network interface port as being the "female end," the adolescent mind might struggle to compartmentalize this imagery in ways that would make it hard for a female adolescent to appropriately process. This impact is likely to be amplified in an environment where the class of 18 students has just one or two females participating.

Social Perceptions
In a culture which has seen radical change in the definition of marriage, health care rights, executive authority from within what was intended to be a three-branch government that honored the checks and balances of the others, changes in the perception of a sub-group's place in a given field of employment is not uncommon. Society makes links between the essence of womanhood and trends in the work force, motherhood, and consumer participation, and these links can serve to either limit women to the positions they have traditionally held in the home and workplace, or they can serve to *release* women beyond the bounds of conservative norms from the past (Negra, 2009).

Beyond society in general, the guidance system is bound to certain pre-conceptions about the proper courses for female and male program enrollment. In the CTE realm, male students are disproportionately enrolled in carpentry, masonry, and automotive courses and females are disproportionately enrolled in cosmetology, nursing, early childhood development, and dental assisting programs. There is potential for technology-based courses such as radio and television broadcasting, advertising design, computer assisted design, computer systems, and networking courses to stand in that gender gap, especially considering the interests exist in IT college

programs and the IT workplace at more of a balance than what can be observed in secondary CTE programs.

Studies have indicated there is an interest on the part of females to participate in technology-based CTE programs at the secondary level, but that there is frustration at the hurdles that stand in their way. "As cultural, social, political and economic changes take place, the secondary or high school curriculum should reflect and respond to changing needs and aspirations of students" (Mativo, Womble, & Jones, 2013, p.103). It is incumbent upon stakeholders in the field to be responsive to these changing needs and aspirations and move beyond stereotypes that serve no purpose in advancing America's standing in the global marketplace of products and ideas.

While the implementation of the STEM umbrella has allowed Title IX watchers to suggest that female participation in technology and the sciences has grown, female participation in very specific technology majors has been on the decrease for software development and systems engineering programs during the past decade (Harris, et al, 2009). Part of this may have to do with inadequate high school and community college preparation, but there is also research to suggest that women have steered clear of certain segments of the IT field due to their own perceptions of the work environment or the job descriptions themselves. "These perceptions include the feeling that technology and computing are 'nerdy,' and a career in the IT field would mean sitting in front of computers all day with little social interaction" (Harris, et al, 2009, p.23). Therefore it would seem that not only are decisions being made about female participation in technology-based training, IT college majors, and IT jobs as a result of outside influences in terms of societal perceptions, but internal influences as well in terms of how women view some training and work environments.

Best Practices
Social interaction in the workplace may be an element of the job environment sought by female IT professionals that distinguishes them from their male counterparts, but in order to make instruction as sound and effective as possible there needs to be some readjustment in the way the secondary system of education treats the recruitment, enrollment, and instruction of females in technology-based CTE courses (Saini, 2012).

To begin, in order to recruit females into IT courses there ought to be an effort on the part of current female participants who are enjoying success in these courses to communicate that to their peers. When recruitment activities are scheduled by CTE centers at local middle and high schools, both male and female students, instructors, and administrators might need to be present in order to grab the attention of female students who have expressed interest in the courses and to speak to them about whatever fear and reluctance they might have in pursuing IT-related programs of study. Some school systems have gone so far as to bring in female representatives from industry in order to specifically address the need for increasing female participation in the early stages of training (Obaidat & Alqatamin, 2011). Buy in from the guidance departments might be simpler to coordinate if there is an effort being made to put "boots on the ground" in terms of recruitment that can relate to qualified female candidates.

Often instructors in CTE centers are contracted beyond the standard ten-month contract of the core classroom teacher due to the hands-on nature of the instruction and the requirement to order

and maintain a large inventory of very expensive equipment and emerging technologies. Training industry professionals who are making a transition to the classroom how to individualize instruction in order to meet the needs of students, while at the same time considering methods for delivering key content to large groups of students, can be a challenge. When you throw into the mix this need to present a learning environment absent of enmity towards any given sub-group, those extended contracts provide an opportunity to deploy training in the most effective strategies for delivering instruction to a diverse population of learners.

In PBL environments, it is important to answers questions about how active participation looks for a male or female, exceptional learner or student with disabilities, student with a substantial background in utilizing technology or student who is taking courses in order to learn as much as possible about an area of interest that might include technologies they don't have the resources to afford at home (Mager, 1997). Some school divisions have gone so far as to implement female-only courses that focus on IT. Designed specifically to fit the most effective methods of instruction for a given sub-group, such teaching environments have proven to improve credentialing exam scores, increase class participation, and bolster post-course student evaluations (Parkay, Haas, & Anctil, 2010).

Strategies for Practical Application
According to Maslow's hierarchy of needs, direction, intensity, and persistence are indicators of a properly motivated individual. Increasing female participation in technology-based CTE programs is a goal that is worthy of pursuit as far as industry is concerned only if the process produces motivated employees that are trained and capable of functioning in such a way as to improve performance (Bowen & Sadri, 2011).

If the key to being welcomed through the door of the IT workplace is motivation, and one of the indicators of motivation is "direction," the females who have expressed an interest in receiving training for careers in IT and have chosen this as their area of interest should be afforded at least the opportunity to enroll in the courses. Such motivating factors are part of training that in experienced by guidance counselors, and so there would be buy-in right there if the female candidates can communicate the desire to be placed in such a program of study. Again, this may require a targeted recruitment effort that involves class participants, instructors, and administrators capable of speaking to the merits of enrolling in CTE programs, and involving female stakeholders in this process can provide representation with whom female candidates are more likely to relate.

Relevant, rigorous programs of study are the hallmark of well-respected CTE programs, and such programs also go a long ways towards training students about the nature of IT careers, which can involve intense troubleshooting and maintenance requirements. There are physical requirements and skills that must be mastered, such as installing and testing cable and devices, yet over the course of a given IT project the work can become monotonous and repetitive. Modeling the intensity of the IT work environment goes a long way towards training any CTE program participant to be ready for the rigors of their chosen career (Dick, Carey, & Carey, 2001).

The final element of motivation, persistence, is also inherent in the design of many CTE programs of study. Industry certifications require a broad range of skills and knowledge in order to pass written and practical credentialing exams. The preparation for such exams often involves redundant skills training and practice, and ultimately students who are provided the opportunity to work in leading small teams and being assessed in that leadership role can add another level of rigor to the program. Online learning environments can infuse even more opportunity to develop a persistent attitude towards the work by allowing students to take work home with them. Electronic texts, discussion forums, technical support message boards, and the option to submit written work electronically can help to make the student feel as though the content of the course is becoming embedded in their day-to-day lives. While it is true that, just like in-person learning environments, "there are members of [online learning] groups who do not participate or are totally absent" (Capdeferro & Romero, 2012), there is an ability in the online learning environment for the instructors and participants both to be able to track student persistence and contributions to collaborative learning activities beyond what is typical for in-person learning experiences. Online learning and virtual learning environments also mesh well with technology-based programs of study.

Conclusion
The issue of diversity in modern education spans concerns over student achievement to needs for special services to the goal establishing equitable balances for course enrollment and career preparation. Females "continue to be a disadvantaged group compared to their male peers" (Aldridge & Goldman, 2007, p. 40) in developing various interests and areas of giftedness that have been identified in primary and elementary school, leading to low female enrollment in technology-based CTE courses at the secondary level. Societal influences, such as preconceptions about gender roles within the CTE community, have an influence on program demographics, but current trends appear to stand at odds with areas of interest and aptitude that are observed in the middle school female population. Female digital natives are not only more comfortable with emerging technologies that drive institutions of industry, commerce, medicine, education, and even recreation than those from previous generations, but they are seeking opportunities for technology-based training prior to commencing college studies and securing entry-level jobs within their chosen careers (Garcea, et al, 2012).

Some strategies for increasing female enrollment in technology-based CTE programs involve recruitment, placement, and teacher training. Targeting recruitment in order to increase female participation can be as simple as involving female stakeholders, such as current and past students, instructors, and administrators. Past students who are employed in the IT field can not only serve as a model for women interested in enrolling in STEM courses, but can also serve as a resource for answering candidate's questions and allaying fears.

Once student interest is identified, guidance departments need to be willing to work with CTE centers to place students who have met minimum course qualifications and have expressed an interest in the relevant career fields, be it construction, cosmetology, computer networking, or HVAC installation. A student with aptitude and interest represents the first pages of a potential success story that can benefit both the student and the reputation of the CTE center. Finally, once the student has cleared the hurdles of recruitment leading to valid candidacy and a guidance system willing to enroll the students for the program of study, instructors need to be prepared to

deliver instruction to a diverse population through application of varied, robust, dynamic instruction that allows for hands-on and problem-based learning and collaboration on content in an environment that seeks to prepare technology-based CTE students for the realities of the IT workplace.

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