APPLIED TEACHING METHOD AT A CAREER TECHNICAL CENTER TO SUPPORT BUSINESS AND INDUSTRY DEMAND FOR AN ACADEMIC AND TECHNICAL SKILLED WORKFORCE

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Career Technical Education is at the forefront of education reform efforts. This is in response to business and industry demand for a workforce that is both academically and technically skilled at proficiency levels to meet workforce needs. Additionally, the Carl D. Perkins Improvement Act of 2006 mandates the integration of academic standards within career technical content to support business and industry with skilled workers to compete in the global economy. However, shared-time career technical centers often do not employ full-time academically certified teachers, which limits teacher collaboration opportunities to support academic integration. The aim of this qualitative study was to apply a teaching method that employs academic and technical skill content simultaneously using an integrated real-work project-based learning design to determine students' reception to learning academic content while also learning technical skill content. A welding program of study teacher and students participated in this study. Three findings emerged with implications that the integrated project design supports students' academic and technical skill growth, as well as employability skill development.

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GLOSSARY OF TERMS AND ABBREVIATIONS

Term	Definition
Academic Integration	Mandate by the Carl D. Perkins Career and Technical Education Improvement Act of 2006 (PL 109-207) to integrate academic content standards within career technical education programs of study curricula.
Academic Proficiency	Reading, writing, and mathematics level of cognitive ability required to reach the proficient level on the Pennsylvania Keystone literacy and algebra assessments; interchangeable with academic proficiency.
Academic Skills	Reading, writing, and mathematics development to reach academic proficiency.
Act 6 of 2017	**A**mended section 121 of the Pennsylvania School Code, 24 P.S. § 1-121; sets forth alternative pathways to graduation for students who are career and technical education (CTE) concentrators. (Appendix B for full version of Act 6)
Career Ready	Includes three skill areas: academic skills and the ability to apply those skills in order to function in the workplace, employability skills that are essential in any career area, and technical skills related to a specific career program of study.
Career Clusters	Provides a structure for organizing and delivering quality CTE programs of study; 16 Career Clusters that help students discover their interest and empowers them to select a program of study that can lead to career success.

Career Pathway	Integrated collection of programs and services intended to develop students' core academic, technical and employability skills; provide them with continuous education, training; and place them in high-demand, high-opportunity jobs.
Career Technical Student Organization	(CTSOs) Student organizations designed to support students in CTE programs of study; career preparation opportunity for students to develop the technical and leadership skills that will earnable them to succeed in their career paths.
College	Education beyond high school; interchangeable with postsecondary.
College and Career Ready	Students prepared for postsecondary education (meet college entrance requirements), workforce training, and career readiness.
CTC	Career Technical Center – career technical education centers in the state of Pennsylvania that students elect to attend to learn technical skills and to prepare for future careers.
CTE	Career Technical Education - educational programs that specialize in the skilled trades, applied sciences, modern technologies, and *career* preparation; provides students with the academic and *technical* skills, knowledge, and training necessary to succeed in future careers and to become lifelong learners.
CTE Academic Mandate	Mandated by the Carl D. Perkins Career and Technical Education Improvement Act of 2006 (PL 109-207) to integrate academic content standards within career technical education curricula.
CTE Concentrator	A student who, by the end of a reporting year, will be reported as successfully completing at least 50 percent of the minimum technical instructional hours required under 22 Pa. Code Ch. 339; the student must be enrolled in a PDE-approved CTE program to be considered a CTE concentrator (as defined in Act 6 of 2017).

Employability Skills	The general skills that are necessary for success in the labor market at all employment levels need for success on the job that include: work ethic, motivation, positive attitude, active listening, communication, teamwork ability, prioritizing, responsibility, adaptability, networking, decision making, problem solver, critical thinker, empathy, flexibility, and self-starter (Appendix D).
Industry Credential	Certification a student may earn that demonstrates competency in specific knowledge and technical skills recognized by businesses, trade associations, or other industry groups.
New Vocationalism	A movement that promotes linking secondary and post-secondary education as well as teaching the technical and work-related skills needed by employers.
Nontraditional Career Growth	A non-traditional career is defined as one where more than 75 percent of the workforce is of the opposite gender; or, in other words, where less than 25 percent of the workforce is of one gender. The purpose of identifying non-traditional careers is to *grow* interest and accessibility to these careers with the goal of training and employing the under-represented gender. Examples of nontraditional careers: females employed in construction and automotive careers that traditionally employ males; males employed in cosmetology, elementary teaching, and clerical/secretarial careers that traditionally employ females.
Occupational Advisory Committee	(OAC) Established for each CTC approved program of study; the majority of the members of the committee are industry representatives to advise administration and teachers on curriculum, equipment, instructional materials, safety requirement, and other related matters and to verify that the programs meet current industry standards.
PDE	Pennsylvania Department of Education
Performance Indicators	Accountability measurers used to evaluate CTCs on an annual basis. Following are the performance

indicators measured as mandated by Perkins IV (Appendix C).

Perkins IV	Abbreviation for the Carl D. Perkins Career and Technical Education Improvement Act of 2006 (PL 109-207).
Postsecondary	Education beyond high school; interchangeable with college.
Program of Study	Continuous course work that integrates technical skills with academic content that prepares students for the workplace and further education and training; aligns secondary and postsecondary curricula and offers students the ability to explore careers, earn industry recognized credentials, and participate in articulated credit-earning postsecondary opportunity.
Shared-time CTC	Career technical center consisting of several adjacent school districts within an approved regionally based area that agree to offer students CTE programs of study at a common school campus.
Soft Skills	Personal attributes needed for success on the job; includes: reading, writing, mathematics, work ethic, motivation, positive attitude, communication, teamwork ability, networking, decision making, problem solver, critical thinker, flexibility, and self-starter; interchangeable with employability skills.
Teamwork	Involves two or more individuals with complementary background and skills, sharing common goals and work requirements to meet employer expectations.
Technical Assistance Program	**(**TAP) Provided by PDE, the Technical Assistance Program assists CTCs with increasing quality CTE programs of study and ensuring that programs align with workforce development priorities by providing professional development opportunities for administrators and teachers that are designed to improve students' academic and occupational learning.

Technical Skill	Career occupational-specific knowledge and skill.
WIOA	Workforce Investment Opportunity Act - designed to help job seekers access employment, education, training, and support services to succeed in the labor market and to match employers with the skilled workers they need to compete in the global economy.
Work-based Learning	On-the-job training; includes internships, mentoring, and apprenticeship; allows students to gain hands-on work experience outside of the classroom.
Workplace Competency	Characteristics needed to succeed in a particular career; combined academic proficiency, soft skill, and technical skill competence.
Workforce Investment Board	(WIB) Conducts and publishes research on programs and the needs of their regional economy and arranges for a service delivery system that meets the workforce needs of businesses.

1.0 INTRODUCTION

Since the early 1900's, public education has prepared students for the workforce and their individual contribution to the economy through vocational education programs. First introduced through the Smith-Hughes Act of 1917, vocational education classes were designed for students not considered smart enough to attend postsecondary education (Threeton, 2007). This non-academic track emphasized separating vocational students from general education courses, and instead offered vocational curriculum designed to meet the needs of students of the working class and were headed in the direction of traditional blue-collar non-professional jobs (Gray, 1991). Because early vocational programs had a narrow focus on entry-level job training with an inadequate academic foundation, students' access to postsecondary education opportunities were limited (Zisner & Poledink, 2005). Additionally, vocational programs were not effectively preparing students to enter highly skilled work-related occupations.

However, today's requirements for postsecondary education, coupled with the demand from business and industry for an academic and skill proficient workforce, dictate that vocational programs should integrate academics within vocational education curriculum to enhance academic knowledge and skills embedded in technical content (NRCCTE, 2010). This concept was first introduced through Perkins II in 1990 and Perkins III in 1998 (PCRN, n.d.). The Carl D. Perkins Career and Technical Education Improvement Act of 2006 (PL 109-207), also known as Perkins IV, was enacted and officially changed vocational education to Career Technical

Education (CTE). A major policy objective of Perkins IV is the integration of academics into CTE curriculum to increase career and academic proficiency. Perkins IV also strengthened the responsibility of CTE educators to integrate academics within technical standards to support the college and career readiness initiative and to reduce remediation in academic areas (NRCCTE, 2010). A study conducted by the National Research Center for Career Technical Education (2010) states:

> Vocational and academic education have been growing apart at least since 1890; the split between the two is a deep one—one which affects content and purpose, teaching methods, teacher training and philosophy, the kinds of students in vocational and academic programs, and status. Healing this division is a difficult and time-consuming process. (p.3)

In other words, by integrating academic standards within CTE curriculum, career technical education is attempting to break educational traditions that have been historically legislated and funded to operate as a separate track of learning. Nevertheless, changing the mindset that CTE is an inferior educational option for students hinders efforts to educate students through CTE programs of study because it is perceived as a "second-best" or a "blue collar" future for students that limits their postsecondary options (NRCCTE, 2010).

The purpose of this study is to evaluate project-based learning that implements academic integration into a CTE program of study at a shared-time Career Technical Centers that lacks full-time academically certified teachers. I am seeking information to gain knowledge and understanding about the "how" of the problem; the phenomenon of how CTE students increase their academic learning that is generally not expected while taking CTE courses at shared-time CTCs. In other words, how do CTE instructors teach academic content within their technical skill content? Are students motivated to take more interest in their academic learning as a result? Researching these types of questions may provide exemplars of academic integration success that may lead to instructional change for CTE teachers to increase students' learning gains.

Information may also guide teachers to develop new outlooks for teaching integrated curriculum and evaluate what is important, which could influence their perception of the integration process. This is important for career technical education throughout the state of Pennsylvania because, as noted earlier, academic integration is a mandatory requirement for recipients of Perkins IV; to comply with the mandate, each Perkins recipient must provide a description of how support of the integration of academics into career-related programs of study is conducted. Additionally, the requirement to succeed in today's global industry has changed as the demand for a workforce both academic and career-related skill proficient has increased. (Threeton, 2007). Teaching challenging CTE courses will assist with changing the inferior education mindset currently perceived (NRCCTE, 2010, EPLC, 2016).

Furthermore, the integration of academics into career technical education is a concept that CTE instructors struggle with because they are not trained academic teachers (Drage, 2010). The study will investigate not only how academic integration into career technical education may motivate and improve student achievement, but also support teachers as they struggle to master academic integration. It is also important to note that the current Pennsylvania Department of Education's Educator Effectiveness evaluation system, using the Danielson Framework for Teaching, is designed to "support the development of more effective teachers in the classroom as well as educators in school leadership positions. The goal is to improve student achievement so that all of the children in Pennsylvania's public schools are prepared to enter a career or postsecondary training and become productive citizens." (Danielson, 2009). Providing CTE teachers with professional development and resources to help them overcome their struggle to implement academic integration for students' success is interconnected through the Danielson Framework for Teaching: Domain 1, Planning and Preparation; Domain 2, Classroom

Environment; Domain 3, Instruction; and Domain 4, Professional Responsibilities (Danielson, 2009).

Figure 1 illustrates how academic integration into career technical education programs of study can lead to improved student achievement through teachers' professional development and growth:

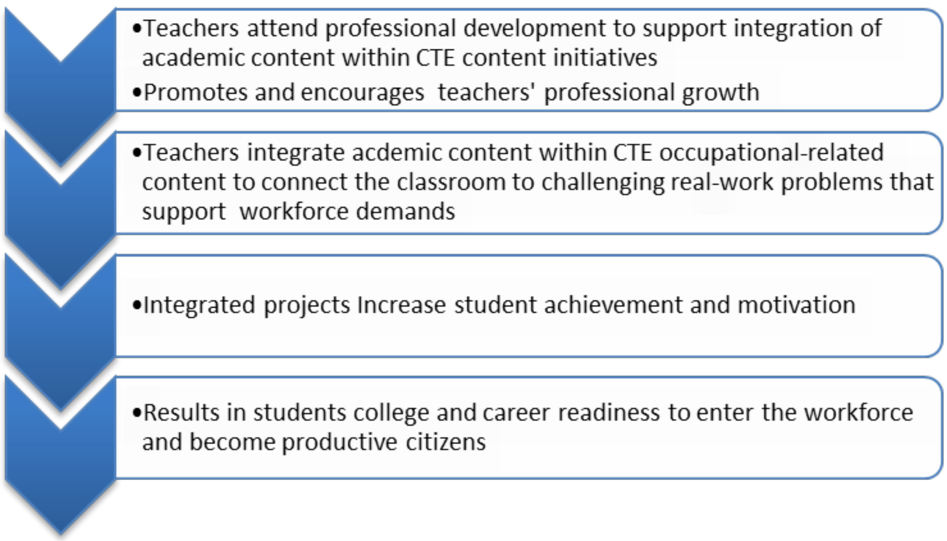


Figure 1. Linking academic integration within CTE programs of study to improve student achievement and teachers' professional development and growth.

1.1 RESEARCHER'S POSITION

As a CTE teacher, district level supervisor, and CTC Administrative Director, I have attended many professional development opportunities to learn integrated teaching methods. In my position as a CTE supervisor and Director, I have worked with teachers to develop lesson plans that embed academic standards into CTE curriculum; but creating a lesson plan with both academic and technical standards is not enough. Application of the combined standards must be implemented during teaching and learning for integration to be effective. Additionally, it has been my experience that CTE teachers are often not adequately prepared to teach academic content within their program of study and some are resistant to integrated strategies because they do not think it is their job to teach academic content.

Research indicates, “secondary vocational education is not likely to be a widely effective strategy for improving academic achievement or college attendance without substantial modifications to policy, curriculum, and teacher training” (Doughtery, 2016). Nevertheless, academic content that is naturally embedded in a program of study often becomes the responsibility of CTE teachers to teach in order for students to successfully develop occupational skills (Walter & Gray, 2001). However, CTE teachers must be prepared and willing to include academic integration within their content areas but often lack resources, knowledge and professional development to be effective (Neal, 2015).

Most CTE teachers who are employed at shared-time CTCs have, at a minimum, two years of industry experience in their content area and then enter a vocational education teacher certification program through one of three PDE recommended Career and Technical Education Professional Personnel Development Centers: Indiana University of Pennsylvania, Temple University or The Pennsylvania State University (PDE, 2017). Once accepted into a vocational teacher certification program, career center teachers are allotted twelve (12) years to earn their Vocational Education II teacher certification (PDE, 2017). Given the twelve-year allowance to earn a permanent vocational teaching certificate, are CTE teachers prepared to adequately teach students to be academic and occupationally skill proficient to meet high skill, high demand workforce trends by integrating academic standards in CTE content? Teachers may also struggle with preparing students for industry certifications because of reading, writing, and mathematics application requirements. Applying academic content within technical training could also increase students' successful industry certification attainment as well as academic proficiency.

To compound the problem of mandated academic integration and college and career readiness is CTC students' academic achievement in general. That is, before students enroll in a CTC, many are already identified as low achievers, yet the CTC is held accountable through performance indicators for their academic success (Bozock & Dalton, 2013, Carl D. Perkins, 2006). The accountability and challenges placed on the CTC and its teachers is also compounded by the continuous demand for a proficient academic and occupational skilled workforce.

As a CTC Administrative Director, I am in a position to conduct a study that could influence statewide use of a real-work project design that may reduce teachers' resistance to teaching academic and technical skill content and increase students' academic proficiency. Specifically, the purpose of my inquiry is to identify a strategy that could eliminate teacher resistance to academic integration. This strategy could also help students gain the employability knowledge and skills necessary to take on the demands of today's workforce for their chosen career pathway (Employability Skills Framework is in Appendix D).

2.0 LITERATURE REVIEW

"Well, I guess I have to be a math teacher now, too!" said a frustrated welding instructor one day while he was in my office because he had to teach a math lesson as part of his certification process. Though the math lesson was required, it has been my experience that many Career Technical Education (CTE) teachers do not realize that math, science, and literacy are naturally embedded in the theory behind their occupational skill. Despite this, CTE teachers are not comfortable teaching reading, writing, and math because they are not trained academic teachers, though they are highly skilled and experts in their industry field. To compound the problem, numerous shared-time Career Technical Centers (CTC) in Pennsylvania have few academic teachers or do not employ them at all. Therefore, CTE teachers often lack academic support (math and literacy teachers) which prevents the opportunity for CTE and academic teachers to foster collaboration around a common mission: to promote academic rigor and skill development that will support the growing demand for a workforce that is both academic and skill proficient.

2.1 PENNSYLVANIA CAREER TECHNOLOGY CENTERS

For this review, it is important to understand the structure of Career Technical Centers in the state of Pennsylvania that support workforce initiatives and teach students occupational and work-related skills. Occupational career technical education programs are normally offered at shared-time Career Technical Centers. Shared-time Career Technical Centers (CTCs) are joint schools consisting of several adjacent school districts within an approved regionally based area that agree to offer their students CTE programs of study at a common school campus. Each member school district of a CTC has representation on the CTC's Joint Operating Committee (JOC). The JOC acts as the school board for the CTC, which includes monthly board meetings, budget approval, personnel decisions, and support of CTC policy. Member school districts also provide the operating funds for the CTC; contributions to the CTC are determined through articles of agreement designed to outline the terms, rights, and obligations of the participating districts (EPLC, 2016).

There are 60 occupational shared-time CTCs in the state of Pennsylvania that only offer technical programs of study (limited or no academics courses). Students attend their CTC for half of the school day and attend academic courses at their sending school the other half of the day. CTCs offer career technical programs built around high expectations for student learning that include the development of strong reading, writing, numeracy, and employability skills (work ethic, motivation, active listening, communication, teamwork ability, decision-making, problem solving, critical thinking, prioritizing, and flexibility), in addition to the technical skills that motivate students and help them develop a career path for future education and work (Preble, 2018, Stringfield & Stone, 2017). However, several shared-time CTCs do not have the resources to support students' academic proficiency since students take academic courses at their sending schools and centers often do not employ full-time academically certified teachers. Due to the absence of academic teachers, integration at shared-time CTCs is a challenge for CTE teachers (EPLC, 2016; Restuccia et al., 2016).

2.2 FUTURE WORKFORCE

Career technical education is vital to our future workforce. The Pittsburgh region alone will require 34,000 new workers per year from 2015 through 2025 (Restuccia et al., 2016). The modern version of career technical education (skill and academic proficiency) is designed to meet the demand for the workforce by preparing secondary students with the skill and knowledge for entry-level employment, life-long learning, and postsecondary opportunities (PACTA, n.d.). Furthermore, modern CTE programs have high expectations for students' learning. These expectations include the development of strong reading, writing, numeracy, and employability skills in addition to the technical skills that motivate students and help them develop a career pathway for future education and work (Preble, 2018, Stringfield & Stone, 2017). The new CTE model is also part of the College and Career Readiness initiative that includes academic integration embedded in CTE curriculum (Stone & Lewis, 2012, Perkins IV, 2006). At the secondary level, instructors are encouraged to integrate rigorous academics into their occupational curricula with the emphasis of preparing students to enter the workforce or postsecondary education. In other words, the old "Vo-Tech" no longer exists…it has evolved into career technical centers that offer programs of study with rigorous standards for students' skill and academic learning to prepare them for industry certification attainment and postsecondary entrance and to prepare learners to take on the demands for todays' workforce (Perkins IV, 2006, EPLC, 2016, Boettcher, 2017). A Program of Study (POS) is a sequence of academic and career technical education coursework designed to help students attain a postsecondary degree or industry-recognized certificate or credential (Perkins IV, 2006, Garnes, D. & Hart, D. n.d., EPLC, 2016, Stipanovic, Lewis & Stringfield, 2012).

2.3 IMAGE OF CAREER TECHNICAL CENTERS

With increased expectations and workforce demands, CTCs continue to suffer from an "image" problem as occupational programs are often criticized for not offering rigorous curriculum (EPLC, 2016). In addition, CTE students typically do not perform well on state assessments that are required for all high school students (EPLC, 2016). As a result, students attending CTE programs have remained separated from the general education curriculum that offers advanced level course work since they are not considered smart enough to be "college material" (Threeton, 2007; Stone & Lewis, 2012; Meeder, 2009). This has caused concern among those that fear competition from global business markets, because the economic terrain has changed and employers are looking for employees with a different skill set. (Threeton, 2007). These skills include advanced technology, rapid decision-making, problem solving, and intelligent social skills (Threeton, 2007, Boettcher, 2017). As a result, the environment around CTE changed as modern programs from Computer Networking and Communications, Computer Programming, and Engineering to Sports Medicine and Exercise Science, Biomedical Science, Veterinary Science, and Biotechnology, require more academic content with the application of math and literacy in real-world context (Boettcher, 2017).

Earlier versions of Perkins II and III made headway to address workforce concerns, which resulted in the development of the Carl D. Perkins Career and Technical Education Act of 2006 (Perkins IV) as the driving force supporting current workforce demands. In spite of this, schools struggle to implement Perkins IV largely because of the separation of academic and CTE classes, especially at shared-time CTCs. Even though research indicates the value of CTE, as a context to support academics, student achievement remains allusive. Strong CTE programs minimize performance gaps, but there are inconsistencies in the way the schools classify students who enroll in CTCs and their coursework is limited (Aliaga, Kotamraju & Stone, 2014).

Furthermore, Pennsylvania's House Bill 202, also known as Act 6 of 2017 (Appendix B), was recently passed into law amending the Public School Code and allowing CTE concentrators to demonstrate academic proficiency in alternative pathways (see Appendix B for a description of alternative pathways). However, rigorous course work should persist as CTE students must continue to take the state's required Keystone Exams with the goal of meeting academic proficiency levels; if a CTE student does not meet the proficiency level, then the student will be eligible for an Act 6 alternative graduation pathway. Even so, educators still have a responsibility to ensure students are prepared to enter the real world with the employability skills to advance beyond entry-level positions in their chosen career pathway. Therefore, more balance is needed between curriculum integration and attention to individual students' literacy and math needs to increase student achievement levels. Literacy and math specialist could enhance students' learning by providing academic coaching support to CTE teachers (Meeder, 2009). Aliaga, Kotamraju & Stone (2014) state that evaluation of CTE both in the context of how well it prepares high school students for the workplace and its implications for students' achievement and continuing education are key issues with CTE reform efforts. Multiple activity systems such as programs of study, academic classes, earned industry-recognized credentials, work-based learning experiences, worksite visits, and Career Technical Student Organizations (CTSOs) are all relevant to CTE students' learning process to increase achievement and to enhance workforce development.

In addition, established Occupational Advisory Committees (OAC) review CTE curricula biannual to advise teachers about new industry trends and skill sets. This enables teachers to update objectives for their program so that they can prepare students with the recommend knowledge and skills for workforce needs. (Rojewski, Asunda & Kim, 2008). To support workforce demands, academic integration should be implemented into CTE course work at shared-time CTCs so that students graduate math and literacy proficient. With this in mind, can CTE teachers successfully integrate academic content into occupational curriculum without appropriate resources?

2.4 TECHNICAL AND ACADEMIC SKILLS

> Career technical education provides students and adults with the technical skills, knowledge, and training necessary to succeed in specific occupations and careers. It also prepares students for the world of work by introducing them to workplace competencies that are essential no matter what career they choose. And, career technical education takes academic content and makes it accessible to students by providing it in a hands-on context (Rojewski, Asunda & Kim, 2008).

Career Technical Education has a broad mission to educate students with technical and academic skills as it prepares students for a variety of career options via the national 16 Career Clusters and more than 79 career pathways (Advance CTE, n. d.). Career Clusters function as a guide in developing programs of study that connect secondary to postsecondary education and are used to create students' plans of study for a range of career pathway options (Stipanovic, Lewis & Stringfield, 2012). As such, it helps students choose a career pathway that leads to the steps required for their future career success (Advance CTE, n. d., Stipanovic, Lewis & Stringfield, 2012). Therefore, teachers must use a range of strategies to motivate students while integrating academics within skill context. The integration of CTE standards with academic content is associated with students gaining knowledge and skill in context that reinforces intellectual as well as practical learning (NRCCTE, 2007). As a result, students remain engaged and motivated because they are stimulated intellectually and can see how their learning applies to their lives and future career (Stone & Aliaga, 2014).

The theory of action for academic integration within CTE curricula stems from the U.S. Department of Labor‘s Workforce and Innovation Opportunity Act (WIOA). WIOA states that employment and training services should coordinate so that job seekers acquire skills and credentials that meet employers' needs (2015). The Carl D. Perkins Career and Technical Education Improvement Act of 2006 supports the WIOA by mandating integrated academic standards into CTE curriculum so that students graduate academic and work-related skill proficient, college and career ready, and with an industry-recognized credential to enter the workforce with the ability to advance beyond entry level positions.

Career technical education is a critical element in the development of highly skilled talent. A decline in the number of CTE graduates and inconsistencies in the overall quality of the K-12 system present a substantial risk to employers’ long-term ability to fulfill hiring needs in an increasingly skill-driven economy (Bottoms & Sundell, 2016). Areas of excellence exist within the region, but large-scale policy and spending reforms are necessary to minimize performance gaps and better prepare students for postsecondary training and the workforce (Restuccia et al., 2016). The assessment of CTE both in the context of how well it prepares high school students for the workplace and its implications for continuing education are key issues with the CTE reform efforts (Aliaga, Kotamraju & Stone, 2014). Rojewski, Asunda and Kim (2008) suggest that CTE curriculum be continuously reviewed to support trends and needs affecting industry. The curriculum review stimulates programs of study to meet goals and objectives in order to meet the demands for a skilled workforce that is academic and skill proficient (Rojewski, Asunda & Kim, 2008). As a result, OACs are established for each approved program of study to ensure CTE curriculum meets industry standards.

2.5 CTE TEACHERS AND ACADEMIC INTEGRATION

Many CTE teachers have not been trained to teach academic components within their skill curricula because professional development is either not provided or teachers do not attend training when available, as they are often resistant to the academic integration initiative (Drage, 2010). CTE teachers struggle with designing lesson plans to include academic standards with skill tasks and resources are limited as well. Professional development for CTE teachers is of vital importance since there is a strong emphasis on language arts, math and science in secondary school graduation requirements and many CTE courses are eliminated in a student's course selection as a result of increased academic course requirements (Drage, 2010). Then again, some CTE teachers are "intrinsically motivated to attend professional development" when they are "motivated by their individual need for wanting to become better teachers and their commitment to lifelong learning" (Drage, 2010, p. 35). Today, CTE teachers teach occupational skills, meet the needs of special education students, integrate academic and occupational standards, prepare students for industry credentials and a final skill assessment, as well as coordinate work-based learning opportunities to prepare them to enter the workforce and postsecondary education to support workforce initiatives (Drage, 2010).

In general, the design of the CTE academic integration initiative is to address the demand for the growth of a skilled workforce that is academic and skill work ready and meets high-demand and high-skill occupations in current or emerging professions. Given the fact that CTE teachers struggle with academic integration, reform efforts have been slow for teachers to recognize and apply academic standards within CTE content during instruction (Stipanovic, Lewis & Stringfield, 2012).

2.6 CARL D. PERKINS IMPROVEMENT ACT OF 2006

The Carl D. Perkins Career and Technical Education Improvement Act of 2006 (PL 109-207), also known as Perkins IV, was passed by Congress and signed into law by President George W. Bush, officially changing the title. The purpose of Perkins is to develop more fully the academic, technical, and employability skills of secondary students who choose to enroll in CTE programs (Threeton, 2007; Perkins, 2006). Perkins IV also focuses on career guidance, articulation between secondary and postsecondary institutions, industry certifications, and nontraditional gender career growth to strengthen the response to the U.S. Department of Labor's demand for a skilled workforce that is academic and skill proficient and to remove the negative stigma attached to career technical education (Threeton, 2007; Perkins, 2006; Workforce & Innovation Opportunity Act, 2015). Perkins IV provides funds to develop rigorous academic and career and technical skills for students who enroll in CTE programs of study. The funds received from the grant are an inducement for the purpose of increasing the academic and technical rigor of secondary CTE instruction in order to prepare students for high-skill, high-wage, high-demand occupations (National Assessment for Career and Technical Education, 2014). CTCs must apply for Perkins grant funds each year. The funds are allocated to the state by the National Center for Education Statistics (NCES) using a complex formula based on the state's population size in particular age groups and per-capita income over a three-year period (National Center for

Education Statistics, 2003). Once the state receives Perkins funds, the CTC applies to the state and receives an allocation based on the CTC's demographic area.

In addition, Perkins IV holds CTCs accountable for students' academic proficiency using performance indicators, but does not provide specific direction on how to use the funds to provide academic integration and support. Performance indicators are accountability measurers that assess the effectiveness of the state in achieving statewide progress in career and technical education and to optimize the return of investment of federal funds in career and technical education activities (Perkins, 2006). However, Perkins IV dictates that funds may not be used for academic remediation purposes (Perkins, 2006). This limits resources for shared-time CTCs that may lack academic support or employ full-time academically certified teachers needed to support the academic integration initiative (Stipanovic, Lewis & Stringfield, 2012).

2.7 COLLEGE AND CAREER READINESS

The National Assessment for Career and Technical Education states that "economic globalization and technological innovations are redefining the knowledge and skill expectations for 21st century workers" (2014, pg. 2). Policymakers and educators are responding by emphasizing the preparation of high school students for postsecondary education and careers – both options, not just one or the other – with the understanding that all youth will require some form of advanced education or skill training if they are to compete in today's labor market. Therefore, policymakers designed Perkins IV to address the knowledge and skill expectations for future workers which promoted the "'new vocationalism' movement linking secondary and postsecondary education as well as teaching the kinds of technical and work-related skills needed by employers" (Aliaga, Kotamraju & Stone, 2014, p. 131). That is, "instead of being a system for students who are not going to college, CTE today is a system for all students who wish to succeed in the 21st-century workplace, whether they are earning high school diplomas, industry-recognized credentials, certificates or college degrees" (Boettcher, 2017, pg. 42).

2.8 PERKINS IV PERFORMANCE INDICATORS

Despite Perkins IV support, CTCs lack the resources to follow market trends closely on their own and are dependent on workforce investment boards and local businesses to supply them with information to define the training that industry is requesting. CTCs do not always respond to industry requests as they are restricted by financial issues and Pennsylvania Department of Education (PDE) directives. Perkins IV mandates that CTE teachers integrate academic standards within CTE curricula and regulates this mandate through performance indicator data sets. If set performance indicator levels are not reached, the school receives a sanction letter from PDE that states future Perkins funds may be withheld if corrective action to reach performance levels is not applied.

When Perkins IV was enacted, academic integration had already been included in earlier versions of Perkins II, and III without performance indicators to monitor students' achievement levels, so many schools ignored the academic integration mandate. Furthermore, teachers do not understand the rationale for the Perkins IV mandate; therefore, they do not have an incentive to change. Instead administrators are asked "why?" "Why do I need to teach math and reading while I am teaching students how to weld?" Teachers may lack understanding of the demand for a skilled workforce that is academic and skill proficient, and that, consequently, integrated skill training could also provide opportunity for minorities and those living in poverty to enter the workforce with a high-paying job and a chance for advancement, except there are inequities in the availability of work experiences for these students (Stipanovic, Lewis & Stringfield, 2012, Jackson & Hasak, 2014. Additionally, as Perkins IV progressed with the recognition of accountability measures, teachers and administrators learned from these measures that CTE coursework is still failing to teach a large proportion of students the basic skills that will provide them the chance to enter the workforce successfully and adapt in our society (Stipanovic, Lewis & Stringfield, 2012, Jackson & Haska, 2014). Perkins performance indicators are negotiated with an increase each year; and as a result, simultaneously, building capacity should be aligned to higher standards as well but teacher motivation must be encouraging and willing to meet integrative instruction such as project-based learning as their primary instructional method (Stipanovic, Lewis & Stringfield, 2012).

2.9 SCHOOL CAPACITY

Education and policy leaders benefit from information about the quality and effectiveness of CTC programs that support the WIOA so that they can continue to make informed decisions that will support workforce growth. Expectations for CTC students' achievement levels are more demanding than ever as they are expected to demonstrate proficiency on state assessments as well as occupational assessments. To ensure CTCs are meeting or exceeding students' achievement levels and that the Perkins IV academic integration initiative meets the planned effect, educational leaders must evaluate their school capacity. McDonnell and Elmore state that capacity building assumes "longer-term benefits are either worth having on their own right, or are instrumental to other purposes that policymakers regard as important" (1987, p. 143). The long-term benefit of Perkins IV is skilled workforce growth. By evaluating their school capacity administrators can craft coherence that will support academic integration in CTE curricula. Involving teachers in goal and decision making related to the Perkins initiative will assist with facilitating the process of crafting coherence to achieve the desired outcome of meeting performance indicators. Professional development can influence and alleviate teachers' fears and lack of confidence with teaching academics imbedded in skill curricula. Nunnery (1998) indicates that "change projects were successful when developers or demonstrators provide in-depth information and training prior to implementation and continuous follow-up assistance and training during implementation" (p. 290) because "the central problem of education reform is teacher learning" (p. 290). It has been my experience that when a teacher experiences successful academic and skill-related instruction directly with students, there is little remaining resistance.

2.10 ACADEMIC INTEGRATION WITHIN CTE CURRICULUM

While this review focuses on Perkins IV and the mandate to integrate academics standards into CTE curriculum to support the workforce demand for an academic and technical skilled workforce, the question emerges…does academic integration increase student achievement? Research suggests that integrated academics within CTE programs of study do, in fact, lead to improved student achievement (ACTE, 2005). Furthermore, the National Research Center for Career and Technical Education indicates that high school students who receive a semester of math integrated CTE lessons performed better than their classmates on standardized math tests (ACTE, 2005). Vardia and Ciccarelli (2008), also determined that when students actively engage in real work problems, they show increased motivation to master content, including academics. Students also tend to be more focused in the classroom (often called the theory room) when they see the relevance of their lessons to the real world of work and connect the classroom to the workplace. In other words, when CTE course work is focused toward students' interest, their motivation for learning academic content increases and their attention span lengthens.

On the other hand, studies show that academic integration and the necessary teacher collaboration associated with it has many obstacles (Morgan, Parr & Fuhrman, 2011). These obstacles include insufficient planning time, incomplete teacher training, and a lack of academic and administrative support. This is even more apparent when integrating academics into programs of study in shared-time CTCs since academic related course work is usually not offered at these schools which naturally causes an unavoidable disconnect of CTC and academic teachers with the ability to collaborate. Additionally, even though the opportunity to teach academic concepts is common in CTE since it is naturally embedded in the content, few CTE instructors teach the academic component when it presents itself because they either do not think that it is their responsibility or do not feel qualified to teach academic content (Threeton, 2007; Walter & Gray, 2001). CTE teachers need to understand that the integration of academics into their curricula and pedagogy is their responsibility and is critical to students' achievement success and workplace readiness (Walter & Gray, 2001).

The image problem mentioned previously triggered the historic separation of CTE and academic education and is part of the reason why academic integration within occupational curricula rarely occurs (Stone & Lewis, 2012). In some areas of CTE, especially the mechanical and construction industry, most teachers have not completed a four-year teacher education program. Instead, CTE teachers are required to have several years of relevant work experience and then earn a vocational instructional certificate (Stone & Lewis, 2012; Walter & Gray, 2001). Additionally, Stone and Lewis state that most teachers teach the way they were taught when they were students; as a result, the integration of academic integration does not fit into the "core of education practice" (Stone & Lewis, 2012). Nonetheless, it is essential for CTE and academic teachers to collaborate because teaching academics requires knowledge and skill that CTE teachers may not have; that is to say, they may be required to teach a level of math that they have not studied (Walter & Gray, 2001). With academic and CTE teacher collaboration, CTE teachers can learn the academics embedded in their curricula to strengthen the learning concepts essential to occupational skills and knowledge (Stone & Lewis, 2014). However, if academic and CTE teachers are to work together they will need common planning time to determine intrinsic academic content (Threeton, 2007; Stone & Lewis, 2014).

Bozick and Dalton (2013) conducted a study about balancing CTE and academic courses to examine the relationship between CTE coursework and the level of math achievement in high school. Using a qualitative survey method and math assessment data from over 9,000 10^{th} grade students in 2002 and the same students in 12th grade (2004), they determined that CTE courses do not limit overall math achievement levels nor the attainment of basic math skills (Bozick & Dalton, 2013). They concluded that "most of the achievement differences between students who take a large number of occupational course and students who take few or no occupational course are largely due to preexisting differences between students before they enter high school, not the courses taken" (Bozock & Dalton, 2013, p. 135). Specifically, high achieving students are placed in more advanced level academic courses to prepare them for postsecondary education, while low achieving students are placed in CTE courses. This is very distinct in Pennsylvania CTCs, so it is even more essential that CTE teachers support academic integration to assure that students graduate with the employability skills needed for success in today's workforce.

2.11 CONCLUSION

> Career and Technical Education will be a critical element of its ability to develop high skill talent. A decline in the number of graduates and inconsistencies in the overall quality of the K-12 system present a substantial risk to employers' long-term ability to fulfill hiring needs in an increasingly skill-driven economy. Areas of excellence exist within the region, but large-scale policy and spending reforms are necessary to minimize performance gaps and better prepare students for postsecondary training and the workforce (Restuccia, D., Bradley, B., Chong, S., Taska, B., Liu, J., Reddish, J. & Arn., J., 2016, p. 13).

Although employers and educators hope that Perkins IV requirements will simultaneously improve CTE teaching and learning at shared-times CTCs, broaden its appeal, and reverse the historical practice of tracking low-achieving students into CTE programs, as well as graduate students academic and technical skill proficient, research indicates that CTCs still function as the best option for students who struggle academically and excludes students considered postsecondary bound (NRCCTE, 2005). Regardless of students' achievement levels, CTE teachers are expected to teach rigorous work-related content with integrated academic standards despite the fact that many students enter CTC programs of study with reading and math skills far below grade level. In today's workforce environment, students must have academic skills to be successful in postsecondary education and careers. But academic proficiency alone will not guarantee a successful career. Students also need technical and employability skills (Preble, 2018, Stringfield & Stone, 2017). The past division between preparation for postsecondary education and preparation for work represents a false dichotomy (Brand, 2003). The skill demands for work and postsecondary education are converging so that soon there will be one set of skills needed for success in careers and postsecondary education. The U.S. Department of Education should promote a vision of education in which all high school students take high-level courses and technical work-related skill courses so that every student is prepared for postsecondary education and careers with the employability skills needed to advance beyond entry-level positions (Brand, 2003).

3.0 METHODOLOGY

3.1 INTRODUCTION

This chapter outlines the research design that examined a welding program of study integrating academic content within occupational technical content. The conceptual framework, research questions, method and approach are explained in detail. Limitations and assumption of the evaluation are also discussed in this chapter. This study was approved by the University of Pittsburgh Institutional Review Board on November 20, 2017 (PRO17110131).

Through this study, a teaching method that employs academic and technical skill content using an integrated real-work project-based learning design was examined to determine if students are receptive to learning academic content while also learning skill content so that they may improve their academic proficiency. A welding program was selected for the evaluation because in 2016 over 58% of students in welding programs across the state of Pennsylvania did not achieve academic proficiency in both math and literacy by the end of their 11th grade school year (K. Springman, Pennsylvania Department of Education, Education Research Associate, personal communication, April 20, 2016). Therefore, the rationale for conducting this evaluation was to support the growing demand for a workforce that is both academic and skill proficient by studying a teaching method that can be applied to increase welding students' postsecondary and career pathway readiness.

3.2 CONCEPTUAL FRAMEWORK

The literature review in Chapter 2 discussed the Carl D. Perkins federal mandate of the academic integration initiative to address the demand for the growth of a skilled workforce that is academic and skill work-ready and meets high-demand, high-skill occupations in current or emerging professions, as well as preparing students to graduate high school college and career ready, guided the conceptual framework for the evaluation of a teaching method that could increase students' academic and technical attainment, while also supporting CTE teachers that may not be comfortable teaching academic content within technical skill content (Drage, 2010). Therefore, the purpose of the evaluation was to:

1. Determine if an academic and technical skill integrated project engages students in learning mathematics, reading and writing while also developing employability skills (Preble, 2018, Stringfield & Stone, 2017, Stipanovic, Lewis & Stringfield, 2012)
2. Determine if an integrated real-work project results in students' academic and technical skill achievement as assessed by the welding teacher who will use specifically designed rubrics to evaluate students' work as they complete the project.
3. Identify the challenges a CTE teacher may have teaching academic content while at the same time teaching technical skill content.

A qualitative research method provided evidence for evaluating a teaching strategy through an individual interview with the welding teacher and focus group interviews with the welding students who participated in the real-work integrated project. Grounded theory analysis with initial and axial coding was used to interpret and capture frequencies embedded in the focus group interviews. The initial coding phase allowed the me to code specific individual words and lines from the interviews (Mertens, 2015, Saladana, 2016). Once the initial coding was completed, axial coding was applied to look for relationships (concepts) among the initial codes so that the theoretical framework emerged from the data (Mertens, 2015, Saladana, 2016).

3.3 RATIONALE FOR EVALUATION METHOD

An evaluation employing qualitative methods was used to conduct the research for this study. Although the exact definition for program evaluation has been debated, Mathison and Fournier state that:

> Evaluation is an applied inquiry process for collecting and synthesizing evidence that culminates in conclusions about the state of affairs, value, merit, worth, significance, or quality of a program, produce, person, policy, proposal, or plan. Conclusions made in evaluations encompass both an empirical aspect (that something is the case) and a normative aspect (judgment about the value of something). It is the value feature that distinguishes evaluation form other types of inquiry, such as basic science research, clinical epidemiology, investigative journalism, or public polling. (as cited in Mertens, 2015, pg. 48)

In other words, the value of academic integration is determined by how effective the integrated real-work project is in meeting the needs of those it is intended to help (teachers and students); while the worth refers to the extrinsic value of those outside the classroom, such as industry representatives requiring a skilled workforce that is academically proficient (Mertens, 2015).

3.3.1 Qualitative approach

The qualitative approach was used for data collection for this study because it created the opportunity to influence change and allowed me to provide an in-depth description of a program (Mertens, 2015). One of the strengths of data collection in qualitative research is that it depends on human experience and this is more compelling and powerful than data gathered through quantitative research. Therefore, by conducting focus group interviews with the welding students and an individual interview with the welding teacher, the I was able to study the effect a teaching method has on the teacher's integrated instruction as well as on the students' learning.

3.3.2 Focus group interviews

Focus group interviews as the data collection method for the study allowed the welding students within each team and class session to interact while discussing their thoughts about the successes and challenges they had completing the integrated project (Mertens, 2015). The interviews were in a structured, face-to-face group setting with predetermined questions (Park, Pearson & Richardson, 2017, Mertens, 2015). Details of the interview protocol are in section 3.7.2.

3.3.3 Individual interview

An interview was conducted with the welding teacher in a semi-structured, face-to-face format using predetermined questions (Park, Pearson & Richardson, 2017, Mertens, 2015). The individual interview allowed the teacher to reflect on the successes and challenges of using the integrated real-work project. Using open-ended questions and probes encouraged in-depth responses regarding the teacher's experience implementing this strategy (Mertens, 2015). Details of the interview protocol are described in section 3.7.3.

3.4 RESEARCH QUESTIONS

This study was designed to explore academic integration within a welding program of study at a shared-time Southwestern Pennsylvania Career Technical Center that does not employ regular full-time academically certified teachers to address the following questions:

1. What lessons can teachers learn about the integration of academic content (mathematics) within CTE content that improves upon student academic and technical skill attainment?
2. What challenges do CTE teachers face when integrating academic content within programs of study technical skill content?

3.5 SETTING AND PARTICIPANTS

The inquiry setting for this evaluation was a welding program in a rural Southwestern Pennsylvania CTC that does not offer academic courses on site. The welding teacher had eight (8) years teaching experience, 18 years welding industry experience, and is currently completing the Pennsylvania Department of Education Vocational Teaching Level II Certification. Interestingly, the welding instructor was also a former CTC welding student. Additionally, this CTC supports five sending school districts and enrolls approximately 328 students, with 61% of the CTC students categorized as economically disadvantaged (PSPP, 2017). Below are additional demographics:

Table 1. CTC and Sending School Districts High School Demographics

CTC and Sending School Districts High School Demographic Information					
Demographic Information	**School 1**	**School 2**	**School 3**	**School 4**	**School 5**
CTC Enrollment	80	107	54	34	53
* High School Enrollment	322	553	339	279	188
Number of 10th grade Welding students	3	4	1	3	0
Number of 11th grade Welding students	2	4	1	0	4
Number of 12th grade Welding students	3	6	1	1	1
Male Welding Students	7	12	2	4	4
Female Welding Students	1	0	1	0	1
Welding Special Education Students	3	4	1	2	1
CTC 2015-2016 Performance Level 2S1 Technical (NOCTI/NIMS) Passage Rate (Advanced and Competent)	10%	64.71%	81.82%	92.31%	72.73%
CTC 2015-2016 Performance Level 1S1 Algebra 1 Keystone Exam Passage Rate	30%	47.62%	33.33%	33.33%	50%
*High School- Algebra I Keystone Exam Passage Rate	45.16%	68.8%	32.72%	38.41%	42.86%
CTC 2015-2016 Performance Level 1S2 Literature Keystone Exam Passage Rate	25%	47.62%	8.33%	6.67%	18.75%
*High School- Literature Keystone Exam Passage Rate	60.32%	74.8%	46.25%	53.68%	57.14%
CTC Special Education Students	31%	42%	41%	47%	28%
*High School Special Education Students	15%	14%	21%	13%	20%
*High School Economically Disadvantaged	52.%	38%	53%	54%	38%
*Data retrieved from the 2016-2017 Pennsylvania School Performance Profile (http://www.paschoolperformance.org) IS – Insufficient Data – number of students completing the NOCTI/NIMS not sufficient for SPP data calculation Notification of CTC Performance Levels are two-years behind the active school year.					

The welding program was selected for this study for the following reasons:

1. According to the 2017 High Priority Occupations list, welding is in high demand, requires high skill, and offers high wages (PAWorkStats, 2017).
2. The American Welding Society predicts a shortage of almost 400,000 welders by the year 2025 that have the employability skills required to meet the demand (Boettcher, 2017).

At the end of the 2016 school year:

2. State-wide, 58% of Keystone tested welding students did not reach proficiency in Literacy by the end of their 11th grade school year (K. Springman, Pennsylvania Department of Education, Education Research Associate, personal communication, April 20, 2016).
3. Perkins IV performance indicators for the CTC state that 75% of Keystone tested welding students did not reach proficiency in Literacy by the end of their 11th grade school year; only 25% obtained proficiency (R. Steinmeier, Pennsylvania Department of Education, CTE Advisor, personal communication November 2, 2017).
4. State-wide, 59.5% of Keystone tested welding students did not reach proficiency in Algebra 1 by the end of their 11th grade school year (K. Springman, Pennsylvania Department of Education, Education Research Associate, personal communication, April 20, 2016).
5. Perkins performance indicators for the CTC state that 85.5% of Keystone tested welding students did not reach proficiency in Algebra 1 by the end of their 11th grade school year; only 12.5% obtained proficiency (R. Steinmeier, Pennsylvania

Department of Education, CTE Advisor, personal communication November 2, 2017).

3.6 INITIATION OF THE EVALUATION PROJECT

The welding teacher initiated the project with the students and informed them that the project would be used for research in a dissertation. The welding teacher also informed the students that they will be asked to voluntarily participate in a focus group interview with the I to talk about what they learned while completing the project.

3.7 DATA COLLECTION AND ANALYSIS

A program evaluation was the primary inquiry method with qualitative data collection and analysis to study the implementation of an integrated real-work project in a welding program at a shared-time CTC (Jez & Adan, 2016). The shared-time CTC selected to conduct the qualitative research offers a welding program but does not offer academic courses (reading, writing, and mathematics) or employ full-time academically certified instructors.

3.7.1 Integrated project-based learning

The Southern Education Region Board (SREB) enhanced CTE integrated project design was used for the application of the evaluation study. SREB is a nonprofit, nonpartisan organization headquartered in Atlanta, Georgia and well known for their work to improve public education by helping educators strengthen student learning with professional development, proven practices, and curricula (SREB, n.d.). A “crosswalk” of welding tasks aligned to academic standards was used to develop the integrated project for this study. The welding teacher, CTC Administrative Director, and I designed the project to include applications that would strengthen students’ math skills. A full detailed description of the project linking academic and technical standards is in Appendix A; both the teacher and CTC Administrative Director had been trained by SREB to design a project-based integrated plan. The project participants included students in grades 10, 11 and 12 from five different sending school districts who were placed into teams: two teams in the morning session with eight (8) students on each team and two teams in the afternoon session with nine (9) students on each team (total of four teams with 34 student participants). The teacher selected students for each team based on grade and experience levels (combined first, second or third year students); the sending school a student attends was not considered in the team selection to promote teamwork. Specifically, each team researched, designed, created, and presented an outdoor fire pit that can be mass-produced and sold to the public. The teacher assessed the students applied reading, writing and math applications using research, materials and cost estimate, manufactured fire pit, and presentation rubrics. The design of the project was to promote problem solving and critical thinking to actively engage students in a real-work problem.

3.7.2 Focus group interview protocol

Four 30-minute focus group interviews were conducted for the qualitative data collection at the conclusion of the fire pit integrated project with each team in the morning and afternoon sessions. The focus group interview design allowed students to interact within their group to discuss their reaction completing their fire pit and their perception of the project's relationship to math, reading, and writing, as well as the successes and challenges they had completing the project. As recommended by Mertens, 2015, six (6) open-ended questions were asked in order to receive in-depth data for the evaluation. A pilot study of the questions was not conducted due to the small size of the target population; however, modifications to the focus group interview design during the actual interviews were made. (Breen, 2006). Table 2 below identifies the first research inquiry question and the related open-ended, in-depth interview questions:

Table 2. Research Question and Open-Ended, In-Depth Focus Group Interview Questions

Research Question	**Related Questions for Focus Group Interview**
Research Question 1. What lessons can teachers learn about the integration of academic content (mathematics) within CTE content that improves upon student academic and technical skill attainment?	• What did you like most about the fire pit project? • What was the most difficult part of the project (material estimate, design, fire pit production, presentation, teamwork? Why? • What were your academic strengths in completing the project? Math? Reading and writing? • How could your teacher improve the fire pit project? • How does what you have learned completing the project relate to your future welding career? • Tell me more about the successes and challenges that you had completing the fire pit project that you can build upon for your future welding career.

To begin the interview and to overcome possible ethical issues, instructions for the interview process were read to the students in each focus group so that the same procedures were followed. A rapport was established with the students by talking about the interview process to explain why the I was taking notes, recording their responses, and assuring them of confidentiality (Breene, 2006). The interviews were transcribed with initial and axial coding to determine common themes and recurring patterns relevant to each question to increase interview validity (Mertens, 2015, Breen, 2006).

3.7.3 Teacher interview protocol

This study was designed to explore the challenges teachers may have implementing academic integration at a shared-time CTC that does not employ academic content teachers, especially since the enactment of the Educator Effectiveness evaluation system. The purpose of the evaluation system is to promote professional growth of teachers that improves student achievement. Applying integrated project based learning may support teachers in overcoming their resistance to teaching academic content within skill content as well as support their professional growth that is required to meet the proficiency level for the domain elements of the Educator Effectiveness evaluation system (Danielson, 2009).

Using pre-selected and casual questions, the welding teacher was interviewed once the project was completed to discuss the successes and challenges he had administering the integrated project. The questions asked were designed to probe the teacher's experience administering the fire pit project. The questions were also designed to align with the domains in the Educator Effectiveness evaluation to demonstrate the teacher's professional growth. Table 3 identifies the second research inquiry question and the related open-ended, in-depth interview questions.

Table 3. Research Question and Open-Ended, In-Depth Individual Interview Questions

Research Question	Related Questions for Interview
Research Question 2. What challenges do CTE teachers face when integrating academic content within programs of study technical skill content?	• What did you like most about the fire pit project? (Domain 4) • What was the most difficult part to of the project to teach? Why? (Domains 2, 3, 4) • What were your strengths in instructing students to complete the project? Math? Reading/writing? Research? Fire pit production? (Domains 2, 3, 4) • How would you improve executing the fire pit project next time? (Domains 1 and 4) • How does what you learned teaching the fire pit project connect to your future teaching abilities? (Domains 1 and 4) • Tell me more about the successes and challenges that you had implementing the fire pit integrated project that you can build upon to improve instruction. (Domains 1, 2, 3, 4)

3.8 LIMITATIONS AND ASSUMPTIONS OF THE PROGRAM EVALUATION

One important limitation of the study was the size of the CTC and the number of students participating in the project (approximately 34 students in the welding program). That is, this study and subsequent interviews used for quantitative analysis focused on one CTC and only one teacher and program of study within the CTC. Several assumptions of the study are as follows:

- Students may have low academic achievement levels.
- The economy continues to grow and demand a highly skilled workforce.
- The nation has a critical shortage of a skilled workforce that is academic proficient.

- Current industry needs are not being met for an academic proficient skilled workforce.

3.9 ETHICAL ASSURANCES

This study was approved by the University of Pittsburgh Institutional Review Board on November 20, 2017 (PRO17110131). Based on the information provided, the research study met all the necessary criteria for an exemption and was designated as "exempt" under section 45 CFR 46.101(b) (1) for "Educational Strategies, Curricula, or Classroom Management Methods Request for Exemption."

3.10 SUMMARY

A qualitative approach was the methodology used that supports this study through four focus group interviews with students and one in-depth, semi-structured individual interview with a teacher. It was my intent to use an approach that provided information that may assist CTC teachers with integrating academic content within CTE content standards; especially when the CTC does not employee full-time academically certified teachers. The approach outlined in this chapter facilitated the research questions of this study and furthered the study of academic integration within career technical education to support students' academic and work-related skill development to support the growing demand for a workforce that is both academic and skill proficient.

4.0 FINDINGS

The focus of this program evaluation was to identify the challenges CTE teachers may face when integrating academic standards within CTE curricula. The importance of this teaching practice is to support the demand from business and industry for an academic and skill proficient workforce as well as to meet Perkins IV Performance Indicators. As stated previously, a major policy objective of Perkins IV is the integration of academics into CTE curriculum to increase career and academic proficiency and to strengthen the responsibility of CTE educators to integrate academics within technical standards in support of the college and career readiness initiative (NRCCTE, 2010).

The purpose of this study is to evaluate project-based learning that implements academic integration into a CTE program of study at a shared-time Career Technical Centers that lacks full-time academically certified teachers. The evaluation was conducted at a shared-time career technical center that does not employ full-time academically certified teachers in rural southwest Pennsylvania. A welding teacher and students enrolled in the welding program of study at the CTC were the focus of the project-based learning integrated project.

4.1 DATA ANALYSIS AND REPRESENTATION

This chapter presents the findings based on the research questions identified in Chapter 3. The findings for research question number one were gathered from four structured focus group interviews conducted with the welding students. The findings for research question number two were gathered from one semi-structured interview conducted with the welding teacher. I recorded the interviews and submitted the audio recordings to a service that transcribes audio recordings of focus groups interviews (rev.com). Once transcribed, I reviewed the data to process the information to pre-code by make notes and underlining key phrases on the transcribed interview documents (Saldana, 2016). From these notes, I analyzed the data and applied the first cycle initial coding method (Saldana, 2016). Initial coding allows a researcher to break down qualitative data into parts to look for similarities among the coding (Saldana, 2016). Initial coding is also the first stage of coding applied when using the grounded theory approach and because it is the most suitable coding for interviews (Mertens, 2015, Saldana, 2016). Grounded theory is the approach used to analyze qualitative research data by applying codes to the data that ultimately leads to the development of a theory…a theory "grounded" in the data (Mertens, 2015, Saldana, 2016). After the initial coding was complete, I applied a second phase of coding known as the axial coding method by looking for themes and connections among the initial coding data (Saldana, 2016). The purpose of axial coding is to determine which codes from the initial coding phase are dominant and which are less important (Saldana, 2016). When the axial coding was complete, emerging themes were identified for each research question.

4.2 FOCUS GROUP PROFILES AND INTERVIEWS

4.2.1 Group 1

Group 1 consisted of eight male welding students who participated in the real-work integrated fire pit project. These students attend the CTC during the morning session and return to their sending school for their academic course work in the afternoon.

Table 4. Welding Group 1 – Demographic Information

Welding Group 1 - Demographic Information					
	School 1	**School 2**	**School 3**	**School 4**	**School 5**
Number of 10th grade students	1	0	0	3	0
Number of 11th grade students	0	1	0	0	0
Number of 12th grade students	0	2	1	0	0
Male students	1	3	1	3	0
Female students	0	0	0	0	0

Additional demographic information for each sending high school is identified in Chapter 3.

Six of eight students identified in Group 1 participated in the interview; two students were absent from school on the day of the focus group activity. I met the students in the CTC's conference room and informed them that I would be asking questions about the fire pit project that they completed in their welding program and that I would be recording their responses to my questions. I also stated that their participation in the interview was voluntary and that their responses would be kept confidential. Additionally, I gave the students the option to leave the interview before I started recording their statements; all students agreed to participate in the interview. Following is an outline of emerging themes that surfaced from the structured focus group interview.

4.2.1.1 Emergent themes – Group 1

RQ1: *What lessons can teachers learn about the integration of academic content (mathematics) within CTE content that improves upon student academic and technical skill attainment?*

Students in group one enjoyed working on the work-related integrated fire pit project. When the group was asked what they liked most about the project, the students respond that it was fun, hard work, and different from their usual welding tasks. As one student stated: "it was a lot more different than just sitting there doin' the same old task over and over." The group recognized one of their strengths was working together. A student stated, "being able to work together and put everybody's ideas together" but that "not everyone pulled their weight." When I probed for more information about students not pulling their weight, the students in the room mumbled that some of them were absent a lot so when the absent students came to class they did not know what to do, which made it hard to pull together to get the project done, but they got it done. Another student was able to connect the group's interaction with each other during the real-work integrated project to his place of employment by stating:

> *"One of the things when you build, you have to be able to talk about what you did and know about it [work assignment]. Like, right now, I work in a weld shop and I've been working there since school started, and everything we do we got to discuss."*

When asked to describe the math they used a student responded with "making up the degrees; angles; measurements." Additionally, when asked what their teacher could do to improve the project because of challenges they had, the students agreed that "the blueprint was hard, drawing it out. Maybe teach us more about that before we get started." because "we had to change our plans 10 times because it just wasn't working out. We changed the handles for safety, added legs on all four corners of the fire pit and made angles on all fours sides." A result of designing and drawing their fire pit, a student stated, "it might be easier to understand blueprints now because we did it for the project."

Table 5 below provides a visual representation of the first and second cycle coding (Saldana, 2016) developed when analyzing the transcripts from the structured focus group interview with the welding students in Group 1:

Table 5. RQ1 – Coding Analysis Welding Group 1

Research Question	Interview Questions	1st Cycle Coding Initial Coding	2nd Cycle Coding Axial Coding
RQ1: What lessons can teachers learn about the integration of academic content (mathematics) within CTE content that improves upon student academic and technical skill attainment?	What did you like most about the fire pit project?	Hands-on fabrication; different then just sitting and doing the same old task over and over	Applied technical skill growth (Preble, 2018; Stringfield & Stone, 2017).
	What was the most difficult part of the project (material estimate, design, fire pit production, presentation, teamwork?	Drawing blueprint was hard; getting the fire pit stable so that it did not wobble (revisions)	Employability skills (soft skills): critical thinking, troubleshooting, information processing (Preble, 2018; Stringfield & Stone, 2017)
	What were your strengths in completing the project?	Figuring cost estimate for project; used angles and degrees; addition; measurements	Math integration (Boettcher, 2017; Stone & Lewis, 2012; Perkins IV, 2006).
	How could your teacher improve the fire pit project?	Teach blueprint reading; smaller groups	Technical and literacy skill integration (Boettcher, 2017; Stone & Lewis, 2012; Perkins IV, 2006).
	How does what you have learned completing the project relate to your future welding career?	Work with people, got to work together; put everybody's ideas together	Employability skills: teamwork, communication, decision making, problem solving (Preble, 2018;

Table 5 continued

			Stringfield & Stone, 2017)
	Tell me more about the successes and challenges that you had completing the fire pit project that you can build upon for your future welding career.	Calculating cost of fire pit; measurement during production; revisions	Math and technical skill integration (Boettcher, 2017; Stone & Lewis, 2012; Perkins IV, 2006).

4.2.2 Group 2

Group 2 consisted of six male and two female welding students who participated in the real-work integrated fire pit project. These students attend the CTC during the morning session and return to their sending school for their academic course work in the afternoon.

Table 6. Welding Group 2 – Demographic Information

Welding Group 2 - Demographic Information					
	School 1	**School 2**	**School 3**	**School 4**	**School 5**
Number of 10th grade students	2	2	1	0	0
Number of 11th grade students	0	0	1	0	0
Number of 12th grade students	0	1	0	1	0
Male students	1	3	1	1	0
Female students	1	0	1	0	0

Additional demographic information for each sending high school is identified in Chapter 3.

Five of eight students identified in Group 2 participated in the interview; three students were absent from school on the day of the focus group. I met the students in the CTC's conference room and informed them that I would be asking questions about the fire pit project that they completed in their welding program and that I would be recording their responses to my questions. I also stated that their participation in the interview was voluntary and that their responses would be confidential. Additionally, I gave the students the option to leave the interview before I started recording their statements; all students agreed to participate in the interview. Following is an outline of emerging themes that surfaced from the structured focus group interview.

4.2.2.1 Emerging themes – Group 2

RQ1: *What lessons can teachers learn about the integration of academic content (mathematics) within CTE content that improves upon student academic and technical skill attainment?*

The students in Group 2 also enjoyed the project and thought it was a good learning experience. They expressed the skills needed to complete it by sharing their thoughts as one student stated that it required "a lot of MIG welding" (a welding process in which an electric arc forms between a consumable wire electrode and the work piece metal(s), which heats the work piece metal(s), causing them to melt and join) and "it was off the wall, there were so many wedges and gaps that we filled but it looks good though, it works." The students then described some of the challenges they had because "when we first started it [fire pit], we cut the bottom of it, we noticed that we cut 14-inch plates and then realized that the sides were 16 inches long" so they had to redo the plates and wasted material. The students also thought the project took a long time to complete. When I probed for more information about this they stated, "because everybody was not there every day" and "we all leave at different times." (This is a common problem of a shared time CTC since the sending school districts travel different distances so some students arrive late and other's leave early). The female student mentioned that she "kept the work together and made sure I marked every day that people missed" so that the students could keep track of who did the work. She calculated the hours for each team member and how much it cost them in time and materials to complete the project. When I asked the group why this was important they responded with “you don’t get your money back if you don’t know how much it costs.” At this point, we talked about the math they used during the project. One student responded by stating “I can do math. You try and calculate the measurements and stuff and how to add everything together so you can make sure everything fits.” Other students chimed in stating “we had to redo it [fire pit] five times, it was hard” and “we had to use a lot of material because of the mistakes we made measuring.”

Overall Group 2 students expressed their challenge was communication. The group agreed, “we had a communication problem because some people would be there and some wouldn’t. They wouldn’t see the parts we already made and just go make more parts and they’d be messed up, some lopsided.” When we talked about their teacher improving the project, the students expressed that they needed find a way to communicate better because they recognized this as a problem for their group. As we continued our conversation about the other challenges they had, one student stated that “you gotta have a definite leader because, if not, everybody is just walking around, which I am definitely.”

Table 7 below provides a visual of the first and second cycle coding (Saldana, 2016) developed when analyzing the transcripts from the structured focus group interview with the welding students in Group 2:

Table 7. RQ1 – Coding Analysis Welding Group 2

Research Question	Interview Questions	1st Cycle Coding Initial Coding	2nd Cycle Coding Axial Coding
RQ1: What lessons can teachers learn about the integration of academic content (mathematics) within CTE content that improves upon student academic and technical skill	What did you like most about the fire pit project?	A lot of welding; it’s [fire pit] good	Technical skill growth (Preble, 2018; Stringfield & Stone; 2017).
	What was the most difficult part of the project (material estimate, design, fire pit production,	Getting the metal ready; designing	Technical and literacy integration (Boettcher, 2017; Stone & Lewis, 2012; Perkins IV, 2006).

Table 7 continued

attainment?	presentation, teamwork?		
	What were your strengths in completing the project? Math? Reading and writing? Presentation?	Kept the work together; marked every day that people missed; calculate the measurements and add everything together so it fits right; had to redo it [fire pit] five times, it was hard; we used a lot of material; had several revisions because it didn't measure right; we had a communication problem; good learning experience; find a way to communicate better	Technical and math integration (Boettcher, 2017; Stone & Lewis, 2012; Perkins IV, 2006). Employability skills: critical thinking, teamwork, communication (Preble, 2018; Stringfield & Stone; 2017)
	How could your teacher improve the fire pit project?	Different groups; different project	Employability skills: teamwork, communication, decision making (Preble, 2018; Stringfield & Stone, 2017)
	How does what you have learned completing the project relate to your future welding career?	Definite leader; got to have a good leader	Employability skills: teamwork, communication (Preble, 2018; Stringfield & Stone, 2017)
	Tell me more about the successes and challenges that you had completing the fire pit project that you can build upon for your future welding career.	Fire pit came out completely different than planned; communication	Employability skills: information processing, teamwork, communication (Preble, 2018; Stringfield & Stone, 2017)

4.2.3 Group 3

Group 3 consisted of nine male welding students who participated in the real-work integrated fire pit project. These students attend the CTC during the afternoon session and take their academic course work in the morning at their sending school.

Table 8. Welding Group 3 – Demographic Information

Welding Group 3 - Demographic Information					
	School 1	**School 2**	**School 3**	**School 4**	**School 5**
Number of 10th grade students	0	1	0	0	0
Number of 11th grade students	1	3	0	0	2
Number of 12th grade students	1	1	0	0	0
Male students	2	5	0	0	2
Female students	0	0	0	0	0

Additional demographic information for each sending high school is identified in Chapter 3.

Six of nine students identified in Group 3 participated in the interview; three students were absent from school on the day of the focus group activity. I met the students in the CTC's conference room and informed them that I would be asking questions about the fire pit project that they completed in their welding program and that I would be recording their responses to my questions. I also stated that their participation in the interview was voluntary and that their responses would be confidential. Additionally, I gave the students the option to leave the interview before I started recording their statements; all students agreed to participate in the interview. Following is an outline of emerging themes that surfaced from the structured focus group interview.

4.2.3.1 Emerging themes – Group 3

RQ1: *What lessons can teachers learn about the integration of academic content (mathematics) within CTE content that improves upon student academic and technical skill attainment?*

Group 3 students were engaging, outspoken, and confident. When I asked them what they like most about the project, there were several responses: “the welding”; “more realistic”; “it was actual working in the field”; “something besides task plates.” One student stated, “the best part was all of us working together to achieve one goal, just get it done.”

As we continued our discussion, I asked about difficulties they had completing the fire pit. The group agreed that designing the fire pit was a challenge. A student stated, “the design was the hardest part, trying to figure it out, what we were all going to make. Started from absolutely nothing to what we came up with and the involvement.” When I probed for more information about designing their fire pit another student described their process by stating “We started by looking up basic designs and we took what we found online and made our own out of what we found.” The students also acknowledged their difficulty making all the pieces fit together and had to do a lot of revisions. When asked how their teacher could improve the project, they stated they would have liked more materials and different metals to use. The students also stated that their fire pit was expensive because of the “man hours.” Additionally, a student in Group 3 that is employed as a welder connected the project to work as he said, “I do co-op, but it was a good chance to work alongside people in school like you would in real world situations.”

Table 9 below lists the first and second cycle coding (Saldana, 2016) developed when analyzing the transcripts from the structured focus group interview with the welding students in Group 3:

Table 9. RQ1 – Coding Analysis Welding Group 3

Research Question	Interview Questions	1st Cycle Coding Initial Coding	2nd Cycle Coding Axial Coding
RQ1: What lessons can teachers learn about the integration of academic content (mathematics) within CTE content that improves upon student academic and technical skill attainment?	What did you like most about the fire pit project?	Welding; realistic; actual work that is out in the field	Technical skill growth; production of product (Preble, 2018; Stringfield & Stone; 2017).
	What was the most difficult part of the project (material estimate, design, fire pit production, presentation, teamwork?	Design; figuring out what we were going to make; learning to work together; achieve one goal; making sure everything fit; constantly measuring; revisions	Technical and math skills integration (Boettcher, 2017; Stone & Lewis, 2012; Perkins IV, 2006). Employability skills: teamwork, communication, decision making, problem solving (Preble, 2018; Stringfield & Stone, 2017)
	What were your strengths in completing the project? Math? Reading and writing? Presentation?	Welding; we all got along; teamwork	Technical skill growth (Preble, 2018; Stringfield & Stone, 2017). Employability skills: teamwork, communication (Preble, 2018; Stringfield & Stone, 2017)
	How could your teacher improve the fire pit project?	Use of different metals and supplies	Technical skill growth (Preble, 2018; Stringfield & Stone, 2017).
	How does what you have learned completing the project relate to your future welding career?	Good change to work alongside people; real work situation; worked on something different everyday	Employability skills: work ethic, teamwork, communication (Preble, 2018; Stringfield & Stone, 2017)

Table 9 continued

	Tell me more about the successes and challenges that you had completing the fire pit project that you can build upon for your future welding career.	Working with a team	Employability skills: teamwork, communication (Preble, 2018; Stringfield & Stone, 2017)

4.2.4 Group 4

Group 4 consisted of eight male and one female welding students who participated in the real-work integrated fire pit project; there were no absences for the focus group activity. These students attend the CTC during the afternoon session and take their academic course work in the morning at their sending school.

Table 10. Welding Group 4 – Demographic Information

Welding Group 4 - Demographic Information					
	School 1	**School 2**	**School 3**	**School 4**	**School 5**
Number of 10th grade students	0	1	0	0	0
Number of 11th grade students	1	0	0	0	2
Number of 12th grade students	2	2	0	0	1
Male students	3	3	0	0	2
Female students	0	0	0	0	1

Additional demographic information for each sending high school is identified in Chapter 3.

All nine students identified in Group 4 participated in the focus group interview. I met the students in the CTC's conference room and informed them that I would be asking questions about the fire pit project that they completed in their welding program and that I would be recording their responses to my questions. I also stated that their participation in the interview was voluntary and that their responses would be confidential. Additionally, I gave the students the option to leave the interview before I started recording their statements; all students agreed to participate in the interview. Following is an outline of emerging themes that surfaced from the structured focus group interview.

4.2.4.1 Emerging themes – Group 4

RQ1: *What lessons can teachers learn about the integration of academic content (mathematics) within CTE content that improves upon student academic and technical skill attainment?*

Group 4 was the largest group that participated in the interview; there were no absences. The group was lively, talkative and appeared to have developed a unique relationship while they worked together completing their fire pit. When I asked the group what they thought about the project, they were quick to respond with “we had fun”; “great amazing project, I made a great amazing product”; “challenging”; “good team bonding”; “100% we really worked together.” They talked about the difficulties they had designing the project and decided to just build it as they went because their design did not work. When I probed for more details and asked how they overcame these difficulties they respond with we “persevered” and “used our brains.” They also mentioned that they “stayed positive” and just “kept revising it [fire pit].” One student stated “the most difficult part, it was probably the math. Figuring out everything where it lines up, so we just kept cutting, welding, and grinding to make the pieces fit.” They identified fractions and geometry math applications used to manufacture their fire pit.

To improve the project the students recommend having a base design to follow and “don’t make it so complicated, it [their fire pit] looked simple but then became complicated.” They also recommend that their teacher assign jobs. When I probed for more details about their thoughts of the project, I received several responses: “showed us how to work together on something”; “put you in kind of like a real situation”; “how to work on a budget”; “learn from your mistakes”; “you gotta communicate”; “be willing to do the work;”; “work together”; and finally, “we got it done!”

Table 11 below lists the first and second cycle coding (Saldana, 2016) developed when analyzing the transcripts from the structured focus group interview with the welding students in Group 4:

Table 11. RQ1 – Coding Analysis Welding Group 4

Research Question	Interview Questions	1st Cycle Coding Initial Coding	2nd Cycle Coding Axial Coding
RQ1: What lessons can teachers learn about the integration of academic content (mathematics) within CTE content that improves upon student academic and technical skill attainment?	What did you like most about the fire pit project?	Amazing product; it’s [fire pit] already sold; challenging; it was fun; good team bonding	Technical skill growth; production of product (Preble, 2018; Stringfield & Stone, 2017). Employability skills: teamwork, communication (Preble, 2018; Stringfield & Stone, 2017)
	What was the most difficult part of the project (material estimate, design, fire pit production, presentation, teamwork?	Design was too complicated and expensive; math was most difficult part, figuring where it [parts] lines up; measurements; kept revising	Technical and math skill integration (Boettcher, 2017, Stone & Lewis, 2012; Perkins IV, 2006). Employability skills: critical thinking (Preble, 2018; Stringfield & Stone, 2017)
	What were your strengths in completing the project? Math? Reading and writing? Presentation?	Math and welding; fractions; figure out machines; measuring	Technical and math skill integration (Boettcher, 2017; Stone & Lewis, 2012; Perkins IV, 2006).
	How could your teacher improve the fire pit project?	Have a set base design; don’t make it complicated; assign positions [jobs,	Employability skills: critical thinking, team work, communication (Preble, 2018;

Table 11 continued

		duties]	Stringfield & Stone, 2017)
	How does what you have learned completing the project relate to your future welding career?	Put you in a real situation; work on budget; work together; learn from your mistakes	Employability skills: adaptability, responsibility, critical thinking, team work, communication, (Preble, 2018; Stringfield & Stone, 2017)
	Tell me more about the successes and challenges that you had completing the fire pit project that you can build upon for your future welding career.	Don't over complicate things; think realistic; cost can skyrocket because of complications; communication; be willing to work; got to pull your weight	Technical and math skill integration (Boettcher, 2017; Stone & Lewis, 2012; Perkins IV, 2006). Employability skills: critical thinking, work ethic, team work, communication, (Preble, 2018; Stringfield & Stone, 2017)

4.3 TEACHER PROFILE AND INTERVIEW

As previously mentioned in Chapter 3, the welding teacher has taught for eight years and has 18 years of welding industry experience. He is currently completing the Pennsylvania Department of Education Vocational Teaching Level II Certification and plans to pursue a Bachelor of Arts degree once he is a fully certified vocational teacher. The welding teacher was also a CTC student at a shared-time center when he was in high school, which is where he learned his welding skill. After graduating high school, he went straight to work in the welding industry. His interest in pursuing a Bachelor's degree began when he became a teacher.

This was the teacher's first attempt at implementing a project-based learning strategy. Although he had attended a project-based learning training, he had not yet applied the strategy in the classroom with students. The research conducted for this program evaluation provided the teacher the opportunity to apply project-based learning using the SREB template (Appendix A). Following is an outline of emerging themes that surfaced from the semi-structured welding teacher interview.

4.3.1 Emerging themes – teacher interview

RQ2: *What challenges do CTE teachers face when integrating academic content within programs of study technical skill content?*

The welding teacher was articulate with his responses and I enjoyed listening to his experience. At the start of the interview, we discussed what he liked most about teaching the fire pit project. It was interesting to hear that he enjoyed watching the leadership development and growth of the students most. He described the students and their behavior with reference to the project by stating:

> *"With the four groups, two in the morning, two in the afternoon, the best part was watching sophomores, juniors and seniors gathering together to come up with their ideas and to make changes. It was great seeing them all work together. Some [students] didn't feel comfortable in the group working with juniors and seniors, but at the same time I told them that this is the way it is in manufacturing. You've got your laborers, welders, blue printers, and fitters. So, therefore, all of them are important to the process. I liked the fact that while I watched, I saw everybody working. One was grinding, others were helping lay it out, and they all got along. At the end I liked the fact that they designed it [fire pit], they made the changes, and I didn't touch anything on them. Everything was done by the students*."

The teacher also expressed the difficulties he had teaching the project when trying to explain to the students that the fire pit was not just a class assignment but also an item manufactured for public sale so they had to do their best work. He revealed that often students rushed to get their work done instead of taking their time to produce quality work because with this project, the students had become very competitive and one group would rush to beat the other group in their class session. This was a problem at the start of the project because the students sacrificed quality and a lot of material was wasted; however, in the end quality work prevailed and two of the fire pits were placed up for sale and sold before I met with the teacher and students.

The teacher reported that one of his strengths was his ability to ensure fairness among the groups when mixing the grade levels (10th, 11th and 12th), but it was also a challenge because the 10th grade students were not comfortable working the 11th and 12th graders. He stated:

> "*I saw some people become leaders that weren't seniors. Therefore, I see an importance in taking the younger students and giving them a higher part of a project because the senior thinks they're the boss. To me, it's the best worker who becomes the foreman. So, I think my strength was allowing the kids to show their ability regardless of their grade level. I had some kids that were well above some of the seniors. I have two juniors that were phenomenal, and I found out by doing this project how witty they are and how smart they really are. I also found out that one of my junior students is in college math and he was able to figure out slopes. I did not know that prior to doing this project, so what was my strength, figuring out what people are capable of doing.”*

We talked about how the teacher could build upon the use of project-based learning to improve instruction; specifically, had using the project-based learning design template improved his teaching strategies. When asked how he would improve the project, the teacher stated:

> *“I think next time I will sit through the process of the blue print design with the students. I had a volunteer from the outside come in to help with that part because he was an expert draftsman and I am not. I'd much rather see it through next time because from the blue printer’s perspective, he sees it on paper but he doesn't build the items himself, he only builds it on a computer. When I looked at the fire pit designs, I knew they [fire pits] weren’t based on reality. It was never going to happen from 10th, 11th, and 12th graders. So, coming into this next time to improve teaching this type project, I would definitely sit down and help them develop their blue print designs.”*

The teacher also reported that he plans to continue using project-based learning as he shared:

> *"I'd like to do this project every year. But not the fire pit, something different so I can find students strengths in the beginning of the school year. It was a lot of work but at the end I saw a lot of benefits of it. I wouldn't go to this level, of doing the fire pits, but I might scale down to doing something smaller."*

Towards the end of the interview, I prodded the teacher to tell me more about the successes and challenges he had implementing the project that he could build upon for professional growth. We talked about the students' academic abilities and he reported that he did not have any significant challenges with this part of the project because the math consisted mostly of addition, some fractions, and geometry, and that prerequisite learning for the project was completed by having the students work in their journal each day that requires them to practice math and reading skills needed for success in the welding industry. Additionally, the students completed a summary of the project that included their design, cost of their fire pit that included hours and material costs. He expressed another success he experienced was the work ethic he observed as he stated:

> *Well, the success for me was seeing my students work - and I push my kids hard - only few lagged behind but I saw those students that lagged, step it up. They felt that they were a part of something so they came into class and they went right to their fire pit. It was even to the point where they didn't' want to do their journals, which was good."*

Table 12 below lists the first and second cycle coding (Saldana, 2016) developed when analyzing the transcripts from the semi-structured interview with the welding teacher:

Table 12. RQ2 – Coding Analysis Teacher

Research Question	Interview Questions	1st Cycle Coding Initial Coding	2nd Cycle Coding Axial Coding
RQ2: What challenges do CTE teachers face when integrating academic content within programs of	What did you like most about the fire pit project?	Seeing students work together; everything was done by the student	Growing students technical, academic and employability skills (Perkins IV, 2006)

Table 12 continued

study technical skill content?			
	What was the most difficult part to of the project to teach? Why?	Training students to do good work, don't rush; produce quality	Growing students technical and employability skills (Perkins IV, 2006)
	What were your strengths in instructing students to complete the project?	Fostering leadership and teamwork skills; finding students' strengths; students learned production costs	Growing students' employability, technical and academic skills (Perkins IV, 2006)
	How would you improve executing the fire pit project next time?	Pair students differently so that the leader in the group works well with students that may lack welding abilities	Growing students technical and employability skills (Perkins IV, 2006)
	How does what you learned teaching the fire pit project connect to your future teaching abilities?	Prepare students to design blueprints that are realistic for their abilities; give more input on students' blueprints	Growing students' academic and employability skills (Perkins IV, 2006)
	Tell me more about the successes and challenges that you had implementing the fire pit integrated project that you can build upon for future instruction.	It was a lot of work but in the end, I see the benefits of project based learning; getting the students to produce quality work and not rush	Teacher's professional growth (Drage, 2010; Vardia & Ciccarellib 2008; Threeton, 2007; Walter & Gray, 2001).

4.4 EMERGING THEMES ACROSS INTERVIEWS

The following discusses the themes that emerged across the focus group and teacher interviews in relationship to the two research questions. Although each interview was unique with experiences and perspectives, the questions asked during each interview session were similarly aligned to convey validity and consistency. Consequently, commonalities did emerge during the analysis of the data when compared across all five conducted interviews. Additionally, the conceptual framework is reviewed to determine the alignment for each research question.

4.4.1 Emergence of academic and technical skills

Discussed previously is the importance of students of academic and technical skill development so that they are prepared to enter the workforce with the employability skills necessary to meet workforce demands and with the ability to achieve career success. Students in all four of the focus group interviews reported that the fire-pit project provided them a unique experience by giving them the opportunity to participate in real world, hands-on work. Implementing the project-based learning strategy also provided the teacher with the unique opportunity to integrate academic and technical skills to foster the development of students' employability skills that included reading, writing, mathematics, work ethic, communication, teamwork, decision-making, problem solving, critical thinking, initiative.

A theme that emerged from the interviews was the development of teamwork and leadership. The students reported that teamwork was most important when completing a job and that a few of them unexpectedly became the leaders of their group; this was noted because it was the underclassmen (10^{th} and 11^{th} grade students) that emerged as the leaders and not the senior students as expected. The group focus was on completing the job and the best way to accomplish this as a team. Subsequently, the teacher discussed how he stressed the importance of teamwork to the students to complete a job in the real world and witnessed students becoming leaders to complete their fire pit project. Of interest was the absence of academic inability. When discussing challenges, they may have had completing the academic components (math and reading) of the project, the students reported that their greatest challenges were research, design (math and reading), and manufacture of their product, while also learning to work together as a team.

Table 13 below is a visual representation of the emerging themes across the interviews and expected and actual conceptual framework alignment:

Table 13. RQ1 and RQ2 – Analysis breakdown

Research Question	Emergent Themes	Expected Conceptual Framework	Alignment of Conceptual Framework
RQ1: What lessons can teachers learn about the integration of academic content within CTE content that improves upon student academic and technical skill attainment?	• Leadership (employability) • Teamwork (employability) • Research (reading) • Design (math, reading, technical) • Hands-on (technical, employability) • Critical thinking (employability, technical) • Real work (employability)	• Student engagement • Academic skill • Technical skill • Employability skill development	• Student engagement • Academic skill • Technical skill • Employability skill development
RQ2: What challenges do CTE teachers face when integrating academic content within programs of study technical skill content?	• Leadership (employability) • Teamwork (employability) • Design (math, reading, technical) • Technical skill (employability) • Real work (employability)	• Identify challenges teaching academic and technical skill integration	• Teaching strategy • Academic skill development • Technical skill development • Employability skill development

4.5 SUMMARY

Chapter 4 presented the findings of the applied project-based learning teaching method in a welding program of study. Using the ground theory approach, several themes emerged from the qualitative data and were aligned to the research questions and the conceptual framework. Qualitative data was collected through four focus group interviews with the welding students who participated in the project. The major findings that emerged from the welding students' focus group interviews were aligned to research question one (1) and identified as research and design (math and literacy skills), technical skills (welding) and employability skills (teamwork, communication, decision-making, and problem solving).

Additional qualitative data was collected from the welding teacher who applied the integrated project in the welding program. The findings that emerged from the welding teacher's interview were aligned to research question number two (2) and identified as the growth of students' academic, technical, and employability skills. The teacher's professional growth was also identified as he discussed the benefits of project-based learning as a teaching method that supports students' academic, technical, and employability skills growth.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 OVERVIEW

The purpose of this study was to evaluate project-based learning that integrates academic content into CTE curriculum at a shared-time Career Technical Centers that does not employ full-time academically certified teachers. A project-based learning teaching method that integrates academic and CTE content was used to determine if it improves students' academic, technical, and employability skills. Employability skills are transferable core skill groups that represent essential knowledge, skills, and attitudes required for the 21st century workplace and are necessary for career success at all levels of employment and for all levels of education. (Preble, 2018, Stringfield & Stone, 2017); a framework of Employability Skills is available in Appendix D. Additionally, the Carl D. Perkins Act of 2006 requires teachers to apply academic integration that supports the college and career readiness initiative; therefore, requiring teachers to make changes to their teaching strategies in support of Perkins IV mandates. (Kursunoglu & Tanriogen, 2009).

As discussed in the literature review, career and technical education suffers from an image problem (Threeton, 2007, Stone & Lewis, 2012 & Meeder, 2009). Over the years, legislation has addressed the image problem and modified the Carl D. Perkins grant to what is currently known as, Perkins IV, requiring students to learn academic and technical skills content, not just one or the other (Perkins IV, 2006). To address this, Perkins IV includes strict academic standards and accountability measures (Perkins IV, 2006).

The principle behind academic integration supports current business and industry demands for a workforce with the employability skills needed for career success and addresses the research question: What lessons can teachers learn about the integration of academic content within CTE content that improves upon student academic and technical skill attainment? Drage (2010) acknowledges that there are challenges in meeting the requirements of an academic standards and accountability system through academic integration. Challenges still exist for full implementation of academic standards within CTE content as teachers appear to lack the knowledge to support the integration initiative and addresses the research question: What challenges do CTE teachers face when integrating academic content within programs of study technical skill content?

Perkins IV is discussed in the literature review and its relevance to the academic integration mandate along with the Workforce and Innovation Opportunity Act (2015). Earlier versions of Perkins attempted to challenge CTE to support business and industry to produce a workforce that can demonstrate the ability to integrate a high degree of technical ability with academic knowledge. However, these versions were not generally successful as the change to academic instruction has been slow and difficult for teachers to implement (Stipanovic, Lewis & Stringfield, 2012). On the other hand, with the essential constructs in place the implementation of academic integration can be achieved and sustained (ACTE. 2005, Kursunoglu & Tanriogen, 2009).

This chapter discusses the findings of the study that emerged when implementing project-based learning in a welding program of study. The project was planned to intellectually engage students in a rigorous and relevant blend of academic and technical skills as they researched, designed and manufactured an authentic fire pit. A "crosswalk" of welding tasks aligned to academic standards was used to develop the project with the objective to involve students in a real-work, challenging learning activity that supports their academic and technical skills development and growth. The project also promoted the growth of the students' employability, creativity, and problem-solving skills as they led the learning they need for career success. A full detailed description of the planned CTE Real-Work Integrated Project that integrates academic and technical standards to support workforce demands is in Appendix A. Limitations of the study are also addressed and conclude with the implications based on the findings.

5.1.1 Integrated project-based learning

In this study, a welding teacher demonstrated that with a change in curriculum and pedagogy, the possibility exists for CTE teachers, when integrating academic and technical standards, to effectively address federal and state accountability requirements. Project-based learning is identified in Chapter 3 as the primary teaching method used to integrate academics within the context of CTE as a way to meet academic integration and accountability requirements as mandated by Perkins IV performance indicators. Project-based learning provides opportunity for motivating students as they are engaged in intellectual as well as technical learning and can see the relevance of how their learning applies to their future career (Stone & Aliaga, 2014). The literature review in Chapter 2 discusses in detail the need for the integration of academic and technical skills to meet current workforce demands. A full detailed description of the project linking academic and technical standards is in Appendix A.

5.2 DISCUSSION OF EMERGENT THEMES

Themes emerged during the analysis phase of the qualitative study as a result of the examination of each research question. Chapter 4 discussed each research question and the findings and themes that emerged among the student group interviews and the individual teacher interview. These themes are important as they may contribute to future studies or provide for in-depth research as they apply to overcoming the “stigma” of CTCs. That is, the applied project-based learning teaching method demonstrated the rigor and relevance needed to intellectually engage and challenge students as well as to contribute to their academic, technical, and employability skills growth. The project-based learning teaching method relates to industry demands for an academic and technically skilled workforce in order to reach Perkins IV accountability performance levels. The three predominant themes as they relate to the conceptual framework and research questions that will be discussed are: academic skills (research, design), technical skills (revisions, manufacturing), and employability skills (leadership, teamwork, communication, work ethic, critical thinking).

5.2.1 Theme 1: Academic skills (research and design)

Throughout this study, discussion and references about the need for academic skill development occurred regularly as a vital component of workforce initiatives. The importance of academic skill development was evident throughout the analysis of the two research questions but emerged as “research and design.” While there was discussion with the students and teacher about the types of math used for the project such as fractions, addition, angles, and slopes, it was the research and design phase of the project that emerged as the most challenging for the students.

The research required students to read and interpret information needed to design a fire pit. The design phase required students to apply mathematic skills necessary to draw and develop a fire pit blueprint. The students expressed that their blueprints did not match their final product and that when reality surfaced during the manufacturing phase of the project, they realized they had designed a fire pit beyond their technical skill level. As a result of their inexperience, there was a lot of material and time wasted as numerous revisions to their product design were applied.

Consequently, the teacher also discussed the design phase of the project as the most challenging to teach. He reflected that a change he would make to the project-based teaching strategy would be to provide more research and design instruction so that students can proactively evaluate their product designs to match their technical skill level. The teacher believes that his guidance will help reduce wasted material and time as well; however, the teacher also recognized that the research and design phase of the project was not his area of strength. The teacher discussed the possibility of applying the projected-based teaching method at the beginning of the school year to discern the academic abilities of his students to give him the insight and knowledge he needs to support their academic growth. The teacher’s insight correlates to the literature review as it discusses the struggle CTE teachers have with academic integration (Stipanovic, Lewis & Stringfield, 2012). It also provides information for research question #1: what lessons can teachers learn about the integration of academic content (mathematics) within CTE content that improves upon student academic and technical skill attainment? A project-based teaching method is a lesson that is rigorous and challenging. It supports the academic integration initiative and advances the teaching of academic standards within CTE content.

5.2.2 Theme 2: Technical skills

Discussion and references about the need for technical skill development also occurred throughout the literature as a vital component of workforce initiatives. The technical skill (welding) development of manufacturing a fire pit was evident as students discussed the fun and challenges they had completing it. Moreover, many of the challenges students had were a result of the application of academic content during the research and design phase of the project. The students recognized that designing their fire pit was also part of their technical skill development as they discussed making revisions to their product. That is, to process changes, they had to apply academic content (design) first before they could manufacture (technical) the revisions to the fire pit. The project validates that when students actively engage in real work problems, they show increased motivation to master content, including academics (Vardia and Ciccarelli (2008). Therefore, applying integrated project-based learning in the CTE classroom supports students' academic and technical skill development and simultaneously prepares them for post-secondary options and entry to the workforce academically and technically ready.

In Chapter 4 the teacher discussed the benefits of using project-based learning to increase students' technical skill development as a way to teach them how to produce quality work and not rush through the manufacturing process. The teacher also discussed the challenges he had teaching students research, design and blueprint development. This discussion responds to research question #2: what challenges do CTE teachers face when integrating academic content within programs of study technical skill content? Applying the integrated project demonstrates that teaching challenging CTE courses by adding academic rigor to projects will assist with changing the inferiority mindset currently believed about CTE curriculum (NRCCTE, 2010, EPLC, 2016), as well as influence CTE teacher's perception and acceptance of the integration process. As a result, CTE teachers' will directly address students' academic, technical, and employability skills development and growth. The applied integrated project also assists with meeting the CTC's Perkins IV accountability performance levels and supports business and industry demands for a skilled workforce.

5.2.3 Theme 3: Employability skills

The most impactful data that emerged from the project-based teaching strategy was in the area of employability skills. These skills are discussed throughout the literature as an essential requirement of 21st century workplace readiness. Employability skills emerged through the analysis of the study as leadership, teamwork, communication, work ethic, and critical thinking. Students discussed their employability skills often during the interview as they talked about the teamwork and communication required to "finish" the job (work ethic); they discussed the time they spent to complete the project and tracked the "man hours" for manufacturing. Additionally, they discussed their collaboration to work out the problems they had during manufacturing (critical thinking) and how they persevered. At the conclusion of the project, the students recognized the material and time wasted because of their technical inexperience. As a result of the challenges they had completing the project when team members were absent, the students also recognized the importance of regular attendance in the workplace. Overall, they seemed to understand the benefits of the project and the relevance to their future career. They recognized that the project-based learning fire pit project was geared to the "real world" work environment when compared to typical classroom routines. The students engaged in the rigor and challenge of the project while developing their academic, technical and employability skills, which increased their motivation to learn.

Throughout Chapter 2 employability skills are discussed as an area of growth students need to develop to meet workforce demands. Additionally, in Chapter 3 project-based learning is discussed as a teaching method that can be applied in the classroom to encourage the development of employability skills. This was validated from the teacher interview as leadership, teamwork, and work ethic emerged among the students as they engaged in manufacturing their product. Implementing the project was initially a challenge for the teacher since he had not taught an integrated project before this study. The teacher states that he will continue to apply project-based learning as he experienced the value and affect this teaching method has in developing students' employability skills.

As noted in the literature, today's workforce requires students to have academic, technical and employability skills (Preble, 2018, Stringfield & Stone, 2017). Teachers at shared-time CTCs struggle to meet workforce demands and Perkins IV mandates due to an absence of teachers who are trained to deliver academic content in their classes. The real-work integrated project applied in the welding program supports mandates and student employability. CTC administrators should make sure that teachers receive training and promptly apply these methods. Frequently, teachers have received training but have not applied the method in instruction due to their insecurity with academic integration and/or a lack of administrative support. Therefore, supervisors of a CTC must also be receptive to the academic integration process, holding teachers accountable for its application during instruction.

5.3 LIMITATIONS

Valuable information was collected from this study to assist in the integration of academic standards within CTE content. However, there are limitations to the study that must be acknowledged. One of the limitations is that there was only one shared-time CTC visited for the study and within the CTC only one program applied the integrated project-based learning activity used for this study. The inclusion of additional shared-time CTCs and programs would allow for the discovery of additional possibilities that may exist for CTE teachers when attempting the academic integration initiative that supports workforce demands.

A second limitation was that only one type of teaching method was used for the study. While there are numerous pedagogical teaching methods used in education, this method was selected because it incorporated both academic and CTE standards with the theory that it would result in students' academic, technical, and employability skills improvement. Applying more than one teaching method may capture additional information that teachers could use to support the academic integration initiative.

5.4 IMPLICATION AND RECOMMENDATIONS

This study has implications for CTCs, career and technical education, and education in general to consider when integrating academic and CTE standards at the secondary level. PDE conducts an Approved Program Evaluation review every fifth year at each CTC throughout the state. During the review the evaluators look for evidence of academic and technical integration by reviewing lessons plans, but do not evaluate teaching strategies in the classroom. That is to say, PDE evaluators do not necessarily observe teachers applying academic integration during the evaluation review, even though academic and technical content integration is a mandated federal and state requirement. Validity for the Approved Program Evaluation process and academic integration mandates may have more significance for teachers if PDE evaluators observed them applying academic integration methods as part of the review process. But CTC bargaining unit contracts may prevent this. It is also an administrator's responsibility to support and hold teachers accountable for the integration of academic and technical content.

5.4.1 Recommendation 1: Professional growth

CTE teachers and administrators must be willing to reach beyond their comfort zone to explore and attempt new teaching methods that will allow for the integration of academics. Since the push for the integration of academic and CTE content evolved with Perkins IV, there have been a variety of professional development opportunities through the Technical Assistant Program (TAP) provided by the Bureau of Career and Technical Education of the Pennsylvania Department of Education. However, attending professional development is not enough. For example, the welding teacher in this study had attended project-based learning training through TAP two years prior to applying it in the classroom and, therefore, did not recognize the underlying academic and employability standards within technical content until the students completed the project. Although, in the literature review I discuss that CTE teachers often lack professional development for academic integration to be effective (Neal, 2015), it is the application of the method that is needed for professional development to be successful. Furthermore, administrators need to support and encourage teachers to apply newly learned strategies, ensuring the success of students' academic, technical and employability skills development. As the instructional leaders of a CTC, administrators are in a position to influence professional development in support of academic integration initiatives. CTC administrators should also attend training with teachers so that they can more effectively help them to upgrade their teaching methods and better understand the resources and support teachers may require.

Discussion after applying newly learned teaching methods will allow the administrator and teacher to reflect and plan for improvement for professional growth, which is also a requirement of the PDE Educator Effectiveness evaluation system Domain 4 (PDE, 2014). I recommend using the Educator Effective evaluation process to ensure teachers apply new teaching methods that are observed by administrators, as the system is designed for teachers to focus on engaging students with lessons that are intellectually challenging. Specifically, administrators and teachers using the elements in Domain 1, Setting Instructional Outcomes, and Domain 2, Communicating with Students, reinforces teacher professional growth and provides administrators the ability to observe teaching methods that support students' intellectual engagement using rigorous lessons (Danielson, 2009). Therefore, CTC teachers should design rigorous lessons, such as the integrated project used in this research, to earn high levels of performance.

5.4.2 Recommendation 2: Shared vision

It is important to note that academic integration can be achieved through a variety of teaching methods. Flexibility allows CTE teachers and administrators seeking to meet the mandate of Perkins IV the opportunity to develop pedagogy that can lead to multiple methods for academic and technical skill integration. Keeping in mind that a welding program was selected for this study as a result of Keystone assessment data that indicates poor academic achievement levels of welding students. Thus, CTE teachers and administrators must accept that possibilities exist that allow for teachers to teach, and students to learn, academic and technical skills simultaneously. Although the teacher in this study previously taught academic standards as a separate lesson from technical standards, through this experimental lesson he gained an understanding of academic integration within the CTE content. The real work project provided him the opportunity to apply a new teaching method, integrating academic and technical skill content simultaneously, as well as develop his teaching and learning skills. The project also engaged students in rigorous, relevant, real work and allowed them to develop academic, technical and employability skills at the same time.

In a shared-time CTC, the administrator and teachers must develop a shared vision that is communicated to stakeholders that include students, parents, Joint Operating Committee members, and sending school district Superintendents, as well as business and industry partners. The vision should support the culture change required of academic integration reform efforts, indicating that possibilities exist to support workforce needs by teaching academic and technical skills seamlessly. A shared vision promotes instruction that teaches every student the academic, technical, and employability skills needed to succeed in the workforce and continuing education requirements. However, a shared vision is not sufficient. I also recommend the development of an action plan to operationalize the vision. Goals and student achievement milestones must be established so as to prioritize resourcing decisions, getting the teachers motivated and invested in the vision. A partial action plan sample may include resources and schedules for students to earn an industry certification to ensure they graduate with at least one credential that demonstrates a learned technical skill. An action plan may also include CTC-wide integrated project-based learning teacher training and application.

5.4.3 Recommendation 3: Academic and CTE teacher collaboration

In the literature, I discuss that it is essential for CTE and academic teachers to collaborate because CTE teachers may not have the knowledge to teach the level of math students need for success on their chosen career pathway (Walter & Gray, 2001). With academic and CTE teacher collaboration, CTE teachers can learn the academics embedded in their curricula to strengthen the learning concepts essential to occupational skills and knowledge and at the same time, academic teachers can learn technical skill content. Moreover, CTE and academic teacher collaboration will provide the opportunity for teachers to develop curricula for programs of study that are rigorous and prepare students for high-skill, high wage, high demand jobs.

Each year sending school districts and CTCs have professional development days built into their school calendars. Yet, often teachers are directed to attend other professional development opportunities with little time available for teacher collaboration; especially, for CTE teachers located at shared-time CTCs where there may be few, if any, academic teachers. While academic and CTE teacher collaboration is not a new idea, it rarely happens because shared-time CTCs are logistically separated from their sending school partners. By working together, CTE and academic teacher collaboration can transform teaching and learning through career pathways that integrate academic and technical curriculum that requires students to engage in rich multidisciplinary projects and connects the classroom to real-work learning. Because most shared-time CTCs are usually located on a separate campus from sending school districts, administrators and teachers must be creative in providing joint planning among CTE and academic teachers. Collaborative planning could be arranged by meeting after school hours throughout the school year or during summer months. However, hours worked beyond a teachers' contractual workday may be a challenge due to bargaining unit contracts among the schools and negotiating supplemental salaries. Negotiating with bargaining unit representatives and developing a "memorandum of understanding" for supplemental salaries for teachers may remove barriers. Additionally, collaborative planning can be arranged by providing substitute teachers in classrooms while academic and CTE teachers meet during the regular contractual school day. I also recommend that schools organize teacher-to-teacher observations that allow CTE to observe academic teachers and subsequently, for academic teachers to observe CTE teachers so that when collaborative planning occurs there is a level understanding of the concepts to be taught.

5.4.4 Recommendation 4: Reduce absenteeism

While interviewing the welding students, there was discussion about the difficulty they had completing their projects because some of their team members were frequently absent. I also noted student absences during the interviews in my research findings. Although the CTC's sending school partners enforce truancy regulations, it is recommended that the CTC form a committee that is responsible for overseeing student absenteeism as well. The committee could include the administrative director, guidance counselor, two to three teachers, and the sending school principals or guidance counselors. The committee should develop an action plan to reduce absenteeism and to review absentee data. The action plan should include policies and procedures that reflect PDE regulations and actions to take when students are chronically absent as well as incentives to encourage students to attend school on a regular basis. It is important that students attend school as this reinforces employability skill development and academic and technical skill growth. Moreover, when meeting with employers, they often discuss the need for students to understand the value of work attendance as well as timeliness, which they state is lacking in students as they enter the workforce. An action plan that reduces student absences would support business and industry as well.

5.5 FINAL CONCLUSIONS

> For all learners to find success, we must be steadfast in our expectation of excellence for all CTE programs of study. This is the only way we will eradicate the negative stereotypes and realities that persist in communities across the country. The CTE community has worked hard and made great strides to improve the quality of its programs of study. Yet, an even greater commitment from all stakeholders is necessary to ensure excellence in all programs, across all zip codes and for all learners (Wilson, 2018, Pg. 4)

This chapter discussed the emergent themes and implications of the study. Four recommendations for practices were also discussed. The recommendations relate to the integration of academic standards within CTE content and apply well into the CTC visited for this study. These recommendations may also apply to other shared-time CTCs that do not currently employ full-time academically certified teachers.

The first recommendation discussed teachers' professional growth opportunities as well as the support and encouragement needed from administrators for teachers to engage in applying newly learned teaching methods. Specifically, a teacher's newly learned teaching method must be applied in order to demonstrate professional growth to support students learning. That is, attending professional development is not enough; application is essential. The second recommendation looked at the CTC visited for this study to develop a shared vision and action plan for reform change so that all programs of study apply rigorous, relevant curriculum such as the real work project applied in the welding program. Observation of the welding students' excitement and positive reaction to the project during the academically integrated curriculum supports a positive image growth for the CTC (Jackson & Hasak, 2014). During the students' interviews it was observed that they valued the learning opportunity and knowledge they gained from the project. This supports the academic integration initiative as CTCs evolve into career technical centers that offer programs of study with rigorous standards for students' skill and academic learning that prepares them for industry certification attainment and post-secondary entrance as discussed in the literature review.

The third recommendation considers the possibility of joint planning among sending school districts academic teachers and CTC teachers to encourage collaboration to support students' development of academic and technical skills to meet high demand, high wage, and high skill careers. This recommendation is a result of the welding teacher's interview and his struggle to support students during the research and design phase of the project. Absenteeism is discussed in the fourth recommendation as the welding students recognized the difficulty to successfully complete their projects when team members where often not present. The welding students seemed to recognize the importance of regular attendance and its significance to their current and future employment.

In closing, as an administrator of career technical education, it is important to help teachers apply teaching strategies that increase student learning as we prepare them for careers and college; especially, at CTCs that seek to eradicate the "stigma" that their programs are only for low performing students. For decades the CTE community has sought to reinvent itself by developing high-tech, rigorous programs of study such as Sports Medicine, Biomedical Technology, Veterinary Science, Computer Network Technology, Engineering, and Robotics has made great strides to improve the quality of CTE programs of study. Additionally, Jackson and Hasak (2014) also recommend a cosmetic change for CTE across the nation to erase the image problem that identifies it as an education track for students who are not qualified for college. They suggest rebranding CTE to "Innovation Pathways" as a way to connect the skills needed to succeed in today's workforce (Jackson & Hasak, 2014.) It is imperative that CTE teachers and administrators continue to not only develop rigorous programs with high expectations for excellence but the relevance to the learning must also be evident for students to engage in learning. Furthermore, it is important to continue to promote that career technical education is for every student as a way to eradicate the negative image that persists at Career Technical Centers and supports the demand for an academic and technical skilled workforce. What's more, removing barriers between academic and technical instruction, secondary and post-secondary education, and career pathways will lead to career success for students.

5.6 IMPLICATION FOR FUTURE RESEARCH

The following implications for future research summarize possible directions for policy reform and support of the academic integration initiative to meet current demands that advocate for a skilled workforce that is academically and technically proficient, along with the employability skills to obtain employment in high wage, high skill, high demand jobs:

1. *Post-Secondary Barriers*. A study of barriers CTC students face transitioning to post-secondary education is recommended since they are often considered low achieving and not college bound. Additionally, students that elect to attend a shared-time CTC may not have the opportunity to take rigorous academic coursework because they spend half of their school day at the CTC. This study may provide information for policy reform that

supports equal access to rigorous academic coursework required for post-secondary preparation for students that elect to attend a CTC.

2. *Absenteeism*. Students interviewed for this research discussed the difficulty they had completing the project due to the absences of their team members. Future research is recommended to determine why students are frequently absent from the CTC. This study may assist CTCs in developing an action plan that supports students' regular attendance and targets policy reform.

3. *CTC-Wide Project Based Learning*. If implemented in each program offered at a CTC during a school year, a larger study may determine if the integrated project-based learning design used in this study changes the culture of students' learning expectations as well as the mindset of teachers that still struggle with the integration process. This study may also assist with eradicating the CTC stigma.

4. *Professional Growth.* The effect that the PDE Educator Effectiveness evaluation system has on teachers' professional growth at a CTC is recommended for future research. A study that attempts to develop and apply a more comprehensive list of teaching methods that supports academic integration may also provide opportunity for teachers to grow professionally. However, bargaining unit contracts may limit access to teachers' evaluation information that may be needed as artifacts for this type study.

APPENDIX A

CTE REAL-WORK INTEGRATED PROJECT – WELDING

Project-based Learning

Project Title: Outdoor Fire Pit	
Course(s): Welding Fabrication	Date:
Teacher(s):	Teacher(s) Email(s):
Instructional Time: 17 class periods of 120 minutes each	Grade Level: 10, 11, 12
School:	Director:
Project's Driving Question: What is the most effective and cost-efficient way to design an outdoor fire pit that is manufactured from steel and is safe for public use?	
Project Description: You are an employee of a local welding fabrication business, and you and your team are charged with researching, designing, building, and testing an outdoor fire pit that is safe for public use (your back yard). As a team, you will be responsible for producing a Research and Design Report stating the nature of the team's research and how the design reflects the research. Secondly, the team will have to produce a Cost Analysis Sheet and submit an Estimate for review. Once the estimate is approved, production of the approved project will begin. Finally, each team involved will be required to present their projects and give a short presentation of why their project is the best.	

Essential Standards	
Career Technical Education:	13.3.11.B: Evaluate team member roles to describe and illustrate active listening techniques 13.3.11.C: Evaluate conflict resolution skills as they relate to the workplace **WELDING OCCUPATIONAL COMPETENCIES:** 300 WELDING, DRAWING, AND WELD SYMBOL INTERPRETATION 301 Interpret basic elements of a drawing or sketch. 302 Interpret welding symbol information. 303 Fabricate parts from a drawing or sketch (class project). 304 Identify structural metals used in the metal fabrication field. 305 Demonstrate knowledge of basic metric conversion. 400 VISUAL EXAMINATION, INSPECTION, AND TESTING 401 Evaluate cut surfaces and edges of prepared base metal parts for testing. 402 Identify and evaluate weld discontinuities as per accept/reject criteria. 403 Demonstrate visual inspection and destructive and non-destructive techniques. 500 SHIELDED METAL ARC WELDING (SMAW) 501 Perform safety inspections of SMAW equipment and accessories. 502 Make minor external repairs to SMAW equipment and accessories. 503 Set up and operate SMAW equipment. 504 Make fillet welds in all positions. 505 Make groove welds in all positions. 506 Pass performance test in all positions. 507 Perform qualification test. 1100 MANUAL PLASMA ARC CUTTING (PAC) 1101 Perform safety inspections of PAC equipment and accessories. 1102 Make minor external repairs to PAC equipment and accessories. 1103 Set up and operate manual PAC operations on ferrous and nonferrous materials. 1104 Perform shape cutting operations on ferrous and nonferrous materials. 1305 Calculate material sizes based upon job needs. 1306 Demonstrate knowledge of third angle projections. 1307 Identify and interpret geometric dimensioning and tolerancing.

Literacy:	**READING:** Standard CC.3.5.9-10.A. Cite specific textual evidence, etc. Standard CC.3.5.9-10B Determine the central ideas or conclusions of a text; etc.... Standard CC.3.5.9-10.C Follow precisely a complex multistep procedure, etc. Standard CC.3.5.11-12A Cite specific textual evidence, etc. Standard CC.3.5.11-12.B. Determine the central ideas or conclusions of a text; etc. Standard CC.3.5.11-12.C. Follow precisely a complex multistep procedure, etc. Standard CC.3.5.9-10.D. Determine the meaning of symbols, key terms, and other domain specific words. Analyze the structure of the relationships among concepts in a text, etc. Standard CC.3.5.9-10.F Analyze the author's purpose in providing an explanation, describing a procedure. Standard CC.3.5.11-12.D. Determine the meaning of symbols, key terms, and other domain specific words. Standard CC.3.5.11-12.E. Analyze the structure of the relationships among concepts in a text. Standard CC.3.5.11-12.F Analyze the author's purpose in providing an explanation, describing a procedure. Standard CC.3.5.9-10.G. Translate quantitative or technical information expressed in a text into visual form (e.g. a table or chart). Standard CC.3.5.9-10.H. Assess the reasoning in a text to support the author's claim for solving a technical problem. Standard CC.3.5.9-10.I. Compare and contrast findings presented in a text to those from other sources, etc. Standard CC.3.5.11-12.G. Integrate and evaluate multiple sources of information presented in diverse formats to solve a problem. Standard CC.3.5.11-12.H. Evaluate the hypotheses, data, analysis, and conclusions in a technical text, verifying the data when possible. Standard CC.3.5.11-12.I. Synthesize information from a range of sources into a coherent understanding. Standard CC.3.5.9-10.J AND Standard CC.3.5.11-12.J. By the end of grades 9-10, AND 11-12, read and comprehend technical texts independently and proficiently. **WRITING:** Standard CC.3.6.9-10.A Write arguments focused on discipline specific content. Standard CC.3.6.9-10.B Write informative or explanatory texts, including the narration of technical processes. Standard CC.3.6.11-12.A Write arguments focused on discipline specific content. Standard CC.3.6.11-12.B Write informative or explanatory texts, including the narration of technical processes. Standard CC.3.6.9-10.C Produce clear and coherent writing...appropriate to task, purpose, and audience. Standard CC.3.6.9-10 D Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. Standard CC.3.6.9-10.E Use technology, including the internet, to produce, publish, and update individual or shared writing products.

	Standard CC.3.6.11-12 C Produce clear and coherent writing...appropriate to task, purpose, and audience. Standard CC.3.6.9-10 D/Standard CC.3.6.11-12.D.Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. Standard CC.3.6.11-12.E.Use technology, including the internet, to produce, publishes, and update individual or shared writing products. Standard CC.3.6.9-10.F. Conduct short and more sustained research to answer a question or solve a problem. Standard CC.3.6.9-10.G.Gather relevant information from multiple authoritative print and digital sources, following a standard format for citation. Standard CC.3.6.9-10.H. Draw evidence from informational texts to support analysis, reflection, and research. Standard CC.3.6.11-12.F. Conduct short and more sustained research to answer a question or solve a problem. Standard CC.3.6.11-12.G.Gather relevant information from multiple authoritative print and digital sources, following a standard format for citation. Standard CC.3.6.11-12.H. Draw evidence from informational texts to support analysis, reflection, and research. Standard CC.3.5.9-10.I AND Standard CC.3.5.11-12.I. Write routinely over extended time frames and shorter time frames for a range of tasks, purposes and audiences.
Math:	Standard 2.1.HS.F.2 Apply properties of rational and irrational numbers to solve real world or mathematical problems. Standard 2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multistep problems. Standard 2.1.HS.F.5 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. Standard 2.1.HS.F.6 Extend the knowledge of arithmetic operations and apply to complex numbers
Science:	Standard11.A.2.1.2 Critique the elements of the design process.
College and Career Success Skills	• Collaboration • Communicating
21st Century Skills	1.1.7 Make sense of information gathered from diverse sources by identifying misconceptions, main and supporting ideas, conflicting information, and point of view or bias. 2.1.2 Organize knowledge so that it is useful. 3.1.1 Conclude and inquiry based research process.

APPENDIX B

ACT 6

PUBLIC SCHOOL CODE OF 1949 - KEYSTONE EXAMS

Act of Jun. 21, 2017, P.L. 200, No. 6 Cl. 24

Session of 2017
No. 2017-6

HB 202

AN ACT

Amending the act of March 10, 1949 (P.L.30, No.14), entitled "An act relating to the public school system, including certain provisions applicable as well to private and parochial schools; amending, revising, consolidating and changing the laws relating thereto," in preliminary provisions, further providing for Keystone Exams.

The General Assembly of the Commonwealth of Pennsylvania hereby enacts as follows:

Section 1. Section 121(a) of the act of March 10, 1949 (P.L.30, No.14), known as the Public School Code of 1949, amended February 3, 2016 (P.L.1, No.1), is amended and the section is amended by adding subsections to read:

Section 121. Keystone Exams.--(a) [Subject to annual appropriation, not later than the 2020-2021 school year, the] The Department of Education shall develop and implement Keystone Exams in [the following subjects:] algebra I, literature[, biology, English composition, algebra II, geometry, United States history, chemistry, civics and government and world history.] and biology. The State Board of Education shall promulgate regulations, subject to the act of June 25, 1982 (P.L.633, No.181), known as the "Regulatory Review Act," necessary to implement this section.

* * *

(c) Notwithstanding section 2604-B(b)(2)(v), 22 Pa. Code § 4.24 (relating to high school graduation requirements) or 4.51 (relating to State assessment system) or any statute or regulation to the contrary, in any school year in which a demonstration of proficiency on a Keystone Exam is required for high school graduation, a CTE Concentrator shall be deemed proficient provided that the CTE Concentrator shall meet all of the following requirements:

(1) completes locally established grade-based requirements for academic content areas associated with each Keystone Exam on which the CTE Concentrator did not achieve proficiency. For the purposes of this paragraph, completion of grade-based requirements in any science and technology and environment and ecology course shall satisfy the requirements for the academic content area associated with the Keystone Exam in biology; and

(2) completes one of the following:

(i) attains an industry-based competency certification related to the CTE Concentrator's program of study; or

(ii) demonstrates a high likelihood of success on an approved industry-based competency assessment or readiness for continued meaningful engagement in the CTE Concentrator's program of study as demonstrated by performance on benchmark assessments, course grades and other factors consistent with the CTE Concentrator's goals and career plan.

(d) As used in this section, the following words and phrases shall have the meanings given to them in this subsection unless the context clearly indicates otherwise:

"Approved industry-based competency assessment." A NOCTI exam, NIMS assessment or other industry-based competency assessment identified by the Secretary of Education and approved by the State Board of Education.

"CTE Concentrator." A student who, by the end of a reporting year, will be reported as successfully completing at least fifty percent (50%) of the minimum technical instructional hours required under 22 Pa. Code Ch. 339 (relating to vocational education).

"NIMS assessment." An assessment based on the National Institute for Metalworking Skills standards.

"NOCTI exam." A National Occupational Competency Testing Institute exam.

Section 2. This act shall take effect immediately.

APPROVED--The 21st day of June, A.D. 2017.

Tom Wolf

APPENDIX C

PERFORMANCE INDICATOR LEVELS

2017-2018
PERFORMANCE LEVELS

Name of Fiscal Agent: [redacted]

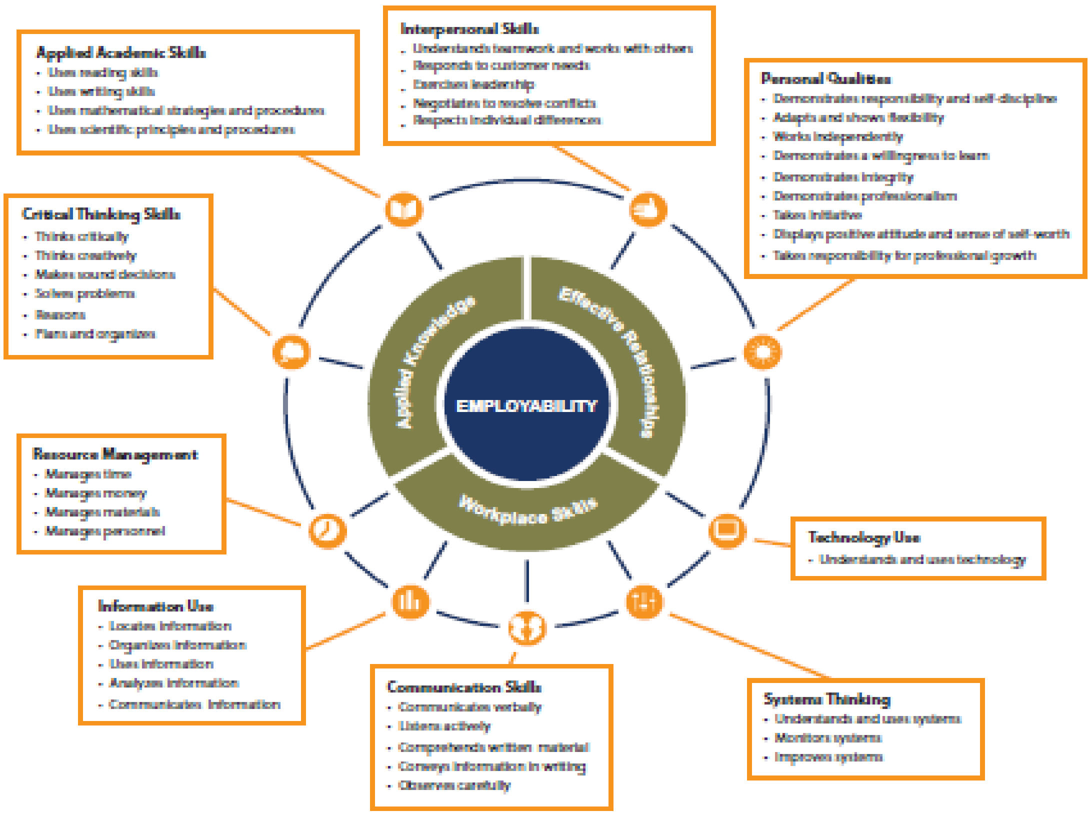
Indicators	1S1 Keystone Literature	1S2 Keystone Algebra	2S1 Technical Skill Attainment (NOCTI)	3S1 Student Attainment (Diploma)	4S1 Graduation Rate	5S1 Placement (Job-Postsecondary-Military)	6S1 Nontradtional Participation (Gender Dominated)	6S2 Nontradtional Completion (Gender Dominated)
	Secondary Performance Indicators (only)							
State Expectations (USDE)	53	43	80	98	98	97.70	17.70	12.80
State Performance 2015-2016	54.23	47.89	84.06	99.00	99.01	90.74	16.74	12.96
Consortium Performance 2015-2016	40.95	28.57	78.57	95.37	93.64	70.69	13.37	15.07
[redacted]							0	
[redacted]	30	25	100	90	85.71	40	10.14	0
[redacted]	47.62	47.62	64.71	97.73	95.56	76.47	13.22	31.03
[redacted]	33.33	8.33	81.82	91.67	91.67	76.92	6.98	0
[redacted]	33.33	6.67	92.31	93.33	93.33	100	6.82	0
[redacted]	50	18.75	72.73	100	100	75	23.46	16.67

APPENDIX D

EMPLOYABILITY SKILLS FRAMEWORK

EMPLOYABILITY SKILLS FRAMEWORK

Employability Skills: A Crucial Component of College and Career Readiness
Individuals require many skills to be college and career ready, including academic knowledge, technical expertise, and a set of general, cross-cutting abilities called "**employability skills.**"



Common Framework for Employability Skills

The Employability Skills Framework advances a unifying set of skills that cuts across the workforce development and education sectors based on an inventory of existing employability skills standards and assessments.

The Employability Skills Framework was developed as part of the Support for States Employability Standards in Career and Technical Education (CTE) and Adult Education project, an initiative of the Office of Career, Technical, and Adult Education, U.S. Department of Education. Framework development was guided by CTE, adult education, workforce development and business organizations, and twelve federal agencies.

http://cte.ed.gov/employabilityskills

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