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Tennessee Colleges of Applied Technology: Student Demographics and Completion Rates

A dissertation

presented to

the faculty of the Department of Education Leadership and Policy Analysis

East Tennessee State University

In partial fulfillment

of the requirements for the degree

Doctor of Education in Educational Leadership

by

Timothy N. Wilson

May 2017

Dr. Donald Good, Chair

Dr. Virginia Foley

Dr. Susan Graybeal

Dr. James Lampley

Keywords: Skilled labor, Technical skills, Labor shortage, Postsecondary training

ABSTRACT

Tennessee Colleges of Applied Technology: Student Demographics and Completion Rates

by

Timothy N. Wilson

The purpose of this quantitative study was to examine relationships between gender and race, disability status, single parent status, and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. Furthermore, this study determined if there were significant relationships between race and disability status, single parent status, and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. Finally, differences in completion rates between female and male students as well as differences in completion rates between white and nonwhite students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

Archival data from Fall 2014 were collected from the Office of Research and Assessment at the Tennessee Board of Regents for each student at the point of enrollment. Chi-square tests of independence were used to determine if significant relationships existed between demographic variables and completion rates.

Significant relationships were found between gender and race where there more white females and males than nonwhite females and males. Significant relationships between gender and disability status were discovered where there were more students of both genders who were not disabled than

were disabled. Significant relationships between race and single parent status were found in that more nonwhite students were single parents than white students. Significant relationships between race and economically disadvantaged status indicated more nonwhite students were economically disadvantaged than white students. Significant differences between gender and program completion rate were realized in that more males completed their programs of study than females. Finally, significant differences were discovered between race and program completion rate revealing more white students completed their programs of study than nonwhite students. However, there were no significant differences found between race and disability, between gender and economically disadvantaged status, and gender and single parent status.

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DEDICATION

“Whosoever findeth a wife findeth a good thing and obtaineth the favor of the LORD.”
(Proverbs 18:22, KJV)

“A virtuous woman is a crown to her husband:”
(Proverbs 12:14a, KJV)

“My most brilliant achievement was my ability to be able to persuade my wife to marry me.”
--Winston Churchill

I dedicate my following work to the bride of my youth, Paige L. Wilson. The realization of this work began in 2007 when Paige encouraged me to complete my bachelor’s degree while working a full-time swing-shift schedule and raising three small children. Paige has always spoken my love language of *words of encouragement* and for that I am grateful.

Following my graduation from Bryan College in Dayton, Tennessee, she encouraged me to continue my work in education, which eventually resulted in my master’s and post-graduate degrees from Tennessee Technological University in Cookeville, Tennessee. Now, at the end of *this unnecessary task* I have imposed on myself, Paige still stands by me with encouraging words; albeit she is ready for this to conclude, as am I. It is with honor, love, and respect I dedicate this dissertation to my love, Paige L. Wilson.

Tibi magno cum amor

ACKNOWLEDGEMENTS

The Holy Scripture admonishes followers of Jesus Christ to “*Trust in the LORD with all your heart and do not lean on our own understanding. In all your ways acknowledge Him, and He will make your paths straight.*” (Proverbs 3:5-6 NSAB). Therefore, with my opportunity to make acknowledgements, I first wish to acknowledge my LORD for affording me the ability and opportunity to begin and complete this task. With this degree or without the final result is the same for me: I will die. However, because of HIS grace and mercy my eternal rest is secure in HIM and in HIM alone because of Christ’s work on the cross and his resurrection so that I may live. It is with thanksgiving and love I acknowledge HIM.

Second, I wish to acknowledge Dr. Don Good who faithfully mentored, guided, and taught me throughout this journey. His ability, patience, and unique sense of humor have been a pleasure and for his service to me I am deeply grateful.

Third, I acknowledge Dr. Virginia Foley and Dr. Susan Graybeal for serving on my dissertation committee. Each of their unique abilities and ways has been useful and needful to complete this task. It is with gratitude I thank each of them. Dr. James Lampley deserves special recognition as late in this journey a member of my dissertation committee decided to retire. I do not begrudge his retirement; however, after being asked Dr. Lampley did not hesitate stepping in to serve on my dissertation committee for which I am grateful.

Fourth, I acknowledge Jon and Mary Wilson, my parents. It is because of their relentless love and support I am what I am today. Any house that is to be built must have a firm foundation or else the house will fall. My parents (affectionately called Dad and Mom) provided that firm foundation in the home so I could accomplish what needed to be accomplished.

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CHAPTER 1

INTRODUCTION

Testifying before the Senate Commerce Committee in Washington, DC, Mike Rowe, creator, producer, and star of the hit cable television series *Dirty Jobs*, petitioned for a national public relations campaign to reconnect the entire United States to the skilled labor force. In his testimony Rowe charged that the overall attitude of parents and high school graduates toward the skilled labor force was a less than ideal plan for those who could not make it in a 2-year or 4-year college (Rowe, 2011). The elevation of college-readiness over learning a skill had created an unintended problem in the United States' economic sustainability: a major skilled labor shortage (Flessner, 2015).

Because of the marginalization of skilled labor in high schools, manufacturing and industrial plants could not produce products at the pace required due to the unavailability of a strong skilled labor force. Rowe (2011) testified that advisement by high school counseling teams promoted careers that did not look like real work. Work was what our economy depends and rests; thus, the perceptions of skilled labor must change drastically and immediately (Anderson, 2015).

Since 2008 I have taught adult learners in a postsecondary technical college and a 2-year community college. Some of my students transferred to technical college from other 2-year and 4-year colleges for various reasons. These adult learners wanted to receive adequate training that would almost guarantee employment in their field of study upon graduation. From June 2012 to about June 2015 the industrial electricity and electronics program enjoyed a 100% placement rating in the field of the students' program of study (Tennessee College of Applied Technology at Athens, 2015). The classes I taught consisted of students who predominately were white males;

however, not exclusively. There were occasions women and nonwhites attended these classes and passed successfully. I was not aware what each student's socioeconomic status was unless he or she revealed it to me personally. Some students were single parents of various ages ranging from recent high school graduates to older more established adults. Few had disabilities but none that prevented them from obtaining training and concluding with full-time employment in their field of study. No matter the demographic characteristics of the students there remained a serious problem: there were more skilled career positions open than I had available students—a seemingly ideal problem for the learner yet, disquieting fact for industries seeking qualified and skilled candidates (Green, 2015).

According to the United States Department of Labor regarding trained electricians, the 10-year (2010-2020) growth projection indicated a 20% rate of increase or 114,700 jobs available. Welders were projected to experience a 6% growth rate or 20,800 career positions available by 2020. Automotive technicians would likely have a 9% growth rate or 60,400 positions available by 2020, and machinists-tool and die technicians would likely experience a 7% growth or 33,700 positions available by 2020 (United States Department of Labor, 2014). Two observed variables contributed to the growth rate of skilled labor careers: 1) the retirement of the “baby-boomers” due to age (Stone, Kaminski, & Gloeckner, 2009), and 2) the misconception of skilled labor as a viable career choice (Pimpa & Suwannapirom, 2008).

As of 2013 the Department of Labor quantified the skilled labor market shortage in the United States as 450,000 (United States Department of Labor, 2015). For the United States to enjoy healthy economic gains the skilled labor market population must be equipped to invent, make, improve, and repair the equipment industries relied on to maintain sustainability. This

research may provide a means to a plan to more adequately educate high school seniors and graduates as well as underemployed adults regarding skilled labor as a worthwhile career path.

In February 2012 vice-president Joe Biden, his wife Dr. Jill Biden, and Secretary of Labor Hilda Solis announced a half-billion dollar initiative by the White House administration which funded community colleges and industries in order to train workers in skills required in the growing economy (The White House, 2012). The funding announcement by the White House was indicative of the dire need of industries to procure workers with the skills needed to sustain business efficiently and effectively.

To demonstrate the importance of a highly trained and skilled workforce, Rowe (2011) encouraged his audience to reflect on their day or week and reminisce on how skilled labor affected the quality of their lives: automotive mechanics, both residential and commercial electricians, automotive collision repair, heating, ventilation, and air conditioning (HVAC) technicians, plumbers, construction technicians, sewer and waste-water treatment technicians, potable water treatment technicians, semi-truck drivers, and television cable and satellite technicians. Other skills could have been included on the list; hence, it has been essential to address the need for skilled workers and how we could encourage our high school graduates to earnestly consider obtaining postsecondary training in one of the many technical skill sets demanded by industries (Widespread efforts promote manufacturing as viable choice, n.d.).

Rosenbaum (2001) asserted that the college-for-all concept, which was publicly promoted since the Clinton administration (1993-2001), had yielded unintended results: Those who attended college were not as employable as first believed in skill sets for which the marketplace was willing to pay. Those who chose not to attend college after high school were underemployed due to lack of marketable technical skills. An initiative to encourage not only traditional college possibilities

but also postsecondary technical training options in proficiencies the market was demanding was the best way to serve the stakeholder.

To support the admission of high school seniors into postsecondary training, which was necessary for career-ready positions, Tennessee Governor Bill Haslam introduced the *Tennessee Promise* program in 2014. The *Tennessee Promise* program paid last-dollar scholarships for Tennessee high school seniors who attended 2-year or technical colleges within the State (Tennessee Promise, 2016). The program's inaugural class began in August of 2015. The last-dollar scholarship helped the bedrock higher education initiative of the Tennessee Governor's *Drive to 55*; an initiative to get 55% of the Tennessee population with some variety of postsecondary credential whether certificate or diploma by 2025 (Drive to 55, 2015).

Statement of the Problem

There was a time in modern U.S. history (post World War II era) where the high school diploma was the gateway to the middle class income bracket. Jobs at that time required a strong work ethic, a strong back, and a willingness to learn industry-specific job skills in the growing economy after World War II. Job skills that were required in the 1950s and 1960s now require training beyond secondary graduation (Gulli, 2013).

The United States experienced a massive gap in technical skills (Harvard Business School, 2011). Job requirements necessitated some postsecondary training specific to industry need. While high school counselors promoted college education, communication regarding technical skills in high demand in the marketplace and what it took to become skilled were not emphasized (Diesing, 2012).

The Career College Association conducted a survey about what was perceived as effective practices when preparing for the workplace (Moser, 2008). When questioned what the respondents felt was the best approach for preparing for the workplace, 62% indicated that technical preparation was a more ideal way of entering the middle class income bracket. Additionally, the survey detailed that formal higher education attainment was not necessarily the only mode of achieving a higher standard of living. Therefore, the positive perception of technical education needed to continue and expand for the economic health of the United States and its citizenry. Moser (2008) predicted that if the United States continued down the path of the college-for-all approach it could suffer the results of manufacturing industries relocating to regions (domestic or foreign) that possess the human capital to staff skilled positions needed for manufacturing sustainability.

Purpose of the Study

The purpose of this quantitative study was to examine relationships between gender and race, disability status, single parent status, and economically disadvantaged status of students who enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

Furthermore, this study determined if there were relationships between race and disability status, single parent status, and, economically disadvantaged status of students who enrolled in Tennessee Colleges of applied Technology advanced manufacturing skills programs. Finally, differences in completion rates between female and male students as well as differences in completion rates between white and nonwhite students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs were examined.

Research Questions

This study was guided by research questions that were designed to identify relationships between gender and demographic variables as well as race and demographic variables with regard to students who enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

This study's research questions are as follows:

RQ1: Is there a significant relationship between gender and race of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

RQ2: Is there a significant relationship between gender and disability status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

RQ3: Is there a significant relationship between gender and single parent status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

RQ4: Is there a significant relationship between gender and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

RQ5: Is there a significant relationship between race and disability status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

RQ6: Is there a significant relationship between race and single parent status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

RQ7: Is there a significant relationship between race and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

RQ8: Is there a significant difference in completion rates between female and male students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

RQ9: Is there a significant difference in completion rates between white and nonwhite students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

Significance of the Study

The findings of this study may affect industries, high school counselors, admissions recruitment teams, parents, and students. For a specific industry the recruitment of a diminishing skilled labor force may focus on the type of person who enrolls in postsecondary technical education such as Tennessee Colleges of Applied Technology. With a clearer understanding of the various demographics and completion rates of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs for specific training for the workforce this study may contribute to target recruitment practices that may yield favorable results.

High school admissions counselors may benefit from this study by better determining how to recruit each student into the right field of study for the workforce. Further, counselors may develop a better understanding of what the market demands are, what the market is willing to pay

for a specific skill, and methodologies of how students should obtain necessary training in a timely manner.

Both students and parents may benefit from this study by the realization and appreciation of the demands in the marketplace. Further, parents and their children may gain a better understanding of the objectives of postsecondary education and its ability to provide training necessary for the workforce.

Definitions of Terms

For the purpose of this study the following terms have been defined to provide clarity and ease of understanding:

Advanced Manufacturing Skills Programs: Electrical related programs offered in Tennessee Colleges of Applied Technology including the programs listed as Industrial Electricity, Electronics Technology, Electromechanical Technology, Electrical and Electronics Equipment Repair, Industrial Electricity and Electronics, Electrical and Power Transmission Installation, Industrial Electronics, Electrical and Plumbing Construction, Residential and Commercial Wiring and Plumbing, and Electrical Maintenance.

Apprenticeship: A combination of on-the-job training and related instruction in which workers learn the practical and theoretical aspects of a highly skilled occupation (Department of Labor, 2016).

Associate Degree: A two-year degree from a community college, university, college, or career school that includes approximately 60 credit hours of general education courses, electives, and required courses of major (Business Dictionary, 2016).

Baby-boom Generation: A generation representing a group of people born between 1946 and 1964 (Byles et al., 2014).

Career Technical Education (CTE): Education that provides secondary students with the academic and technical skills, knowledge, and training necessary to succeed in future careers and to become lifelong learners (Career Tech, 2016).

Disability: A physical or mental impairment that substantially limits one or more of the major life activities of such individual; a record of such an impairment; or being regarded as having such an impairment (United States Department of Justice Civil Rights Division, 2016).

Economically Disadvantaged: One who is determined to be low income according to the latest available data from the United States Department of Commerce.

Postsecondary Education: Education at a level beyond high school. It may include vocational, academic, or adult continuing education. (National Center for Educational Statistics, 2016).

Race: Race is used with reference for white and nonwhite people.

Internship: A form of experiential learning that integrates knowledge and theory learned in the classroom with practical application and skills development in a professional setting (NACE, 2016).

Single Parent: Refers to the student's status of being a single parent by virtue of being legally separated or unmarried who as a minor child or children for whom the parent has either custody or joint custody, or who is pregnant.

Delimitations, Limitations, and Assumptions

The delimitations of this study include data gathered by the Tennessee Board of Regents (TBR) in cooperation with the administration and offices of student services of each of the 27 Tennessee Colleges of Applied Technologies (TCAT). Among the available data I have chosen to examine gender and its relationship with race, disability status, single parent status, and economically disadvantaged status of students who enrolled in Tennessee Colleges of Applied Technology as well as race and its relationship with disability status, single parent status, and economically disadvantaged status of students who enrolled in Tennessee Colleges of Applied Technology. Additionally, I have chosen to examine differences in completion rates between females and males as well as differences in completion rates between white and nonwhite students enrolled in advanced manufacturing skills programs in Tennessee Colleges of Applied Technology.

Potential limitations of this study include the assumption that the data collected were true and accurate and that no human errors have been made in the compilation of data into the Banner software database of the TBR Office of Research and Assessment. It is assumed that students who enrolled in a TCAT provided the data collected by the administration or student services personnel of each TCAT; the data were derived came from the enrollment application (whether handwritten or electronically) of each student. Human error could have arisen from the applicant, the transcriber, or the Research and Assessment Office of the TBR. Relatively little more could have been done in gathering data to further ensure the accuracy of the demographic data collected on each applicant as well as accurate recording of completion rates of advanced manufacturing skills programs in Tennessee Colleges of Applied Technology.

An assumption made was that the data collected from each applicant of the 27 Tennessee Colleges of Applied Technologies were accurate and truthful and that the data collected were accurately transcribed into a database that subsequently was collected by the Office of Research and

Assessment of the TBR. Furthermore, there was an assumption that the data collected from the TBR were representative of the 27 Tennessee Colleges of Applied Technologies.

Overview of the Study

Chapter 1 provides an explanation of the groundwork of this study by way of an introduction to the topic and scope of the study including the purpose and specific research questions. Furthermore, Chapter 1 describes the significance of the study and provides definitions of terms as well as the limitations of the study. Chapter 2 provides a review of the literature on topics including shortage realities of a skilled workforce and perceptions of manufacturing jobs and skilled labor. Chapter 3 is a description of the methodology used to conduct the study and ascertain the directions and strength of relationship of gender and race, gender and disability status, gender and single parent status, and gender and economically disadvantaged status. Chapter 4 presents the findings of the study. Chapter 5 provides a summary, conclusions, and recommendations.

CHAPTER 2

REVIEW OF LITERATURE

Bill Haslam, Governor of the State of Tennessee stated in a 2015 interview,

When we recruit businesses, it's our job to make certain the money we're putting into higher education meets the priorities of these businesses. If the marketplace says it needs more engineers, or more welders or more services, we have to make sure we're funding these opportunities commensurately. I think the perception we want to make certain we communicate is that we have a workforce that has the technical capacity for the business would that exists now, and we'll have one for the one that is going to exist five and ten years from now. (Rogers, 2015, p. 1)

To address the needs of preparing our students, particularly our high school students, as well as training under-employed or under-skilled adults in career fields with the greatest demand and highest earning potential, it was central we understood the significance of a highly skilled labor force that would sustain our economic status and propel our economic growth to an attractive position in the global economy. One way we could begin to realize this positive position in the global economy was to understand the characteristics of those students who were training for the skilled trades.

The review of literature exhibits two main topics to support understanding the characteristics or traits of the current students of technical education for the intent of skilled trades training. Those two main topics include the shortage of skilled laborers in the workforce and the perceptions of manufacturing jobs by the public at large.

The following review of literature was derived from a wide range of sources including university electronic library systems, pertinent trade and manufacturing periodicals, World Wide Web searches, and scholarly documents pertaining to trade or technical education themes. The

election of the literature was grounded on its independence to the subject matter, newsworthiness, and scholarly aptitude.

Shortage Realities of Skilled Workforce

Abel and Dietz (2014) interviewed former United States Secretary of Labor Robert Reich about the shortage of the trained skilled laborer. Reich held that recent college graduates were woefully under-employed and that 46% of those graduates were working in jobs that did not require a baccalaureate degree. He stated that this was due, in part, to high school seniors being told that the only way to enter the middle-class or above was to attend a four-year college. Another reason Reich stated as to the cause of under-employed college graduates was due to students obtaining a degree the marketplace was not willing to financially bear. Reich ascertained that parents, students, and student counselors were avoiding careers in the skilled technical fields because that career avenue was beneath them and that entering the skilled technical field would not lead to a financially successful life.

The problematic matter concerning a skilled labor force was not limited to the United States. The European Union (EU) reported that the countries comprised of the EU had approximately 5.7 million youths under the age of 25 who were unemployed due to their deficiency of a marketable skill set. Therefore, Germany, a member of the EU, developed an apprenticeship dual education model adopted partially or as a whole not only by other members in the EU but including some markets in the United States. The German dual education apprenticeship pedagogy was developed to help answer the question of the skilled labor shortage (Euler, 2013).

Many industries requiring technically skilled personnel were suffering the pains of workforce shortages. Public utilities, such as districts in Michigan, were feeling the shortage phenomena (Gautz, 2013). Because of the retirement waves or cycles, there remained a skilled labor force deficiency in replacing scores of years of experience in the utility fields. One particular reason given for the sudden gap in skilled labor in the Michigan utility districts was the gap in hiring at appropriate times—well before impending retirements occurred. However, Gautz reported the utility districts were combating the sudden shortages by collaboration efforts with technical and community colleges to specifically train individuals in the skills needed to install, maintain, and repair vital utility equipment.

Similarly, Coy (2014) reported that retiring baby boomers were a major contributor to the labor shortage as most have already retired from the workforce. However, the manufacturers and the public have poorly informed the secondary school level students of available careers in manufacturing, thus, leaving a gap that is widening by the month. Companies, Coy continued, were struggling to replace those who had retired; fulfilling the void was outpaced by the retirement phase. Kessler (2014) and Cohn and Taylor (2010) agreed that until the year 2020, 10,000 baby-boomers were retiring every day (or 4 million per year) leaving an enormous unfilled gap in the workforce. McMenamin (2015) agreed the shortages in the skilled labor force were due to the retirements and impending retirements of the baby boomers. He observed a phenomenon in the Chicago area that showed a lack of knowledge of what advanced manufacturing could offer in ways of careers in the skilled trades. He further observed this lack of knowledge phenomena was not isolated to Chicago but rather a nationwide problem. Therefore, industries that suffered shortages in the skilled labor market could not solely assign blame on the retirements of the baby boomer generation but on the correct information regarding career availability and its earning

potential. McMenamin found that those who were aware of the advanced manufacturing sector avoided such careers because of their negative perceptions of manufacturing as being dirty and largely unsafe (Pledger, 2015).

Likewise, Dychtwald, Erickson, and Morison (2006) suggested that no time in recent history had the manufacturing sector experienced as sizeable number of impending retirements than at the present. Dychtwald et al. held that the number of impending retirements was not solely the problem, but rather the neglectful foresight of training the next generation to replace retirees once they had left the workforce. Dychtwald et al. contended the *sin* of the skills gap was a clear lack of attention to a foreseeable issue.

Dychtwald et al. (2006) reported federal and state mandates placed on organizations regarding diversity of the workforce exacerbated the problem of workforce shortages. More emphasis was given to diversity alone rather than filling the workforce pipeline with highly trained and highly skilled workforce. Monnotte (2011), Denson and Park (2013), and Taggart (2007) agree that part of the formula of a robust manufacturing economy was in the diversity of the workforce. It was important for industries to understand the strength of those persons who had a disability (Taggart, 2007), a person of a minority race (Denson & Park, 2013), or one who may be a single parent (Monnotte, 2011). Where Dychtwald (2006) found a deliberate inclusion of diversity not to be as important when compared to the shortage challenge, other researchers reported diversity in the workforce as an imperative not only to meet the market demands of a skilled labor force but to foster a stronger workforce. Considering the manpower it took to operate an organization Dychtwald et al. offered a warning to industrial leadership to consider for future workforce developments: aging, additional women, added ethnic diversity, increasing lifestyle or life-stage variety, tightening labor markets, shortages of skills and experience, shortages of workers,

shortages of educated candidates, pressure on training and development, tension around human resource policies and practices, and strain on organizational coherence. Nevertheless, Dychtwald et al. suggested that the best solution to staffing the impending shortfall in skilled labor lie in the not-yet-retired skilled person. The persons projected to retire in relatively short amount of time should be given the charge to mentor the next generation. This foresight and action would lend to a smoother transition from the retired to the newly hired. However, it would have required industries to add to their headcount for a short amount of time (adversely affecting the personnel budget) until the apprenticeship and mentorships had been completed. Instead companies were hiring retirees back into the workforce as consultants to then take the time to mentor the younger generation with the experience and knowledge necessary to perform the tasks from which the retirees retired (Arnone, 2006). Nevertheless, the aging workforce was found to be valuable in combating the skilled labor shortage. With respect to the workforce and persons who were single parents, Minnotte (2012) found it was more difficult to meld work and home life. Because of the perceived or real issues with single parents entering the workforce implied fewer single parents were acquiring the skills necessary to succeed in the workforce resulting in increased salaries that could result in affordable childcare.

Kim (2015) described that in 2010 there were over 730,000 jobs added to the manufacturing sector in the United States. Additionally, she predicted another 700,000 jobs will have been created by the end of 2020. By that year almost all of the baby-boomer generation will have retired leaving a massive void in the skilled labor force of over 3.5 million. The jobs that would need to be filled required some classification of postsecondary training such as a technical college, a 2-year college, or a U.S. Department of Labor authorized apprenticeship (Williams III, 2016); this is unlike the early days of the baby-boomer generation where workers entered the

workforce with only a high school diploma or no diploma at all. However, with the advent of advanced technologies introduced into manufacturing (computers, robotics, and programmable logic controllers) it was essential for workers to have formal technical training in the field they wished to apply for employment (Kim, 2015).

Kim (2015) offered some reasons why the skills gap was as wide as it appeared. The public's perception of manufacturing remained reminiscent of the 1940s and 1950s where industry plants were filthy, laborious, and unsafe. In addition to the working conditions of modern manufacturing facilities of being clean, safe, and well-lit, while employing the latest in manufacturing technologies the Manufacturing Institute (2015) reported the average wage for skilled manufacturing labor was over \$77,000 in 2013 and expected the wage to increase to meet the market-demand price. Further, the Manufacturing Institute stated in a recent survey that 52% of teens viewed manufacturing jobs or careers as an attractive option for them after graduation. Thirty-seven percent of teens' parents would encourage their children to pursue the necessary training required in the advanced manufacturing industry. Kim reported that perception alone was not the reason for youth not entering the manufacturing sector. Rather, in the 1980s and 1990s, high schools were ceasing manufacturing education because manufacturing was waning in their apprenticeships that were a mainstay decades prior.

Like Kim (2015), Dick (2012) conveyed similar statistics of immediate and projected opportunities in the manufacturing skilled workforce. He described that in a 2- to 3-year time span (2012-2015) there would likely be a 33% increase in manufacturing jobs. Approximately mid term of Dick's forecast, Nicholson and Noonan (2014) reported significant growth in manufacturing as 646,000 jobs were added to the manufacturing workforce in 2014 while still leaving a deficit of 250,000 jobs yet to be filled. However, Dick's prediction for the 2012-2015 time frame was

without consideration that between 1998 and 2013, more than 5.7 manufacturing jobs were lost during the Great Recession to foreign manufacturers with lower labor costs (Scott, 2015).

Notwithstanding, Dick reported that governmental entities, both federal and state, were actively pursuing opportunities for individuals to obtain adequate training to meet the impending skilled labor demand. Dick went further in stating that the solutions to the skilled labor gap should be primarily industry-driven and should not be solely dependent on governmental agencies to remedy the problem. Additionally, Dick specified precise training should be identified by industries so that educational institutes may deliver the training and educational programs needed by industries; a close partnership between industry and training institutions were necessary for successful workforce development.

One such non-governmental industry-driven group that informally formed to discuss and help solve the skilled labor shortage was the Alliance for Working Together Foundation (AWT). This grassroots organization was fashioned with only a dozen manufacturing representatives to have a forum in which to discuss prevailing manufacturing topics (Alliance for Working Together Foundation, 2015). However, the overwhelmingly common topic of discussion was the ability to obtain and retain a skilled workforce. From those discussions the AWT began to do something about the problem. Three areas AWT contributed to resolving the skilled labor shortage was to reform the poor reputation of the manufacturing career path. Beginning in the junior high grades, AWT campaigned to change the minds of students and parents about the viability of manufacturing career paths and that manufacturing jobs were stable in the United States. Secondly, AWT partnered with local community colleges to formulate relevant degrees and certificates pertaining to comprehensive training needed in manufacturing industries. Thirdly, the

intent of the AWT was to build personal relationships between pertinent manufacturing facilities and the learners who were training for the skilled trades.

Siemens, a German company and a global leader in technological manufacturing applications such as programmable logic controllers (PLCs) and medical imaging equipment (e.g. ultrasonography, computerized tomography, and X-ray), showed an additional example of industry-driven solutions that helped abate the skilled labor shortage (Prah, 2015). Siemens donated \$660 million to Massachusetts technical schools and community colleges to aid the effort of obtaining pertinent training equipment for the purpose of comprehensive technical training of students going into the technical fields of manufacturing. Siemens demonstrated an understanding of the skilled labor gap and invested in the future of technical training for the benefit of themselves and manufacturing in general.

Shortages in the skilled labor force were made manifest in the Manufacturing Institute's 2014 study. Increased manufacturing costs were attributed to the vast gap in skilled labor availability. Three main areas in which manufacturing companies suffered loss due to their shortage of skilled labor were overtime pay, the length of manufacturing cycle time, and revenue loss caused by manufacturing processes down time. Most manufacturing participants in the study reported a 5% to 10% adverse effect in revenue loss due to shortages in skilled labor (Manufacturing Institute, 2014).

Moreover, the Manufacturing Institute (2014) found that manufacturers, for the most part, invested an inadequate amount of capital for advanced training of their personnel. Almost a third of the respondents to the survey invested less than \$500 per person annually for training while another third of the respondents invested between \$500 and \$1000 per person annually for training (Cappelli, 2013; Popp, 2013). Consistent with Dick (2012), the burden of technical training

initiatives should not only be on the local, state, and federal government agencies but also the manufacturers needed to have the largest investment in training, retaining, and attracting persons with pertinent skills needed to operate the manufacturing facilities (Manufacturing Institute, 2014).

Similar to the United States manufacturing employment statistic between 1998 and 2013 (Scott, 2015) manufacturing experts reported that Ohio suffered a 35% loss in skilled labor between 2000 and 2013 while wages increased 31% (\$56,000) due to the supply-and-demand taking affect on the cost of manufacturing (Levingston, 2015). Reasons cited were the baby boomer retirements and unfavorable perceptions of recent high school graduates concerning manufacturing. To help raise the perceptions of high school seniors, the Ohio education system in cooperation with state workforce agencies began coaching students as early as seventh grade. There, the junior high and middle school students received pertinent information about the modern-day manufacturing arena and what skills were necessary to enter the middle class in a relatively brief amount of time.

Wisconsin manufacturers (as cited in Prah, 2015) reported that between 2010 and 2020 over 700,000 career opportunities will need to be filled due to current and projected retirements. At about the mid-point of 2010 and 2020, reports indicated that 646,000 manufacturing jobs were added to the manufacturing sector in 2014 (Nicholson & Noonan, 2014) confirming Wisconsin manufacturer's employment opportunity forecasts. Since 2011 until the year 2030, it was estimated that 10,000 baby boomers would have reached the retirement age of 65 every day. For every year during the aforementioned time period more that 3.6 million people will have reached retirement age eligibility nation-wide (Cohn & Taylor, 2010). Manpower Group, a human resources consultation firm, detailed in their recent talent shortage survey (as cited in Prising, 2015), that for the years 2014 and 2015, the technically skilled labor force classification showed

the greatest demand for employees when paralleled to other job classifications. Furthermore, the survey found that for those years 34% of manufacturers said the vast skilled labor shortage had a medium impact on their productivity, profit, and growth while 20% of the manufacturers said the shortage of skilled labor had a high impact. Fifty-four percent of the respondents reported they were experiencing a medium to high negative impact on their productivity, profits, and growth due to a skilled labor shortage. Conversely, 45% of respondents said the skilled labor shortages had little to no impact on the company's financial bottom line (Prising, 2015). The survey did not address gender shortages in the skilled labor workforce while addressing categories of shortages.

Shierholz (2014) agreed that there was a skilled labor shortage, however, she did not attribute it necessarily to the baby boomer retirements but rather to a "skills mismatch" (p. 1). Shierholz contended that the workers were readily available to be employed yet they lacked the skills necessary to fill the available work positions. Like Prah (2015), Shierholz highlighted the need for manufacturers experiencing a skilled labor shortage to engage and invest in the solutions of proper training of the available workforce. It was not that the workers were not available rather they were untrained to be beneficial to the industry.

A comprehensive workforce report by the metropolitan Nashville, Tennessee Chamber of Commerce (2015) indicated that between 2015 and 2020 more than 1.5 million career opportunities would be available. Of the 1.5 million job openings, approximately 15% would require more education than a high school diploma. Moreover, approximately 20% of the 1.5 million projected job openings required a bachelor's degree or greater. However in the meantime, the amount of people who have left the workforce due to retirements has been outpacing the replacement of those vacancies.

In 2016, 20% of the metro Nashville, Tennessee workforce was 55 years old or older; which equated to approximately 1 million people. Therefore, industries attempted to retain the retirement-based personnel to either return as consultants or become a mentor in a Department of Labor approved internal apprenticeship to train the next generation of a skilled workforce (Nashville Chamber of Commerce, 2015). The report continued to note that there was a 3.5% deficit in persons with some type of postsecondary training; a fact that coincides with Tennessee Governor Bill Haslam's 2015 *Drive to 55* initiative that had a mission statement of getting 55% of the constituents of Tennessee to obtain some type of postsecondary training whether it be certificate, associates, or higher degree. Additionally, the *Drive to 55* initiative was initiated to retain industries the state had in addition to attracting additional industries to the state with a skilled talent pool from which to hire. To get to the 55% initiative Tennessee offered two avenues by which Tennessee residents could obtain the necessary training needed by the workforce: *Tennessee Promise* (Tennessee Promise, 2016) and *Tennessee Reconnect* (Tennessee Reconnect, 2016). Both programs offer last-dollar scholarships for first-time college attenders for the completion of a certificate or an associate degree.

Although the state of Tennessee offered several equitable avenues by which to receive proper training to meet the needs of its advanced manufacturing industries, there existed another unforeseen issue: the lack of skilled *trainers*; Career and Technical Education (CTE) educators in high schools. According to the Tennessee Manufacturers Association (2015) it was projected that from the year 2012 to 2022, the demand for CTE instructors would increase by 9%. This projected increase was due to the impending retirement of current CTE educators as well as fewer middle and high school students entering into CTE courses even though the overall student population was projected to rise in the same time frame.

Ewert and Kominski conducted a 2014 study that illustrated the educational achievement by way of differing categories or levels of achievement (certificate, associate degree, bachelor degree, and advanced degree). Ewert and Kominski concluded that there are many avenues of attaining postsecondary credentials other than what they entitled “regular school” (p. 1). Other means of postsecondary training—with credentials—was found in areas such as apprenticeships, on the job training (OJT), professional licenses, certifications, and certificates. These alternative means of postsecondary training could be of benefit to the aforementioned *Drive to 55* program of getting 55% of the population of the state of Tennessee postsecondary credentials by the year 2020. The credentials Ewert and Kominski identified would be necessary to function in the advanced manufacturing field in the United States.

The need for postsecondary training was real and urgent not only domestically, but globally, as well. For example, the global prospectus by researchers indicated that nearly 3% of the global population (90 to 95 million) would be forcibly unemployed by 2020 (Adams, 2012) unless the workforce was retrained in technically advanced skills. The advancement in manufacturing processes mandated extensive technical training for entry-level machine operators. Advancements in manufacturing processes have outpaced the technical training available to properly train existing personnel thus manifesting as a skilled labor shortage even though the human capital existed. With proper training in technical skills, such as an associate degree, the new earning potential would likely increase substantially than with no postsecondary technical training.

For example, according to the Nashville Chamber of Commerce (2015) comprehensive report persons with a minimum of an associate degree could earn an income surpassing 60% of those without any postsecondary training. Their research indicated that more than half of their regional area industries would require personnel with a minimum of an associate degree.

Therefore, the importance of the aforementioned *Drive to 55* initiatives could be the primary catalyst in bringing the qualified candidates to the industries desirous of educated personnel in the state of Tennessee (Drive to 55, 2015). Furthermore, authorities in the metro Nashville region reported that middle-skilled careers (those with an associate degree) grew more than three times the national average (Nashville Chamber of Commerce, 2015).

Not all experts on skilled labor maintained there was an actual skills gap in U.S. manufacturing. Cappelli (2013) refuted the notion that the secondary schools were to blame for the perceived underprepared students entering the workforce. Cappelli contended that since 2003 comprehensive assessment tests indicated elevated scores. Further, since that period of time high school dropout rates had drastically plummeted. Instead, Cappelli suggested that the reasons manufacturing was lamenting a skills gap was due to a lack of workforce readiness which lie at the feet of the manufacturers and that the skills gap was a myth. If training was paramount for the high-skill sector of manufacturing, Cappelli asked, then why had manufacturing overall gutted and were gutting their training budgets? Continuing, Cappelli wondered why starting salaries were extraordinarily low. Moreover, he found that job requirements for the skilled labor force required extensive prior experience to even be considered for a career in advanced manufacturing. Therefore, he concluded that the skills gap concept was a myth contrived by the manufacturing sector; for what plausible reason, Cappelli did not conclude.

Contrasted with Cappelli (2013), plant engineers affirmed that the single most important manufacturing issue to date was that of the lack of a skilled workforce (Vavra, 2011). Forty-seven percent of the respondents to Vavra's survey asserted a well-trained workforce was the main variable that stressed them. The plant engineers surveyed offered solutions and a plan of action to combat the shortage of skilled workers. One such element that needed an overhaul was advanced

manufacturing's own reputation perceived by high school students and their parents. The information received by the technology-savvy generation needed to include an understanding that the technology they use on a daily basis could easily be translated and useful in the highly automated manufacturing sector. The message needed to be clear that the modern-day manufacturing facility presented a highly technical career opportunity. The survey concluded with six main points of interest to combat negative attitudes about manufacturing and to attract high school students into manufacturing careers:

1. Investment in early education
2. The incorporation industry-recognized qualifications in high school and postsecondary degree programs
3. Didactic routes in high school and college that are standards-based, performance-based, and proficiency-based
4. Technological alternatives for high school and postsecondary tutelage
5. Condensed high school and postsecondary schedules by way of dual enrollment dual credit
6. Internships, apprenticeships, and mentorships to ally higher education with industry competency and skills requisites

Still other manufacturing experts have questioned the skills gap or skills shortage. For example, Davidson (2012) concluded the skills gap message was a fabrication and thus not true in most cases. His reasoning was that manufacturer's starting salary was comparable to that of a McDonald's restaurant assistant manager's starting salary of \$10 per hour. Davidson contended that if there truly was a skills gap in manufacturing, the result should be higher wages than positions not requiring any postsecondary training. Still, he found that manufacturers could not

substantiate a real number representative of the so-called skills gap. Similar to Cappelli (2013), Davidson (2012) found that manufacturers were mostly responsible for any gap in skill sets due to the unreasonable requirement of several years of experience. He concluded that that should not have been though the average age of most manufacturers in the U.S. was 65 years old and that manufacturers could not afford to require such experiential requirements of recent high school or postsecondary graduates.

Like Cappelli (2013) and Davidson (2012), Popp (2013) doubted there existed a skills gap in the U.S. manufacturing market. He contended that manufacturers fabricated a skills gap where they were having much difficulty filling high-skilled positions within their organization. However, Popp found that manufacturers were requiring unreasonable expectations of work experience where the experience was not necessary at all. Thus, according to Popp the manufacturers were setting themselves up for viable justification for moving their facilities overseas where the skillsets were much poorer than they required in the U.S. For instance, foreign reading and reading comprehension did not match what was required in the U.S. to operate the same piece of equipment. Further, Popp found that those who had claimed such catastrophic shortages in their manufacturing facility were not proceeding with urgency to rectify the shortages; the manufacturers were lamenting a problem for others to solve. To Popp this was unacceptable where the manufacturers had not invested (time or money) in increasing their skilled personnel headcount. Popp could only conclude the so-called skills gap was mythical and a “purple squirrel” as the article’s title implied.

Williams III (2016) reported findings contrary to Cappelli (2013), Davidson (2012), and Popp (2013). Williams III reported that Tennesseans could lose half its workforce due to the advancement of manufacturing automation, almost 1.4 million people. However, the findings

through the Tennessee Department of Economic and Community Development (2016), stated that there would consequently be the same or increased amount of positions opened due to manufacturing automation technologies. The workers who risked losing their jobs were those who had no skillsets marketable to manufacturers that operated entirely on automation. Therefore, a more skilled workforce would need to be trained quickly and thoroughly. Cappelli (2013), Davidson (2012), and Popp (2013) agreed that manufacturing companies needed to invest their own resources to enjoy a positive return of their investment of a more skilled workforce. Williams III described Tennessee manufacturers who had placed investment dollars into their unskilled workforce for formal training to meet their own manufacturing essentials where computerized automation was predominant. Williams III specified that Tennessee Colleges of Applied Technology partnered with respective service-area manufacturers to keep the school, the school instructors, and student body abreast of prevailing technologies so that proper and useful training could occur that best meet the needs of those manufacturers. For instance, Williams III further illustrated that Eagle Bend Manufacturing in Clinton, Tennessee was reported to have sent four of their production technicians to the Tennessee College of Applied Technology at Knoxville to learn automation systems and upon their graduation the students would be hired as maintenance technicians to keep their manufacturing facility reliable.

An example of industries doing their part to combat the skilled labor shortage, Ford Motor Company established its investment in the training of its workers (Spaulding, 1994). Rather than relying on schools, colleges, local, state, and federal governments to supply such companies with the needed skilled labor force Ford Motor Company partnered with local schools to introduce students to the manufacturing fields. Spaulding reported Ford Motor Company formulated an educational program through its *Ford Academy of Manufacturing Sciences* (FAMS). Through

FAMS, high school students took four semesters of accredited courses that coincided with their general studies (Ford Next Generation Learning, n.d.). During the summer months those students who participated in the FAMS program worked in specialized internships with Ford Motor Company. Although Cappelli (2013), Davidson (2012), and Popp (2013) claimed that companies were not doing their part in recruiting and properly training candidates for their specific workforce, the FAMS program showed to the contrary (Spaulding, 1994).

The *Carl D. Perkins Act of 2006* perhaps best validated the federal government's role in promoting and supporting technical education for the benefit of the manufacturing sector. The act ensured there were elements in place to meet the growing demand for skilled workers in the manufacturing sector (Association of Career and Technical Education, 2015). Annually, more than \$1.3 billion was distributed to secondary and postsecondary education institutions to enforce:

1. Redefined the federal role of career and technical education
2. Targeted expenditures
3. Defined program quality elements
4. Ensured relevant and consistent data
5. Offered incentives for innovation
6. And, provided the infrastructure to support the system

Perceptions of Manufacturing Jobs and Skilled Labor

The *Alliance for Working Together Foundation* (AWT) begun in 2002 as a small unofficially organized group of industrial leaders to discuss the perils of the shrinking skilled-labor workforce. Of the many topics addressed was that of the negative perceptions held by many towards manufacturing careers (Alliance for Working Together Foundation, 2015). Hence, one of

goals of AWT was not only to address the negative perceptions of manufacturing careers but also to work with communities, secondary schools, and colleges in order to help educate the populace of first, the shrinking workforce due to baby-boomer retirements, and second, common misconceptions of manufacturing careers.

To illustrate the attitude or perception toward technical education San Diego School District recommended that high school students be required to take certain credits in Career Technical Education (CTE) courses (Butrymowicz, 2012). Yet, school district officials received unexpected resistance from parents who claimed CTE courses would not help their children get into certain colleges. School district officials argued that it was “logical extension of their goals to get all students college and career ready” (p. 2). The parents argued, on the other hand, that forcing highly intelligent children to take CTE courses would hinder their chances of competing in college admission. The college admission argument, according to Butrymowicz, was the primary battle being fought of changing the mindset of parents and students toward manufacturing or technical careers. He concluded that, although the perceptions of CTE or technical education was changing toward the positive, it was obstructions like the “affluent parents” (p. 4) that still shed a negative light on technical education and advanced manufacturing.

The college entry chances were not addressed by the San Diego School District however, they did reason that those who were CTE students were more likely to graduate than those who were non-CTE students according to education experts. Treschan and Mehrotra (2014) concluded in their quantitative analysis that New York City CTE students were found to be more likely to graduate high school (70%) than their counterparts who were non-CTE students (65%). Additionally, of the 70% of CTE high school graduates, 35% also attained nationally and industrially recognized concurrent assessment affirmations. Furthermore, the largest distribution of

their study (eighth graders who were just below proficiency) showed the group experienced a boost in high school graduates than those who were not enrolled in a CTE school with the same below-proficiency level. Treschan and Mehrotra concluded that CTE promoted the hands-on application of engineering principles and laws and thus resulting in enhanced high school graduation rates.

Similar to Treschan and Mehrotra research conclusions, Shadden (2011) found results of enhanced graduation rates of CTE concentrators in northeastern Tennessee. For the 2007-2008 high school academic year, Shadden reported a 93% graduation rate among CTE concentrators versus an 82% graduation rate among non-CTE concentrators in northeastern Tennessee school systems. Additionally, Shadden discovered that females CTE concentrators had a higher graduation rate than that of males. The graduation rates exceeded the graduation rate expectations by the adequate yearly progress (AYP) report. Shadden concluded that the research evidence showed significant value in the CTE program concentration within the high school system in northeastern region of Tennessee.

Nearly 25% of jobs in Wisconsin, or about 700,000, were manufacturing; therefore, educating high school students in the skilled trades was an imperative if job vacancies were to be filled (Prah, 2014). Manufacturers across the state of Wisconsin visited high schools and colleges to dispel the notion that manufacturing was dirty, grimy, and unsafe as it was in their parents' or grandparents' generation. As in Wisconsin, many manufacturers in Ohio attended over 1,000 events across the state to recruit skilled laborers and at the same time re-educate people about modern manufacturing that required highly trained and skilled workers (Pledger, 2015). The manufacturers who participated in recruitment events wanted to correct misinformed thinking and perceptions about manufacturing careers. Erroneous attitudes and misperceptions about modern

manufacturing, Pledger continued, was the leading cause of why many high school graduates avoided training in the technical skills market.

New Process Rawhide Company in Syracuse, New York combated the erroneous perceptions of skilled labor in a different way than Ohio and Wisconsin manufacturers (Frawley, 2009). From 2006 to approximately 2012, the New Process Rawhide Company had operated a manufacturing awareness program. The 5-week, 3-days per week, 4 hours per day program promoted shadowing different skill-sets required to operate the company. The company's stated intent was to alter the misguided perception of manufacturing careers. The students were transported by bus each morning at 7:30 and were guided in networking, how to think logically, how to ask good questions, and how to approach and solve problems while experiencing various trade skills. At the conclusion of the program, prior to graduation, students were required to make individual presentations of concepts learned and tasks accomplished while in the program. Manufacturing workers, managers, CTE instructors, parents, and students reported at the conclusion of the program their attitude and thinking about manufacturing careers had changed in a positive way. Engagement in the industry for an extended period of time was evident in disbanding poor perceptions of manufacturing careers. However, after 124 years in business, New Process Gear (renamed from New Process Rawhide Company) went out of business thus ending its manufacturing awareness program that ran for approximately six years (Hannagan, 2012).

A survey sponsored by the ALCOA Foundation (ALCOA, 2015) revealed parents' misconception about STEM careers in manufacturing which included misconceptions regarding Science, Technology, Engineering, Math (STEM) programs and Career Technical Education (CTE) for their high school children. The misconceptions included compensation, fringe benefits, and "intellectual stimulation" (p. 1). Furthermore, with regard to manufacturing perceptions, 90%

of parents responded in the survey that they worried about their children's future career with respect to the flailing economy. However, the survey found that most respondents (89%) assumed that manufacturing jobs, in particular, yielded only \$7 per hour to \$22 per hour. Yet, the Manufacturing Institute (Average wages and total compensation for manufacturing workers, 2014) reported that the average pay, including benefits, for manufacturing workers was \$34.00 per hour or \$80,000 annually. The survey supported the ALCOA Foundation's premise that the public was unaware of sustainable manufacturing careers and the facts related to those careers.

The ALCOA Foundation survey revealed that over one-third of the survey participants deemed postsecondary training or education as unnecessary for manufacturing jobs (ALCOA, 2015). The United States Bureau of Labor Statistics (2015), though, reported that for electricians it was required to have a high school diploma, as well as postsecondary technical school credentials or a completed apprenticeship. The survey findings concluded that continued education of both parents and students about the facts of manufacturing, STEM, and CTE careers and education was essential in increasing a skilled workforce.

Comparatively, Moser (2008) reported that 40% of 830 survey participants responded that it was more important to go to technical school than a 2-year college in order to remain competitive in the marketplace. Only 17% responded it was more important to go to at least a 2-year community college than technical school. It should be noted that at the time of the survey the United States was in the midst of the Great Recession beginning in 2007 and thus the job market was dismal (Elsby et al. 2010) and could have had an impact on respondent's answers.

Helms and Adcock (1992) found that misguided notions about manufacturing were roadblocks in recruiting the best and apt candidates for the manufacturing sector—whether it was skilled labor or professionals. Helms and Adcock explained that engineering and business students

tended to avoid careers in the manufacturing field, as they had perceived professional careers in manufacturing could not lead to a career with satisfaction and contentment. Helms and Adcock stated that when manufacturers failed to recruit qualified candidates in their respective fields, not only manufacturing suffered but also the community suffered for the lack of new tax base contributors.

Helms and Adcock (1992) found that 73% of respondents agreed that a college education was important in order to increase income potential in the marketplace. Even with a college education, however, only 14% of the respondents thought that manufacturing could be a viable pathway to an increase in income potential. Furthermore, 7.5% of the respondents would consider manufacturing as a career option. The researchers concluded the prevailing attitudes were not based on actual knowledge but rather a lifetime of misinformation surrounding manufacturing. Helms and Adcock further offered that some ideas that should be considered to help squelch the prevailing negative attitudes toward manufacturing: earlier manufacturing tours (high school and middle school), more frequent recruitment events and speaking engagements, and manufacturers to offer a more robust entry-level jobs once the candidate was recruited.

Representatives from the German educational system observed that the lack of understanding and respect toward secondary technical education was not serving the stakeholder well (Kamm & Lerman, 2015). The mentality of college-for-everyone had skewed the perceptions of necessary training needed to support the workforce. Further, the college-for-everyone has focused its efforts on academic capabilities while seemingly ignoring the “occupational and employability” (p. 12) skill sets.

Kamm and Lerman (2015) found that, under the pretext of the college-for-everyone initiative, 20% of high school students failed to graduate from high school while 60% of high

school graduates who attended a 2-year or 4-year college institution failed to complete the degree sought. Therefore, Kamm and Lerman concluded the college-for-everyone initiative had observably failed. The researchers also pointed out that United States high school counselors were college graduates themselves and thus had reason for a limited knowledge base regarding noncollege curricula or career option pathways. In order to balance the counseling information Kamm and Lerman advised that high school counselors obtain an extensive knowledge base of other occupations that may not require traditional college education while earning a salary comparable to employed college graduates. Lack of knowledge regarding technical career education was supported by additional literature that reported high school counselors were woefully under representing viable careers in the advanced manufacturing realm (Getting Students Informed, 2009). Furthermore, Kamm and Lerman (2015), emphasized that legislators value the viability of high school students who may not thrive in traditional academia while excelling in on-the-job (OJT) learning or “learn by doing” (p. 13) approach. By taking small yet monumental steps of informative counseling in high schools, the perceptions of workforce training may invariably improve while benefiting the student and the industry.

The United States secondary education system was not completely disregarding the importance of Career Technical Education (CTE). Initiatives such as Project Lead The Way (PLTW) incorporated academic rigor coupled with hands-on and problem resolving teaching (Anthony & Bottoms, 2005). When compared with similar students in the technical field, PLTW students exhibited higher test scores in mathematics, science, reading, and problem solving. Anthony and Bottoms concluded the results could have contributed to a positive perception of technical training outside of traditional 2-year or 4-year colleges. These results coincide with the methodology and pedagogy the German dual education system employed in secondary-level

education system. The results were indicating positive perceptions of skilled labor career choices by students, teachers, parents, and public stakeholders (Anthony & Bottoms, 2005; Kamm & Lerman, 2015).

Similarly to Kamm and Lerman (2015), other studies (e.g. Ferris State, 2002) found that United States high school counselors were not adequately advising high school students regarding technical or manufacturing career opportunities, what criteria it took to enter those careers, and what those careers' earning potential could be. The Ferris State study indicated that 70% of students were receiving career counseling from their parents although the parents were inadequate in recommending careers that the market was needing and was willing to adequately compensate. Almost 70% of respondents indicated that college was the best pathway for career success even though two-thirds of the college-bound respondents did not complete college. The unfamiliarity of available careers in advanced manufacturing fields lent to the adverse perceptions of manufacturing careers in general. Therefore, like Kamm and Lerman (2015) and Anthony and Bottoms (2005), Ferris State (2002) agreed that a major contributor to negative perceptions of manufacturing rested at the feet of high school counseling endorsed methodologies.

Chapter Summary

There exists a skilled labor shortage in the United States as well as globally. The literature presented made clear that baby-boomer retirements were foreseeable and that all entities involved such as state and local governments, colleges, technical schools, high schools, and industries were affected by their own inadequate action of filling the pipeline with a qualified workforce (Abel & Dietz, 2014; Euler, 2013; Prah, 2015).

The challenges advanced manufacturers experienced in filling their skilled labor pipeline included not only their shortages of properly trained personnel but also the negative perceptions regarding manufacturing by parents and students (Butrymowicz, 2012). However, governmental and industrial representatives, for example, have made positive strides in educating the public with information about the skills needed in today's manufacturer facilities, how to obtain the skills needed in advanced manufacturing, the new advanced manufacturing atmosphere (cleanliness and safety), and the compensation potential. The United State Bureau of Labor Statistics (2016) projected until the year 2024, the U.S. labor force could continue to grow at a rate of .5% annually. Albeit slow, the labor force is growing helping meet manufacturer's demand for a skilled workforce. It is apparent that a continued national campaign initiated by governmental agencies, educational entities, and manufacturing sectors has been progressing in the right direction (Rowe, 2011) to help project the facts regarding a skilled workforce and how to become a contributor in that workforce.

CHAPTER 3

RESEARCH METHODOLOGY

According to McMillan and Schumacher (2006) a quantitative research design “maximizes objectivity by using numbers, statistics, structure, and control” (p. 23). Further, quantitative nonexperimental research design “describes things that have occurred and examine relationships between things without any direct manipulation of conditions that are experienced” (p. 24).

A quantitative nonexperimental descriptive study was conducted to determine if significant relationships exist between gender and race, gender and disability status, gender and single parent status, and, gender and economically disadvantaged status, race and disability status, race and single parent status, and race and economically disadvantaged status of students who enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. Finally, differences in completion rates between female and male students enrolled as well as differences in completion rates between white and nonwhite students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

Research Questions and Null Hypotheses

Nine research questions and related null hypotheses were addressed in this study to assess potential relationships between gender and race, gender and disability status, gender and single parent status, and gender and economically disadvantaged status as well as race and disability status, race and single parent status, and race and economically disadvantaged status of students who enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. Additionally, differences between gender and program completion rates and race and program completion rates who enrolled in Tennessee Colleges of Applied Technology advanced

manufacturing skills programs were studied. The nine research questions were addressed through testing the related null hypotheses.

RQ1: Is there a significant relationship between gender and race of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

H₀1: There is not a significant relationship between gender and race of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

RQ2: Is there a significant relationship between gender and disability status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

H₀2: There is not a significant relationship between gender and disability status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

RQ3: Is there a significant relationship between gender and single parent status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

H₀3: There is not a significant relationship between gender and single parent status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

RQ4: Is there a significant relationship between gender and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

H₀4: There is not a significant relationship between gender and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

RQ5: Is there a significant relationship between race and disability status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

H₀5: There is not a significant relationship between race and disability status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

RQ6: Is there a significant relationship between race and single parent status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

H₀6: There is not a significant relationship between race and single parent status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

RQ7: Is there a significant relationship between race and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

H₀7: There is not a significant relationship between race and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

RQ8: Is there a significant difference in completion rates between female and male students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

H₀8: There is not a significant difference in completion rates between female and male students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

RQ9: Is there a significant difference in completion rates between white and nonwhite students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

H₀9: There is not a significant difference in completion rates between white and nonwhite students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

Population

The population of the study consisted of 4,352 students who were first-time enrollees beginning fall 2014 trimester at 27 Tennessee Colleges of Applied Technology (TCAT). The 27 TCATs are public technical colleges governed by the Tennessee Board of Regents (TBR). Each TCAT serves a specific service area consisting of two or more counties throughout the state of Tennessee (Figure 1) where residents can obtain postsecondary technical training in order to be competitive in the marketplace. Additionally, the TCATs assure that businesses and industries have a pipeline of qualified workforce personnel (Tennessee Colleges of Applied Technology, 2016). The TCATs serve a diverse student population from a variety of ethnic and socioeconomic backgrounds and a total population of approximately 17,500 students statewide. Although TCATs serve a diverse population across the state of Tennessee, there remains unintended gender dominated programs of study. For example, Administrative Office Technology, Pharmacy Technology, Practical Nursing, Early Childhood Education, Surgical Technology, Health Information Management, Cosmetology, Dental Assistant, Dietary Management, Certified Nurse Aide, and Phlebotomy represent programs of study traditionally and predominately dominated by females. Programs of study such as Automotive Technology, Collision Repair Technology,

Computer Electronics, Electromechanical Technology, Machine Tool Technology, Welding Technology, Heating Ventilation Air Conditioning Technology, Building Construction Technology, Electronics, Industrial Maintenance, Truck Driving, Drafting and CAD Technology, Industrial Electricity, Diesel Power Equipment Technology, Mechatronics, Pipe fitting and Plumbing, Aircraft Mechanics, Avionics Maintenance Technology, and Masonry represent unintended male dominated programs of study (Smith, 2013; Tennessee Board of Regents, 2016a). However, neither the perceived female dominated programs of study nor the perceived male dominated programs of study are exclusive to gender by design.

The criteria used for selecting research variables were the Tennessee Colleges of Applied Technology information system enrollment report instructions sheet provided by the Office of Research and Assessment at the TBR that recorded numerous variables collected by each TCAT for each student at the point of enrollment. The available data (fall 2014) were collected from of the Office of Research and Assessment of the Tennessee Board of Regents, Nashville, Tennessee.



Figure 1. Locations of Tennessee Colleges of Applied Technology (Tennessee Board of Regents, 2016c).

The identification of the 27 Tennessee Colleges of Applied Technologies (TCAT) as depicted by number (alphabetical) in Figure 1 is as follows: 1-Athens, 2-Chattanooga, 3-

Covington, 4-Crossville, 5-Crump, 6-Dickson, 7-Elizabethton, 8-Harriman, 9-Hartsville, 10-Hohenwald, 11-Jacksboro, 12-Jackson, 13-Knoxville, 14-Livingston, 15-McKenzie, 16-McMinnville, 17-Memphis, 18-Morristown, 19-Murfreesboro, 20-Nashville, 21-Newbern, 22-Oneida, 23-Paris, 24-Pulaski, 25-Ripley, 26-Shelbyville, and 27-Whiteville.

Instrumentation

Archival data were used in this study. Utilizing archival data from the Tennessee Board of Regents (TBR) database lessened the probability of violating privacy expectations of the individual participant and reduced prejudice (McMillan & Schumacher, 2016). The TBR employs Banner software for data collection of its three higher education entities: 27 Tennessee Colleges of Applied Technologies, 13 Community Colleges, and 6 Universities (Tennessee Board of Regents, 2016b). Banner data collection software was designed for collection of student personnel data primarily for but not limited to six higher education departments: finance, alumni, student, financial aid, human resources, and general use (What is Banner?, 2016).

Data Collection

After completing preliminary tasks set forth by the Special Assistant to the Vice Chancellor for Academic Affairs (submission of study title, research questions, and contact information of the East Tennessee State University Institutional Review Board) of the Tennessee Board of Regents (TBR) and having received a memo of support for this study (see Appendix A) my dissertation committee granted permission to proceed with the study. I made application to the East Tennessee State University (ETSU) Institutional Review Board (IRB) for permission to collect necessary data. Once the letter of exemption (see Appendix B) of human subject study was submitted to my

dissertation committee chair, I petitioned the Special Assistant to the Vice Chancellor for Academic Affairs of the TBR and received requested data by way of a password-protected PDF file via personal password-protected email. The data were provided without personal identifiable information to ensure confidentiality and to satisfy the *Family Education Rights and Privacy Act* (FERPA). The data were filed in password-protected personal computer as an additional measure of confidentiality.

Data Analysis

After the data were obtained from the Tennessee Board of Regents Office of Research and Assessment, they were analyzed using the Statistical Package for Social Sciences (IBM-SPSS) software program. A series of chi-square tests of independence was employed to analyze data and determine if significant relationships existed between gender and race, disability status, single parent status, and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology as well as establish if significant relationships existed between race and disability status, single parent status, and economically disadvantaged status of students who enrolled in Tennessee Colleges of Applied Technology. Additionally, differences in completion rates of two sets of demographics were studied: males and females, and white and nonwhite students enrolled in an advanced manufacturing skills program in Tennessee Colleges of Applied Technology. All data were analyzed at the .05 level of significance.

Chapter Summary

Chapter 3 detailed information concerning the research design, methods, and procedures. The population consisted of students who enrolled in the 27 Tennessee Colleges of Applied

Technology. This study was to determine if there were significant relationships between gender and race; disability status; single parent status and, economically disadvantaged status of students who were enrolled in Tennessee Colleges of Applied Technology. Additionally, this study was to determine if there were significant relationships between race and disability status, single parent status and, economically disadvantaged status of students who were enrolled in Tennessee Colleges of Applied Technology. Chapter 4 provides findings and Chapter 5 includes summary, conclusions, and recommendations.

CHAPTER 4

RESULTS AND ANALYSIS OF DATA

The purpose of this quantitative nonexperimental descriptive study was to determine if significant relationships exist between gender and race, gender and disability status, gender and single parent status, and gender and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. Finally, differences in completion rates between female and male students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs as well as differences in completion rates between white and nonwhite students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs were examined.

Data for this study were housed in the Tennessee Board of Regents Office of Research and Assessment database. The study used data from the beginning of the fall 2014 trimester until the end of the fall 2015 trimester (a total of 4 academic trimesters). The students studied were enrolled in the 27 Tennessee Colleges of Applied Technology advanced manufacturing skills programs. A series of chi square tests were applied to determine if there were significant relationships between the variables.

Research Question 1

Is there a significant relationship between gender and race of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

H₀1: There is not a significant relationship between gender and race of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

A two-way contingency table analysis was conducted to evaluate whether there was a significant relationship between gender and race of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. The analysis indicated that the relationship between gender and race was significant, $\chi^2(1, N = 4,352) = 23.36, p < .001$, Cramer's $V = .07$. Therefore, the null hypothesis was rejected. Figure 2 displays proportion of female and male students to that of their race (nonwhite and white). In summary, there was a significant relationship between gender and race of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs whereas more white females and males were enrolled than nonwhite females and males. Table 1 indicates the frequencies and associated percentages of female and male students to that of their race (nonwhite and white) who were enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

Table 1

Gender and Race of Participants

	Nonwhite		White		Total
	N	%	N	%	
Female	504	27.7	1,317	72.3	1,821
Male	540	21.3	1,991	78.7	2,531
Total	1,044		3,308		4,352

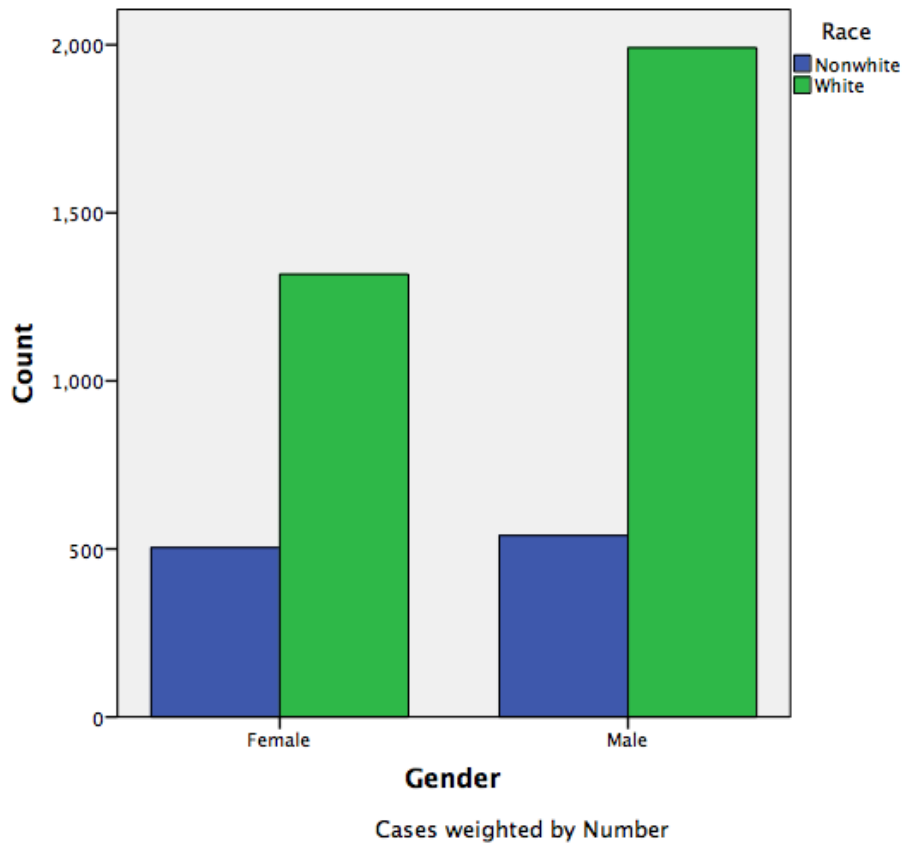


Figure 2. Gender and Race Proportions.

Research Question 2

Is there a significant relationship between gender and disability status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

H₀2: There is not a significant relationship between gender and disability status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

A two-way contingency table analysis was conducted to evaluate whether there was a significant relationship between gender and disability status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. The analysis indicated that the relationship between gender and disability status was significant, $\chi^2(1, N = 4,352) = 4.91$, $p = .027$, Cramer's V = .03. Therefore, the null hypothesis was rejected. Figure 3 displays proportion of female and male students to that of their disability status. In summary there was a significant relationship between gender and disability status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs whereas there were more females and males who were not disabled than there were females and males who were disabled. Table 2 indicates the frequencies and associated percentages of female and male students to that of their disability status who were enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

Table 2

Gender and Disability Status of Participants

	Not Disabled		Disabled		Total
	N	%	N	%	
Female	1,805	99.1	16	0.9	1,821
Male	2,489	98.3	42	1.7	2,531
Total	4,294		58		4,352

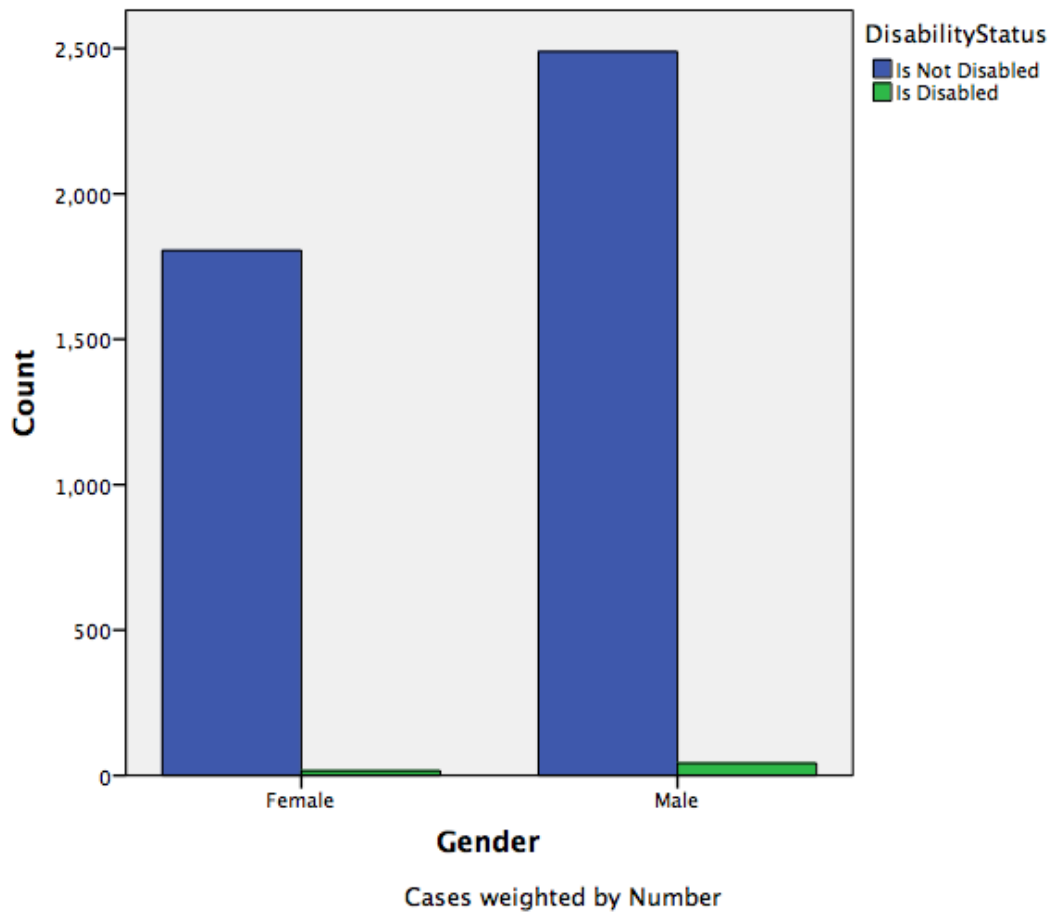


Figure 3. Gender and Disability Proportions.

Research Question 3

Is there a significant relationship between gender and single parent status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

H₀3: There is not a significant relationship between gender and single parent status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

A two-way contingency table analysis was conducted to evaluate whether there was a significant relationship between gender and single parent status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. The analysis indicated that the relationship between gender and single parent status was not significant, $X^2(1, N = 4,352) = .87, p = .351, \text{Cramer's } V = .01$. Therefore, the null hypothesis was retained. Figure 4 displays proportion of female and male students to that of their single parent status. In summary there was not a significant relationship between gender and single parent status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. Table 4 indicates the frequencies and associated percentages of female and male students to that of their single parent status who were enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

Table 3

Gender and Single Parent Participants

	Not a Single Parent		Is a Single Parent		Total
	N	%	N	%	
Female	1,656	90.9	165	9.1	1,821
Male	2,322	91.7	209	8.3	2,531
Total	3,978		374		4,352

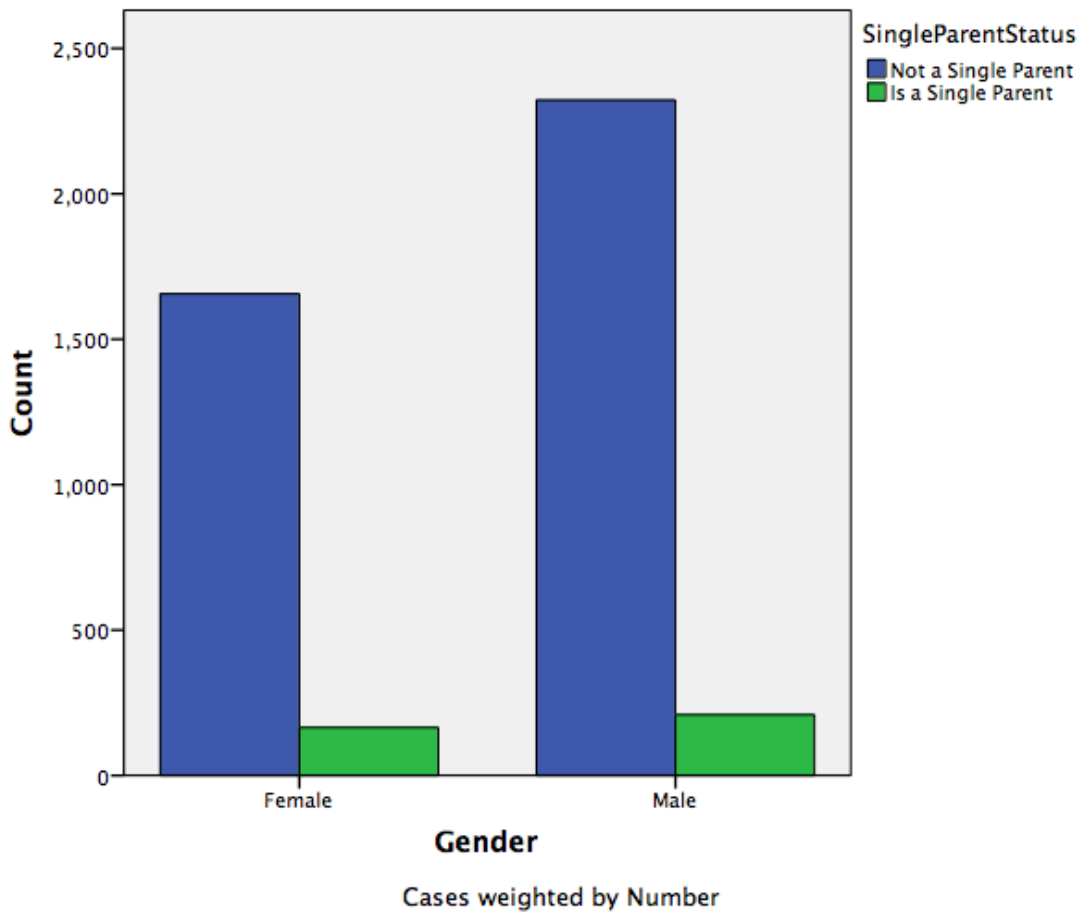


Figure 4. Gender and Single Parent Proportions.

Research Question 4

Is there a significant relationship between gender and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

H₀4: There is not a significant relationship between gender and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

A two-way contingency table analysis was conducted to evaluate whether there was a significant relationship between gender and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. The analysis indicated that the relationship between gender and economically disadvantaged status was not significant, $X^2(1, N = 4,352) = 1.08, p = .299$, Cramer's $V = .02$. Therefore, the null hypothesis was retained. In summary, there was not a significant relationship between gender and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. Figure 4 displays proportion of female and male students to that of their economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. Table 5 indicates the frequencies and associated percentages of female and male students to that of their economically disadvantaged status who were enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

Table 4

Gender and Economically Disadvantaged Status of Participants

	Not Economically Disadvantaged		Is Economically Disadvantaged		
	N	%	N	%	Total
Female	1,110	61.0	711	39.0	1,821
Male	1,582	62.5	949	37.5	2,531
Total	2,692		1,660		4,352

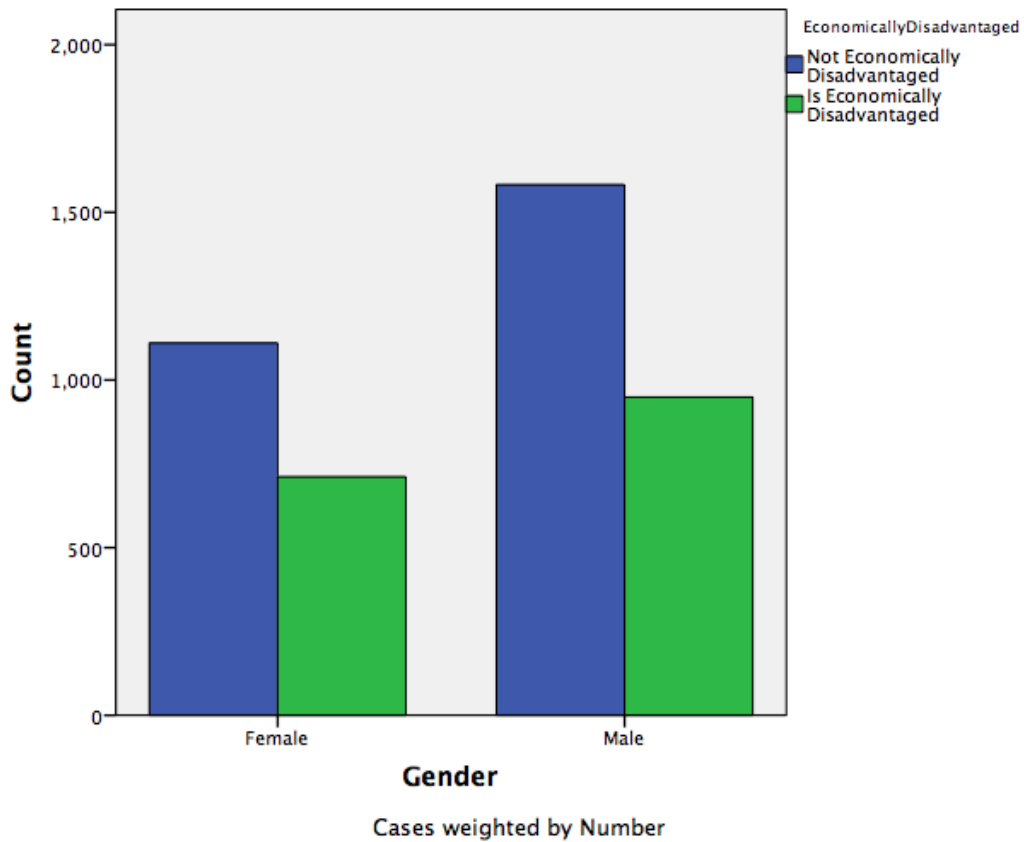


Figure 5. Gender and Economically Disadvantaged Proportions.

Research Question 5

Is there a significant relationship between race and disability status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

H₀5: There is not a significant relationship between race and disability status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

A two-way contingency table analysis was conducted to evaluate whether there was a significant relationship between race (nonwhite and white) and disability status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. The analysis indicated that the relationship between race and disability status was not significant, $X^2(1, N = 4,352) = .11, p = .737, \text{Cramer's } V = .01$. Therefore, the null hypothesis was retained. Figure 5 displays proportion of nonwhite and white students to that of their disability status. In summary there was not a significant relationship between race and disability status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. Table 6 indicates the frequencies and associated percentages of nonwhite and white students to that of their disability status who were enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

Table 5

Race and Disability Status of Participants

	Is Not Disabled		Is Disabled		Total
	N	%	N	%	
Nonwhite	1,029	98.6	15	1.4	1,044
White	3,265	98.7	43	1.3	3,308
Total	4,294		58		4,352

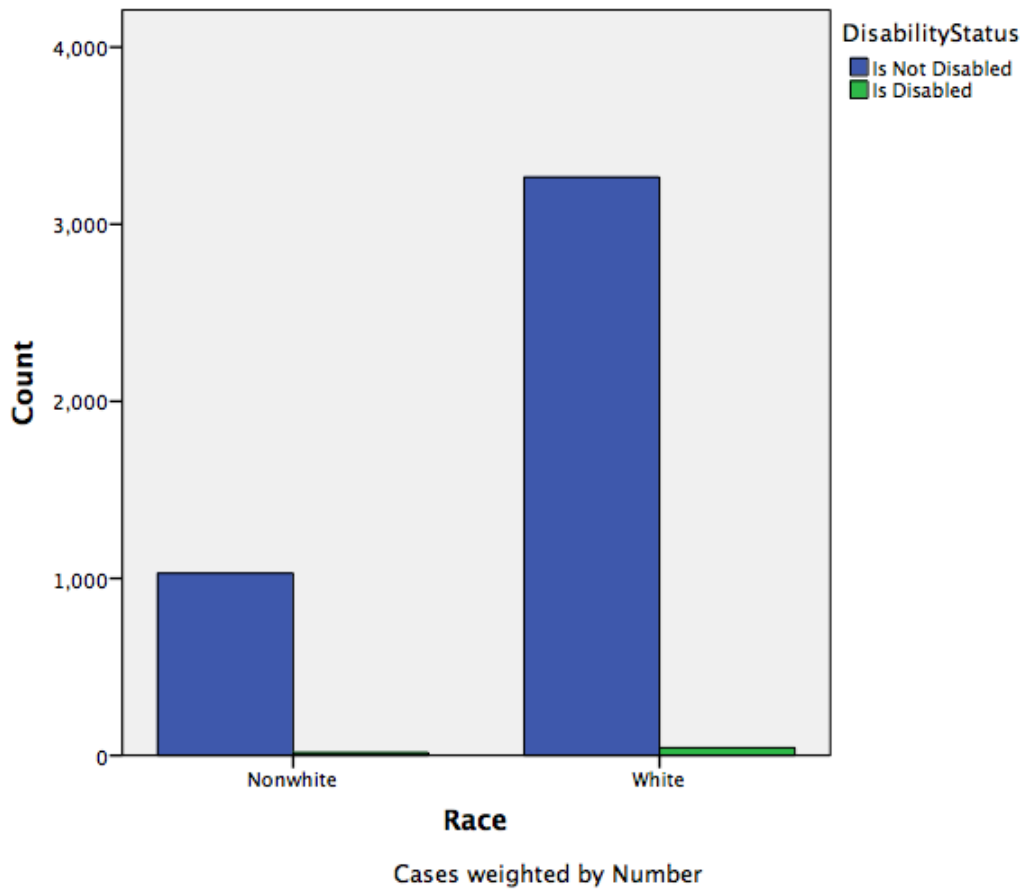


Figure 6. Race and Disability Proportions.

Research Question 6

Is there a significant relationship between race and single parent status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

H₀6: There is not a significant relationship between race and single parent status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

A two-way contingency table analysis was conducted to evaluate whether there was a significant relationship between race (nonwhite and white) and single parent status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. The analysis indicated that the relationship between race and single parent status was significant, $X^2(1, N = 4,352) = 28.68, p < .001, \text{Cramer's } V = .08$. Therefore, the null hypothesis was rejected. In summary there were significantly fewer white students who were single parents than nonwhite students who were single parents. Figure 6 displays proportion of nonwhite and white students to that of their single parent status. Table 7 indicates the frequencies and associated percentages of nonwhite and white students to that of their single parent status who were enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

Table 6

Race and Single Parent Status of Participants

	Not a Single Parent		Is a Single Parent		Total
	N	%	N	%	
Nonwhite	912	87.4	132	12.6	1,044
White	3,066	92.7	242	7.3	3,308
Total	3,978		374		4,352

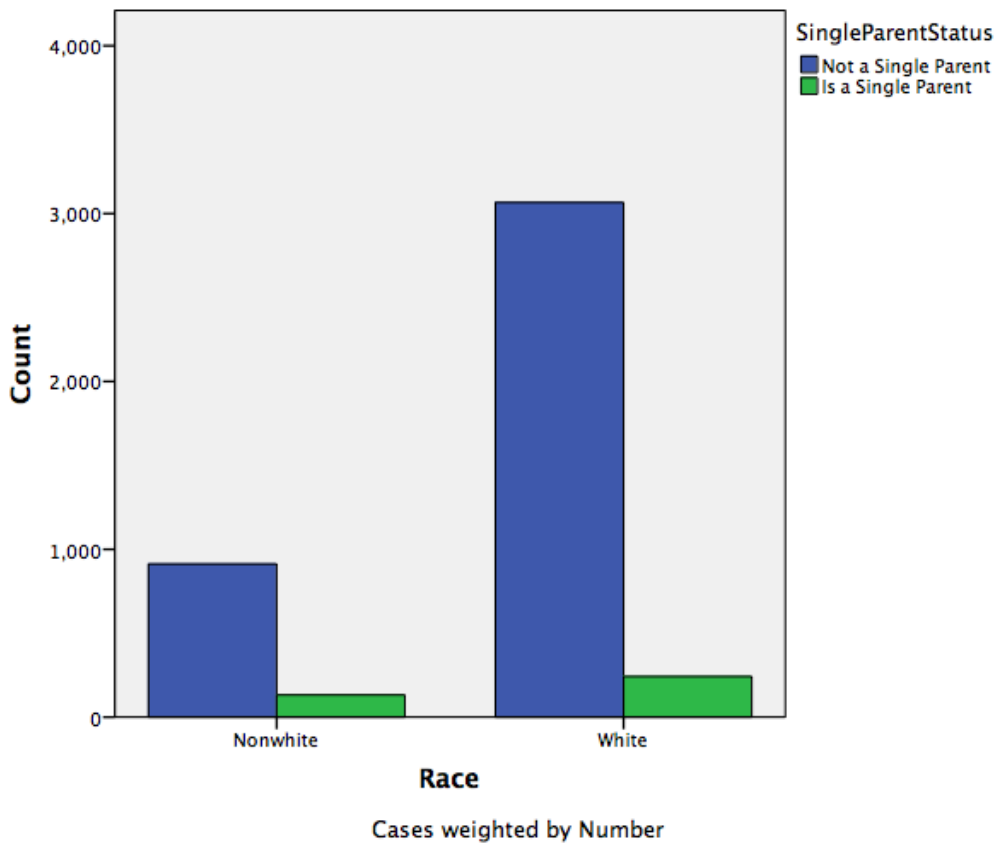


Figure 7. Race and Single Parent Proportions.

Research Question 7

Is there a significant relationship between race and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

Ho7: There is not a significant relationship between race and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

A two-way contingency table analysis was conducted to evaluate whether there was a significant relationship between race (nonwhite and white) and economically disadvantaged status of students enrolled at Tennessee Colleges of Applied Technology advanced manufacturing skills programs. The analysis indicated that the relationship between race and economically disadvantaged status was significant, $X^2(1, N = 4,352) = 166.92, p < .001$, Cramer's $V = .20$. Therefore, the null hypothesis was rejected. Figure 7 displays proportion of nonwhite and white students to that of their economically disadvantaged status. In summary there was a significant relationship between race and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs whereas there were fewer white students who were economically disadvantaged than nonwhite student who were economically disadvantaged. Table 8 indicates the frequencies and associated percentages of nonwhite and white students to that of their economically disadvantaged status who were enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

Table 7

Race and Economically Disadvantaged Status of Participants

	Not Economically Disadvantaged		Is Economically Disadvantaged		
	N	%	N	%	Total
Nonwhite	469	44.9	575	55.1	1,044
White	2,223	67.2	1,085	32.8	3,308
Total	2,692		1,660		4,352

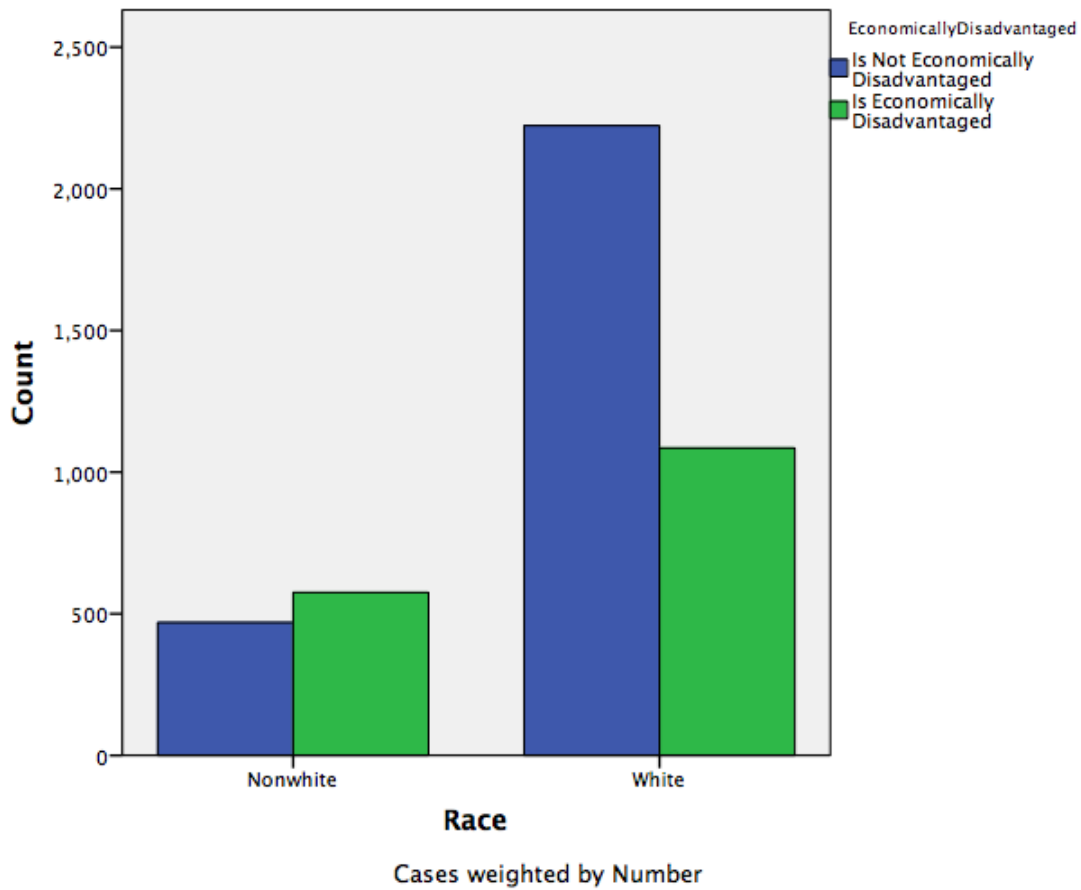


Figure 8. Race and Economically Disadvantaged Proportions.

Research Question 8

Is there a significant difference in completion rates between female and male students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

H₀8: There is not a significant difference in completion rates between female and male students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

A two-way contingency table analysis was conducted to evaluate whether there was a significant difference between female and male students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. The analysis indicated that the difference between female and male was significant, $X^2(1, N = 4,352) = 8.94, p = .003$, Cramer's $V = .05$. Therefore, the null hypothesis was rejected. Figure 8 displays proportion of female and male students to that of their program completion rates. In summary there was a significant difference between female and male students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs whereas more males completed the program than did females. Table 9 indicates the frequencies and associated percentages of female and male students to that of their program completion who were enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

Table 8

Gender and Program Completion Status of Participants

	Did Not Complete Program		Did Complete Program		Total
	N	%	N	%	
Female	656	36.0	1,165	64.0	1,044
Male	802	31.7	1,729	68.3	2,894
Total	1,458		1,660		4,352

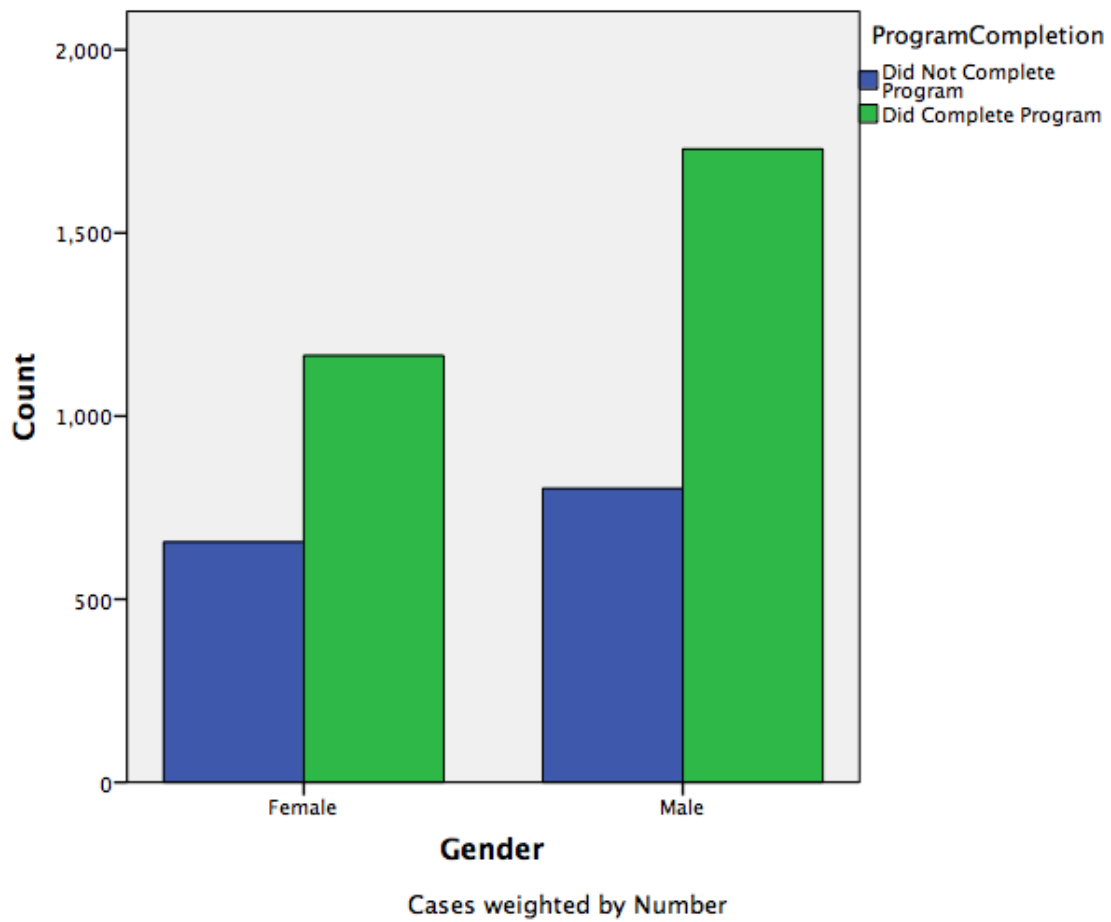


Figure 9. Female and Male Program Completion Proportions.

Research Question 9

Is there a significant difference in completion rates between white and nonwhite students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs?

H₀9: There is not a significant difference in completion rates between white and nonwhite students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

A two-way contingency table analysis was conducted to evaluate whether there was a significant difference between nonwhite and white and program completion rates of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. The analysis indicated that the difference between female and male was significant, $X^2(1, N = 4,352) = 17.89, p < .001$, Cramer's V = .06. Therefore, the null hypothesis was rejected. Figure 10 displays proportion of nonwhite and white students to that of their program completion rate. In summary there was a significant difference between nonwhite and white students and their program completion rate who were enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs whereas more white students completed their program of study than nonwhite students. Table 9 indicates the frequencies and associated percentages of nonwhite and white students to that of their program completion rates enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

Table 9

Race and Program Completion Status of Participants

	Did Not Complete Program		Did Complete Program		Total
	N	%	N	%	
Nonwhite	406	38.9	638	61.1	1,044
White	1,052	31.8	2,256	68.2	3,308
Total	1,458		1,660		4,352

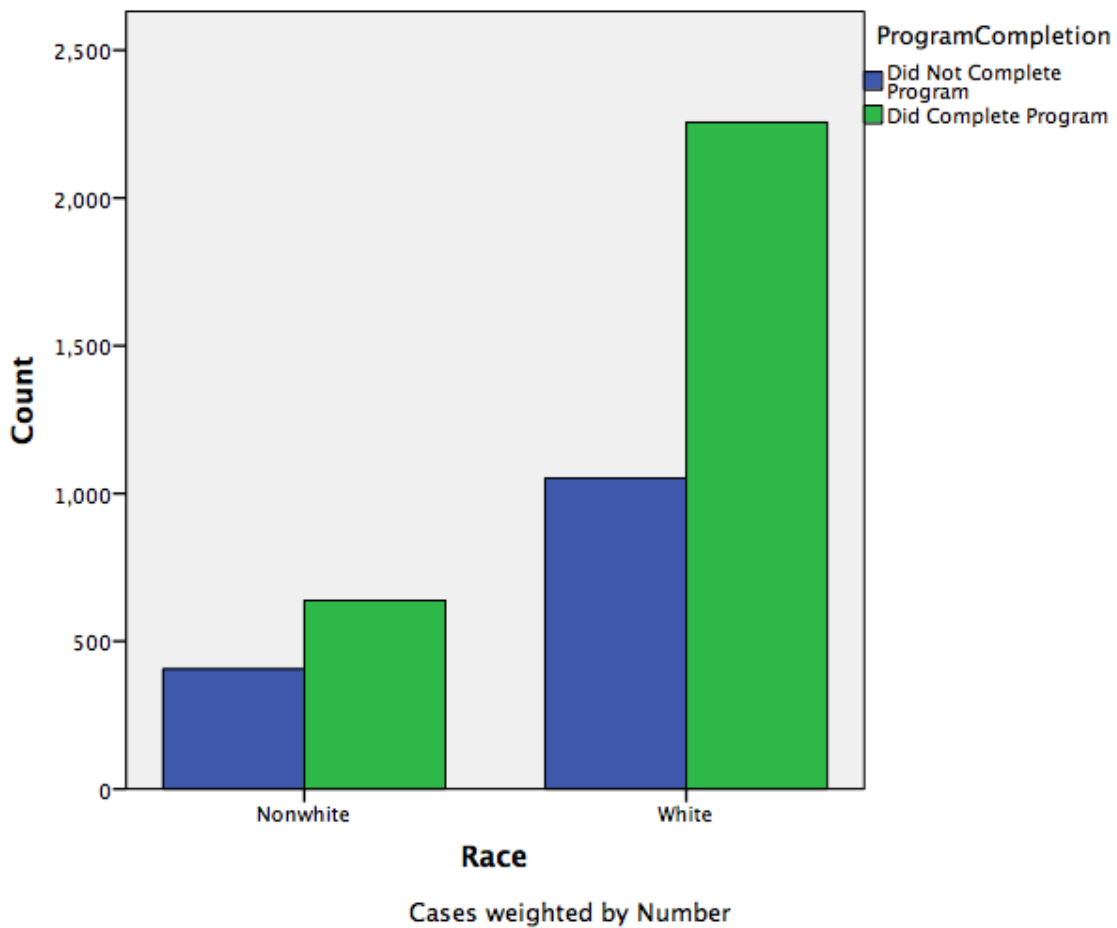


Figure 10. Nonwhite and White and Program Completion Status Proportions.

Chapter Summary

Chapter 4 presented the data analysis that addressed each of the nine research questions. Student demographic information was used to explore each hypothesis to determine if significant relationships existed between gender and race, gender and disability status, gender and single parent status, gender and economically disadvantaged status, race and disability status, race and single parent status, and race and economically disadvantaged status. Additionally, differences of program completion status between females and males and differences of program completion status between nonwhite and white students were examined.

Results from the two-way contingency table analyses indicated there was a significant relationship between gender and race whereas there were more white females than nonwhite females and more white males than nonwhite males. There were fewer females with disabilities than males with disabilities. Data indicated there were fewer white students who were single parents than nonwhite students. More nonwhite students were economically disadvantaged than white students. Fewer females completed their program of study than males who completed their program of study and finally more white students completed their program of study than nonwhite students.

CHAPTER 5

SUMMARY, RECOMMENDATIONS, AND CONCLUSIONS

The implications of the results defined in Chapter 4 are presented in this chapter. It also restates the purpose, reviews the process, summarizes the results, and provides recommendations for additional research question.

According to Kessler (2014) and Cohn and Taylor (2010) until the year 2020, 10,000 baby-boomer workers are and will be leaving the workforce due to their retirement. This is especially important to bear in mind when considering the pathway of staffing the depleting workforce with a skilled and diverse workforce in order to maintain whatever economic strength the United States wishes to enjoy. Therefore, understanding the demographic characteristics of students currently enrolled in the 27 Tennessee Colleges of Applied Technology may foster understanding of how to recruit and attract a diverse workforce to replenish the waning workforce due to the lack of skilled personnel.

Summary

The purpose of this quantitative nonexperimental descriptive study was to determine if significant relationships exist between gender and race, gender and disability status, gender and single parent status, gender and economically disadvantaged status, race and disability status, race and single parent status, and race and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. Finally, differences in completion rates between female and male students as well as differences in

completion rates between white and nonwhite students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

Research Question 1

Results indicated that both white female and white male students outnumbered nonwhite female and male students. Collectively, there were almost four times as many white students as nonwhite students. Denson and Park (2013) confirmed that institutions of higher education were woefully under-represented in the areas of both socioeconomic diversity as well as diversity in race; schools still lacked the heterogeneity desired in higher education. However, they stated that schools were actively involved in recruiting nonwhite students with benefits of special financial aid availability yet with less than desired results of a more racially diverse campus. Tennessee Colleges of Applied Technology encourage a diverse student body. The data results of relationships between race and economically disadvantaged status will be addressed in Research Question 7 findings where similar results are indicated.

Research Question 2

Relatively few students were categorized as being disabled (0.9% of females and 1.7% of males). Overall, only 1.3% of the total population indicated a disability. Therefore, there was no significant relationship between the variables. The category of disability was not disclosed in the data received and could have included disabilities ranging from learning disabilities to physical disabilities. Dychtwald et al. (2016) indicated that the lack of a diverse workforce could be problematic when meeting federal mandates. They implied that the workforce was not meeting or

exceeding federal mandates including persons with disabilities. The results of a significant relationship between gender and disability status found here were consistent with that research.

Research Question 3

The results indicated no significant relationships between female and male students and their single parent status while enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. Only 9.1% of the 1,821 females reported being single parents while only 8.3% of the 2,322 males reported being single parents. Overall, only 8.6% of the population (4,352) reported being single parents. These results were consistent with Monnotte (2012) in that although single parents found it difficult to meld work and home life there was no indication there was a lack of diversity with respect to persons categorized as single parents.

Research Question 4

The results indicated no significant relationships between gender and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. Thirty-nine percent of females were economically disadvantaged while 37.5% of males were economically disadvantaged. Collectively, 38.1% were economically disadvantaged. These results were inconsistent with Dychtwald et al. (2006) who found that the workforce was underperforming with respect to a diverse workforce including those who were economically disadvantaged.

Research Question 5

Where significant relationships between race and disability status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs were concerned, the results implied that there was no significant relationship between race and disability status. Only 1.4% of nonwhite students were disabled. Further, 1.3% of white students were disabled. No significant relationship was reported between race and their disability status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills program. These results were inconsistent with Taggart (2007) who inferred the workforce was not diverse enough where disabilities were concerned. Taggart found that persons with disabilities were less likely to enter the workforce where discrimination was probable and that human resources needed specific plans of merging those with disabilities into the workforce.

Research Question 6

The results indicated significant relationships between race and single parent status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills program. Approximately 12.6% nonwhite students were single parents. Additionally, 7.3% of white students were single parents. Overall, 8.6% of students were single parents. The results showed a significant relationship between race and their single parent status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. These results were consistent with Minnotte (2012) who reported fewer single parents were entering the workforce for various reasons also suggesting that single parents were less likely to gain necessary skills to succeed in the workforce.

Research Question 7

Results indicated a significant relationship between race and economically disadvantaged status. Approximately 55.1% of nonwhite students were economically disadvantaged and 32.8% of white students were economically disadvantaged. Collectively, 38.1% of nonwhite and white students were economically disadvantaged. The results showed a significant relationship between race and their economically disadvantaged status of students who were enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. These results were consistent with Dychtwald et al. (2006) who found that the workforce was underperforming with respect to a diverse workforce including those who were economically disadvantaged.

Research Question 8

The results showed there was a significant difference between gender and program completion rates. Sixty-four percent of female students completed the program while 68.3% of males completed the program. Collectively, 66.5% of females and males completed the program. The results indicated a significant difference between females and males and their program completion rates. In both cases almost one-third of students did not complete the program while two-thirds did complete the program. These results were inconsistent with Buchmann and DiPrete (2006) who found that in general females were surpassing postsecondary completion rates than males. However, the researches claimed that mitigating factors such as race and socioeconomic status could contribute to females not completing postsecondary training.

Research Question 9

The results indicated a significant difference between race and program completion rates of those enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. Approximately 61.1% of nonwhite students completed the program and 68.2% of white students completed the program. Collectively, 66.5% of nonwhite and white students completed the program. However, these results were inconsistent with Krymkowski and Mintz (2011) who reported in their study that white female and male college students slightly decreased in college completion rates than that of nonwhite female and male college students.

Recommendation for Practice

This research can be used by varying groups of people who have the responsibility of recruitment of students graduating from high school in addition to potential nontraditional students. Those groups may include but are not limited to teachers, principals, guidance counselors, Tennessee Colleges of Applied Technology student services and recruitment departments, employers, academic advisors, and parents. Therefore the following must occur:

1. The understanding of the characteristics of current postsecondary technical school enrollees should be evaluated and recruitment practices adjusted to better target ideal students who would be beneficial to the advanced manufacturing sector as well as provide an above average paying career that would directly and positively effect local and state economies.
2. Administration and recruitment personnel of postsecondary technical schools should evaluate and adjust recruitment practices of nonwhite students as well as

female students and how to effectively inform them the market need of a skilled labor force.

3. Target recruitment should occur of nonwhite and white students who are economically disadvantaged concerning the means and ways this demographic could take advantage of readily available financial aid in order to become highly trained in what the skilled labor market demands.
4. Postsecondary technical schools administration and recruitment personnel should evaluate program and course accessibility in order to deliver the teaching material to persons with disabilities. Additionally, recruitment of persons with disabilities must occur in order to encourage those potential students with disabilities the possibilities to train for the skills the market demanded.

Recommendations for Future Research

The following recommendations for future research could aid in improved understanding of the populace when recruiting potential students for postsecondary training as skilled laborers.

1. Conduct further research that focuses on specific areas of the state of Tennessee (east, middle, and west) to discover more specific data of the characteristics of students enrolled in Tennessee Colleges of Applied Technology and how the three main geographic regions of the state are compared to the others.
2. Expand research concerning reasons students withdrew or were withdrawn from their program of study. Conducting such research could aid in remedying potential roadblocks for students to be able to complete their course of study.

3. Qualitative research should be conducted involving high school seniors to discover their perspective and attitudes towards postsecondary technical training versus postsecondary 2-year or 4-year college education in order to evaluate and adjust where necessary marketing methodologies.
4. Investigate successful Tennessee Colleges of Applied Technologies that enjoy a diverse student body as well as successful completion and placement rates of their respective program of study. Such research could help struggling Tennessee Colleges of Applied Technology to implement best practices in their particular service area.
5. Examine skills programs other than advanced manufacturing skills programs to discover if similar phenomena exist. Other skill programs could include but not limited to nursing, machine tool and die, automotive disciplines, welding, and allied health programs of study.
6. Conduct further research of community colleges that offer similar programs of study in advanced technologies (Associate of Applied Science degrees). Comparing and contrasting data from community colleges to Tennessee Colleges of Applied Technology could help understand best practices, student demographic differences and relationships, and perspectives of technical education versus 2-year college training.
7. Conduct qualitative research of parents to discover their perspective and value placed on postsecondary technical education. Such research could aid in understanding what measures are necessary in marketing postsecondary technical education in correcting poor attitudes toward skilled laborers.
8. Replicate this study after the *Tennessee Promise* initiative has completed a full cycle (initial enrollment to graduation) to discover if statistics improved gender and race

equity as well as, and more importantly, improved program completion rates or did the initiative have no effect on the results.

Conclusions

This research discovered relationships between gender and race, gender and disability status, gender and single parent status, and gender and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. Further, this research discovered relationships between race and disability status, race and single parent status, and race and economically disadvantaged status of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs. Additionally, this research discovered differences between gender and program completion rates as well as race and program completion rates of students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs.

With respect to students enrolled in Tennessee Colleges of Applied Technology advanced manufacturing skills programs this study found significant relationships between gender and race (nonwhite and white) where the results indicated there were more white female and male students than nonwhite female and male students. This study found significant relationships between gender and their disability status where fewer females were classified as disabled than males. However, this study did not find significant relationships between gender and their single parent status. Likewise, this study did not find significant relationships between gender and their economically disadvantaged status nor did this study find significant relationships between race (nonwhite and white) and their disability status. This study found significant relationships between race (nonwhite and white) and their single parent status where the results indicated

significantly more nonwhite students were single parents than white students who were single parents. Significant relationships were found between race and their economically disadvantaged status where significantly more nonwhite students not economically disadvantaged than there were white students who were economically disadvantaged. Concerning results of differences between gender and program completion rates and between race (nonwhite and white) program completion rates, this study found significant differences in both cases. More males completed their program of study than did females and more white students completed their program of study than nonwhite students.

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APPENDICES

APPENDIX A

TBR Memorandum of Support



TENNESSEE BOARD OF REGENTS

Office of Academic Affairs

1 Bridgestone Park | Nashville, TN 37214-2428 | Phone 615.366.4482 | Fax 615.366.3903 | www.tbr.edu

November 2, 2016

Janine Olive, BSN, CCRC
Director, HRPP
ETSU
Box 70565
Johnson City, TN 37614

Good afternoon,

I am writing to express my support for Timothy N. Wilson's dissertation project, *Demographic Characteristics of Students Enrolled in a Tennessee College of Applied Technology*. This dissertation will assist the Tennessee Board of Regents to better understand our College of Applied Technology (TCAT) students and thus help us to better tailor student support services. I have been in contact with Mr. Wilson and have a clear understanding of the objective of his research and data needs. Furthermore, Mr. Wilson has acknowledged his responsibility for the protection and security of the data, which will be anonymized prior to delivery. Given that the Tennessee Board of Regents Office of Academic Affairs is prepared to support this dissertation by synthesizing and delivering unit record TCAT enrollment data to Mr. Wilson.

If you have any questions, please feel free to contact me.

Sincerely,



Chris Tingle
Special Assistant to the Vice Chancellor for Academic Affairs
Tennessee Board of Regents
chris.tingle@tbr.edu

APPENDIX B

IRB Letter of Exemption



EAST TENNESSEE STATE
UNIVERSITY

Office for the Protection of Human Research Subjects • Box 70565 • Johnson City, Tennessee 37614-1707
Phone: (423) 439-6053 Fax: (423) 439-6060

November 17, 2016

Dear Tim,

Thank you for recently submitting information regarding your proposed project "Demographic Characteristics of Students Enrolled in a Tennessee College of Applied Technology".

I have reviewed the information, which includes a completed Form 129.

The determination is that this proposed activity as described meets neither the FDA nor the DHHS definition of research involving human subjects. Therefore, it does not fall under the purview of the ETSU IRB.

IRB review and approval by East Tennessee State University is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these activities are human subject research in which the organization is engaged, please submit a new request to the IRB for a determination.

Thank you for your commitment to excellence.

Sincerely,
Stacey L. Williams, Ph.D.
Chair, ETSUIRB



Accredited Since December 2005

VITA

TIMOTHY N. WILSON

Education: East Tennessee State University, Johnson City, TN. Ed.D.
Educational Leadership, May 2017
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Curriculum and Instruction, May 2013
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