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Efficacy of the WorkKeys ACT Assessments in Predicting Student Success in Postsecondary Career Technical Education and Industry Recognized Credential Attainment

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Efficacy of the WorkKeys ACT Assessments in Predicting Student Success in Postsecondary Career Technical Education and Industry Recognized Credential Attainment

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The thesis entitled '**Efficacy of the WorkKeys ACT Assessments in Predicting Student Success in Postsecondary Career Technical Education and Industry Recognized Credential Attainment**' presented by **BROOKLYN BOWERS**, a candidate for the degree of **Master of Science in Mathematics,** has been approved and is worthy of acceptance.

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ABSTRACT

This study examines the efficacy of the ACT WorkKeys assessments in predicting student success within postsecondary Career and Technical Education (CTE) programs at C-TEC Postsecondary. Using a comprehensive analysis of data from students who have either withdrawn or completed their postsecondary CTE program, the research evaluates the predictive strength of student scores on three ACT WorkKeys assessments—applied math, graphic literacy, and workplace documents. The findings reveal that higher scores on these assessments correlate with student success, defined as successfully completing a program and successful attainment of industry recognized credentials. This study's insights suggest potential improvements in educational policy and practice, advocating for the integration of these assessments into the student admissions processes to ensure successful educational and employment outcomes. Additionally, utilizing complementary admissions criteria along with entrance exams is recommended. Furthermore, the research highlights the importance of considering additional demographic variables, such as age, race, gender, and economic disadvantage in predicting student success. Overall, this study contributes to the broader discussion on the role of entrance exams in educational achievement and workforce preparedness in the postsecondary CTE context.

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CHAPTER I: Introduction

Entrance exams are an essential component for admission into postsecondary education institutions but can be a source of anxiety for many students (Çirak, 2016; Steedle, 2018). These requirements are set in place to ensure that potential students are prepared for the level of education they are pursuing and avoid unnecessary failures due to a lack of academic ability (Steedle et al., 2019). While research on postsecondary education entrance exams has focused on pre-college students, little emphasis has been placed on conducting research within adult postsecondary education centers, also known as postsecondary career technical education (postsecondary CTE), vocational, or trade centers (Frey, 2019; Wao et al., 2017). In recent years, there has been a notable rise in demand for specialized trade and industry jobs that require education beyond a high school diploma in the United States. As a result, there has been an increase in the number of adult students seeking admission into postsecondary CTE centers to obtain industry credentials and certificates (Rainie et al., 2022; Parker & Roumell, 2020; Morthland, 2010). However, research on postsecondary CTE centers and their use of entrance exams is lacking.

The ACT WorkKeys assessments were designed to serve as a diagnostic tool to identify potential employees who are job-ready for prospective employers (MPR Associates, Inc. & Academy for Educational Development National Institute for Work and Learning, 2006; *ACT WorkKeys – Workforce Development Solutions*, 2023). In some secondary schools in the United States, these assessments have been implemented as a measure of workplace readiness for secondary CTE exit requirements for students, or as a potential pathway for graduation (Steedle & Girdler, 2020). However, the requirements for entrance exams in postsecondary CTE centers remain poorly understood, and further research is necessary to examine the impact of entrance

exams within postsecondary CTE centers, as well as the reliability of the ACT WorkKeys assessments in predicting student success in such settings (Edgerton, 2022; Erwin, 2019).

Students enrolled in postsecondary CTE centers often encounter distinctive challenges that set them apart from pre-college, high school students. Typically, these students have been away from educational institutions for a prolonged period of time and harbor significant anxiety towards academic and testing environments (Castañeda, 2017). Additionally, these students generally maintain full-time employment and face familial obligations while enrolled in postsecondary CTE programs (MacDonald 2018; Smith, 2013; *Postsecondary CTE*, 2023). Furthermore, students who come from lower socio-economic backgrounds often enroll in postsecondary CTE programs to obtain well-paying jobs that can enhance their quality of life within a shorter timeframe than a traditional four-year degree program would permit (Ahearn et al., 2016; Advance CTE, 2020a).

To identify potential barriers for alternative educational pathways, assessing the effectiveness of an entrance exam's ability to predict success for students who enroll in postsecondary CTE programs is imperative to the success of current and future postsecondary CTE students. This study aims to assess the effectiveness of the ACT WorkKeys assessments on predicting student success in postsecondary CTE programs (as defined by graduating from an enrolled program), obtaining an industry recognized credential (defined by earning at least one industry recognized credential that is not the NCRC), and securing a job in the program field after completion of their enrolled postsecondary CTE program. This study also aims to investigate if retake status (defined by having to retake at least one of the ACT WorkKeys assessments) and the number of retakes a student must complete on the ACT WorkKeys assessments to meet the desired program cut off score impacts the prediction of student success.

Background of the Problem

Postsecondary career technical education, or postsecondary CTE, has played an important role in the history of education in the United States. Also referred to as vocational education, trade school, or adult education centers, postsecondary CTE centers were first designed to provide hands-on training for adults lacking skills required to obtain a job that requires less education than a traditional 4-year degree, but more than a high school diploma (Edgerton, 2022). Determined imperative by the United States federal government for economic growth and prosperity of the country, vocational education first focused on developing adults' knowledge in agriculture, home economics and mechanical works (Parks & Shoemaker, 2007, pg. 4; Kim, 2023). Changing with a rapidly evolving industrial economy, postsecondary CTE centers now offer programs in healthcare services, welding and HVAC trades, mechanic trades, construction, manufacturing, and IT (National Center for Education Statistics, n.d.).

The growth and change of postsecondary CTE during the 1900's was no match for the popularity of the traditional college pathway. Used as a method of tracking and segregating students, postsecondary CTE was labeled as alternative education and was perceived to be an option only secondary to a four-year university degree (Xing et al., 2019; Kim, 2023; Allen & Sconing, 2005). Postsecondary CTE centers were typically composed of students who were considered minorities and special needs students; these students were also more likely to come from lower socio-economic families (Advance CTE, 2020; Dougherty & Lombardi, 2016). With lack of support for postsecondary CTE due to bias that ran rampant during this time period, less support was provided by the local or federal governments to encourage the growth of postsecondary CTE centers, leading to low student enrollment outside of traditional four-year college education (Gauthier, 2020; Waugh, 2018; Lotto, 1988). However, the value of an education that can be obtained from postsecondary CTE programs is starting to gain popularity in the United States, as postsecondary CTE centers have started to rebrand their public

perception (Advance CTE, 2020a). However, some negative perceptions of postsecondary CTE centers still exist (Butrymowicz, 2016).

Although the ACT WorkKeys assessments are not currently recognized as a standard postsecondary education admissions assessment, the traditional ACT exam has been widely used by colleges to predict students' academic success (Allen & Sconing, 2005; Belasco et al., 2015). However, in light of growing concerns about excessive testing and the accessibility of postsecondary education for underrepresented minority and low-income students, many educational institutions have begun implementing test-optional policies for incoming applicants (Rosinger et al., 2021; Belasco et al., 2015). While incoming freshman ACT entrance exam scores have been extensively studied, other measures, such as a student's high school GPA (HSGPA), have been shown to be more reliable predictors of academic success in postsecondary education (Allensworth & Clark, 2020; Woods et al., 2018). Nonetheless, there has been considerable debate over the reliability of HSGPA as an indicator of academic success, given inconsistencies with school funding and curriculum, as well as teacher bias in assigning grades (Woods et al., 2018). Moreover, research suggests that standardized test scores are often unreliable in predicting student success when examining minorities and low-income students' scores (Belasco et al., 2015).

Using entrance exam scores to deny admission to students based on their academic ability can potentially save them from future financial stress, as college dropout rates among unprepared students can result in unexpected costs in the form of student loans without the stability of a four-year degree and the potential for a higher income (Rosenbaum et al., 2015). However, entrance exams can be useful tools for identifying students who may need additional academic support, such as remedial classes in math and English (Woods et al., 2018). Data

collected from entrance exams can also guide educational policies aimed at developing skills that promote higher scores on these assessments (Royster et al., 2015).

The ACT WorkKeys assessments are used nationally by high schools, colleges, and employers as a measure of students' workplace readiness for employment (*National Career Readiness Certificate - ACT Workkeys*, 2023). Given that the primary goal of postsecondary CTE centers is to assist students in obtaining employment quickly after graduating, assessing student preparedness for the workforce is essential to student success (Lefebvre & Steedle, 2019). However, denial of admission based on testing scores can prohibit a student from ever obtaining these skills (Steedle et al., 2019).

Enrolling into postsecondary CTE programs provides a pathway for adults to escape poverty and achieve financial stability (Ohio Board of Regents, 2014; Lefebvre & Steedle, 2019). Students who graduate from a postsecondary CTE program gain specific industry knowledge and skills, and therefore have a higher chance of finding steady employment than those with only a high school diploma (Steedle et al., 2019; Royster et al., 2015). Employers also benefit from postsecondary CTE enrollment, as employers save valuable time and resources that would have been otherwise spent on employee training (Advance CTE, 2021). Furthermore, the sustained employment of postsecondary CTE program graduates increases the state's economic well-being and could reduce the dependence on state resources, such as welfare and subsidized health care (Ohio Board of Regents, 201; Sosulski, 2021). This economic benefit continues with children of adults who attend postsecondary education, as they are much less likely to repeat the cycle of generational poverty (Engle, 2007).

Statement of the Problem

Research examining the success rate based on student ACT scores, college admissions, and student success has been thoroughly researched. The ACT has been

established as a valuable assessment that predicts student success in college courses. Further, the impact of postsecondary education has been shown to have a positive impact on the lives of those who graduate from postsecondary institution. Students who further their education after obtaining a high school degree are more likely to hold a stable job and have little to no dependence on state assistance programs. Additionally, children of adults who complete a postsecondary education degree or program are more likely to continue this trajectory and become productive, hardworking citizens.

While ACT scores are positively linked to student success in college, and postsecondary education benefits are well known, much less is understood concerning adult success in postsecondary CTE programs. Conflicting terminology in the field of postsecondary CTE as well as lack of information regarding entrance exams in postsecondary CTE admissions creates cause for concern (Kosloski & Ritz, 2016; Brixey & Keily, 2021). The option of postsecondary CTE as a pathway for postsecondary education should be a less complicated option for adult students who hold a job, juggle financial and family obligations, and have less free time than traditional college students.

The need for this study is to examine the effectiveness of the ACT WorkKeys assessments in determining the success of adult students who enroll in postsecondary CTE centers. Entrance exams may act as a barrier for some students; understanding this barrier can help determine a solution for assisting them in developing foundational academic skills. If the ACT WorkKeys assessments are shown to be an effective tool in predicting student success in postsecondary CTE centers, schools may consider implementing programs to better assist students who cannot pass the assessments. Further, if the ACT WorkKeys assessments are not effective in predicting student success in postsecondary CTE centers, policies should be changed to better evaluate students who wish to enroll in these programs.

Purpose of the Study

The purpose of this study is to examine the extent to which the ACT WorkKeys assessments predicts student success in postsecondary CTE programs. This study will test four independent variables: student scores on the three ACT WorkKeys assessments (applied math, graphic literacy, and workplace documents), and if the student had to retake one or more of the ACT WorkKeys assessments to meet the minimum cut score required to enroll into their desired program.

The ACT WorkKeys assessments are compiled of three separate tests: applied math, workplace documents, and graphic literacy (ACT, 2017). Admission into any program at C-TEC Postsecondary is contingent on meeting the predetermined cut-off scores for the specific program the student wants to enroll into. Cut off scores for each program offered at C-TEC Postsecondary vary based on the diversity of programs; these scores are determined with the help of the testing center coordinator, program coordinators, instructors, and advisory committees of professionals who are knowledgeable in the field. This study will evaluate if earning a higher score on each of the three ACT WorkKeys assessments indicates that a student will be successful in their program. Additionally, this study will examine the impact of retaking any of the three ACT WorkKeys assessments in order to achieve the minimum cut score required.

This study will evaluate three dependent variables: students' success in their postsecondary CTE program, industry recognized credential obtainment, and obtaining a job in a career aligned with the chosen program's field. Student success is defined as graduating from, or completing, an enrolled program, earning at least one industry recognized credential aside from the NCRC, and obtaining a job in the program's field after graduating, respectively. Failure is defined as withdrawing from or failing out of an enrolled program, not earning at least

one industry credential, and either obtaining a job in an unrelated field or not obtaining a job at all after completing a postsecondary CTE program.

To gain a better understanding of how the ACT WorkKeys assessments predicts student outcomes, this study will consider economically disadvantaged status, age, race, ESOL status, employment status at the time of enrollment, and gender. This study will be conducted in a suburban city that has a predominantly Caucasian population (U.S. Census Bureau, 2022). However, many students who enroll at C-TEC Postsecondary live in surrounding areas, including Columbus, Ohio's capital, which has a large immigrant and refugee population (U.S. Census Bureau, 2022a; *New Americans in Columbus*, 2023).

Significance of the Study

This study aims to contribute to the growing body of research on postsecondary CTE centers and entrance exams. As the popularity of postsecondary CTE increases among the general public, there is a need for guidance on the significance and importance of the entrance exams required by postsecondary CTE centers. Moreover, as the entrance exam requirements are not universally equivalent across postsecondary CTE centers, this study aims to determine whether the scores obtained on the ACT WorkKeys assessments can predict the success of postsecondary CTE students.

This study seeks to investigate if the ACT WorkKeys assessments are effective predictors of student success in postsecondary CTE programs, attainment of industry recognized credentials that align with the program career field, and ultimately, successful job placement in that field. Furthermore, this study aims to investigate whether retaking one or more the three ACT WorkKeys assessments has a significant impact on student success. By examining the effectiveness of the ACT WorkKeys assessments as a predictor of student success in postsecondary CTE programs, this study has the potential to impact and influence

policy regarding student remediation, particularly in the areas of math, reading, and test taking skills. Implementing policies to increase remediation could reduce barriers for postsecondary education and improve the lives of adults in need of steady employment.

Primary Research Questions

Q1. Are scores on the ACT WorkKeys assessments for the students' prospective C-TEC Postsecondary program and retake status on the three ACT WorkKeys assessments significant predictors of student success in the students' chosen postsecondary program at C-TEC Postsecondary?

Q2. Are scores on the ACT WorkKeys assessments for the students' prospective C-TEC Postsecondary program and retake status on the three ACT WorkKeys assessments significant predictors of success in obtaining an industry recognized credential in the students' chosen program field of work?

Q3. Are scores on the ACT WorkKeys assessments for the students' prospective C-TEC Postsecondary program and retake status on the three ACT WorkKeys assessments significant predictors of success in obtaining a job in the students' chosen program field after graduating the program?

Research Design

The study focuses on previously enrolled students who have either withdrawn or graduated from a postsecondary CTE program at C-TEC Postsecondary. Data for the study will be collected from C-TEC Postsecondary, including scores earned on the three ACT WorkKeys assessments received from the Testing Center, graduation status, industry recognized credential attainment as reported by instructors, and student employment data collected by instructors after a student completes the program. The data will be analyzed using a variety of

statistical techniques to determine if scores earned on the three ACT WorkKeys assessments are reliable predictors of student success. The analysis will also examine if retaking any of the three ACT WorkKeys assessments impacts student success.

The goal of this study is to evaluate the effectiveness of the three ACT WorkKeys assessments as predictors of student success in postsecondary CTE programs. Additionally, further analysis will examine whether factors such as economically disadvantaged status, age, race, ESOL status, employment status at the time of enrollment, and gender contribute to predicting student success. Analysis of this data was obtained using the R studio statistical package (R Core Studio, 2022).

Theoretical Framework

This study considers the theoretical framework of human capital that was first introduced by Gary S. Becker in his work on the effects of investment in human capital on earnings. In his investigation into the returns on higher education, Dr. Becker found a lack of information on the theory of investment in human capital (Becker, 1964, p. 7). Subsequent research has further developed this theory and generalized it in various domains. Human capital is considered to be the foundation of economic growth and innovation for both business and nations (Hao et al., 2023).

The human capital theoretical framework is particularly relevant to postsecondary CTE, as students invest in programs to increase their income-earning potential. This, in turn, increases the productivity of businesses and contributes to the growth of local, state, and national economies. High-level skill development is the driving force of economic growth, making it essential for local, state, and national governments to prioritize policy changes that increase the human capital of lower socioeconomic and minority groups (Hao et al., 2023). Postsecondary CTE programs can improve the human capital of individuals from disadvantaged

backgrounds and offers practical education that is relevant to prospective job requirements, providing opportunities for continuous education and upward mobility that might not be available with just a high school diploma. Evaluating the importance of postsecondary CTE in terms of human capital is essential, as it can directly impact the lives of individuals who are struggling.

The development of human capital may not be the sole factor contributing to an individual's success in the workforce. Therefore, the human capital framework might also consider social and cultural values of individuals, including the development of soft skills that enhance employability and productivity in the workforce (DeJaeghere et al., 2016). Research suggests that developing social understandings can create significant changes in the lives of students, particularly those from low socioeconomic backgrounds. Such developments allow students to feel valued by their teachers and peers, helping these students envision a future where the student is able to escape from poverty (DeJaeghere et al., 2016).

Another relevant theoretical framework to this study is the correspondence principle proposed by Bowles and Gintis. This principle argues that the school system in the United States was designed to create employees that are conformed to workplace policies; these employees are inherently obedient to workplace policy and upper management, accustomed to tedious work, and accept hierarchical structures within the workplace. The correspondence principle suggests that rather than enhancing an individual's income and social mobility, school regulations, policies, and course structures promote social class segregation and oppression of minority and low socioeconomic groups. By evaluating the predictability of the ACT WorkKeys assessments as an entrance exam, it is important to examine the correspondence principle and consider policy reforms that promote social equality for individuals who are already disadvantaged.

Assumptions, Limitations, and Scope

This study assumes data collected on students is accurate. However, this study acknowledges potential sources of inaccuracies in this data could be caused by human error, or limitations in tracking student outcomes (Complete College America, 2022). Instructors at C-TEC Postsecondary are responsible for following up with students post-graduation or withdrawal, but outdated or incorrect contact information in the school's database can be an obstacle in obtaining this information. While state databases can provide some assistance in tracking student employment outcomes, the effectiveness of this method may be limited for students who move out of state.

Additionally, this study recognizes that the rigor and complexity of both academic and hands-on abilities required by different programs within C-TEC Postsecondary may contribute to variations in student outcomes. The COVID-19 pandemic also had a significant impact on a portion of the population being studied, which limits this study's ability to conduct a more comprehensive analysis. Furthermore, the results of this study may be limited to the specific demographics, programs, and funding available at C-TEC Postsecondary, and may not necessarily be generalizable to other institutions.

The study focuses specifically on students over the age of 18 who enrolled in a program at C-TEC Postsecondary during the previous 5 fiscal years (2022, 2021, 2019, 2018, and 2017), and primarily consists of rural and suburban individuals. The data used in this study was limited to students who successfully met the minimum required cut scores on the three ACT WorkKeys assessments, determined by their desired program, and no specific programs were targeted for analysis. Data analysis for this study was performed using R studio (R Core Studio, 2022).

Definition of Terms

ATC: Area Technical Centers - these centers are solely focused on career and technical education; can serve either secondary or postsecondary students, or both, and are suited to

help students obtain a sub-baccalaureate-level education (areatechnicalcenters.org)

C-TEC Postsecondary Center: Career and Technology Education Centers Postsecondary Center (c-tec.edu)

CTE: Career Technical Education (careertech.org)

GED: "General Education Development," the GED is a high school equivalence test comprised of four separate subject tests, which are math, science, social studies, and reasoning in language arts (ged.com)

ACT test: A college entrance exam that students take to show readiness for college level courses (act.org)

ACT WorkKeys assessments: The ACT WorkKeys assessments are a series of tests (applied math, graphic literacy, and workplace documents), that evaluates an individual's workplace readiness skills and were designed to be used by both educational centers and employers. Together, these assessments portray the academic ability of students and/or potential employees. (act.org)

ESOL: English for Speakers of Other Languages. (osu.edu)

OTC: Ohio Technical Centers. (ohiotechnicalcenters.com)

Student Success: Student success is defined in three different areas:

1) Success in postsecondary CTE programs is defined as by graduating from, or completing, an enrolled program

2) Obtaining at least one industry recognized credential in the program field

3) Securing a job in the program field

Vocational Education: Education or training in a specific occupation, using both in class educational pedagogy and lab-based instruction (merriam-webster.com)

Industry recognized credential: A type of credential that is approved by an association or organization representing a specific industry. This credential allows employers to find potential employees that are qualified with the necessary skills required by that industry. (ACTE, n.d.)

Summary

In the first chapter, an introduction was provided that discussed postsecondary CTE programs, entrance exam requirements for postsecondary CTE centers, and the importance of standardizing policies and admission requirements for postsecondary CTE programs. Moreover, the need to better comprehend the relationship between the ACT WorkKeys assessments and student success in postsecondary CTE programs were also highlighted. The second chapter will dive deeper into the literature surrounding postsecondary CTE programs and postsecondary CTE entrance exams, clarifying their historical contexts and examining how these programs serve the needs of individuals, states, and businesses. Furthermore, the impact of the ACT WorkKeys assessments on student outcomes will also be discussed. The third chapter will focus on the data collection methodology employed in this study as well as how the collected data is utilized. The methodology chosen to analyze the data will also be outlined. In chapter four, the outcomes of the study will be presented, followed by further discussion topics and a conclusion that summarizes the findings of the research.

CHAPTER II: Background and Literature Review

Postsecondary Career Technical Education (postsecondary CTE), also referred to as vocational education, trade school, adult education, or workforce education (Edgerton, 2022; Gordon & Schultz, 2020, p. 2, 354), has historically played a significant but often overlooked role in education. Postsecondary CTE programs are specifically designed to provide practical, relevant, and cost-effective hands-on training, allowing adults to acquire the skills necessary to secure stable employment (Edgerton, 2022; Gordon & Schultz, 2020, p. 2). These careers typically require postsecondary education after receiving a high school diploma without completing a traditional four-year degree (Edgerton, 2022; Haviland & Robbins, 2021; Gordon & Schultz, 2020, p. 20; Sublett & Tovar, 2021).

Historically, vocational programs were initially established with the intention of preserving social class segregation (Gordon & Schultz, 2020, p. 2; C. B. Thompson et al., 2022), primarily enrolling minority and lower socioeconomic individuals (Advance CTE, 2020; Dougherty & Lombardi, 2016; Michaels et al., 2022; C. B. Thompson et al., 2022; Rojewski & Xing, 2013; Carlson, 2017). This discriminatory history has resulted in fluctuating support for postsecondary CTE funding over the years (Gauthier, 2020; Waugh, 2018; Lotto, 1988; Carlson, 2017). Moreover, public perception has often stigmatized individuals living in poverty, attributing their circumstances to personal shortcomings such as laziness or substance abuse, without considering systemic barriers and lack of opportunities (Laine, 2016; Starke, 2020).

However, postsecondary CTE programs offer a pathway for individuals to overcome these challenges and improve their socioeconomic standing (Haviland & Robbins, 2021; Michaels et al., 2022). Postsecondary CTE serves as a viable option for individuals who either lack the time and financial resources required for a traditional four-year degree, or who lack interest in a traditional four-year degree, providing an opportunity to attain financial stability for themselves and their families (Haviland & Robbins, 2021).

Nationally, postsecondary CTE has been recognized as imperative for economic growth and prosperity of the country (Haviland & Robbins, 2021; Michaels et al., 2022; Sublett & Tovar, 2021). The demand for skilled labor which can be acquired through postsecondary CTE programs remains high (Scott, 2014, p. 47; Manley, 2012; Haviland & Robbins, 2021; Michaels et al., 2022; Sublett & Tovar, 2021). However, the 'college-for-all' mentality that emerged in the late 1970's has created a gap in the availability of skilled labor, as high school students were encouraged to prioritize college enrollment over postsecondary CTE center enrollment (Lauzon, 2019, p. 2, 16; Malkus, 2019).

To address this issue, both federal, state, and local governments have rebranded vocational education as postsecondary CTE, thereby increasing funding and raising student awareness (CAREER AND TECHNICAL EDUCATION, 2022; Advance CTE, 2020a; Connet, 2021; Michaels et al., 2022; Carlson, 2017; Malkus, 2019). While early postsecondary CTE programs focused on developing knowledge and skills in agriculture, home economics and mechanical works, the curriculum has evolved to meet present skilled labor demands, offering programs in diverse fields such as healthcare services, welding and HVAC trades, mechanical trades, and information technology (IT) (National Center for Education Statistics, n.d.; Parks & Shoemaker, 2007, p. 4; Kim, 2023).

The ACT, established in 1959 and based in Idaho City, Idaho (Mathews, 2010), was initially designed as an alternative exam to the SAT's aptitude test (Rivaling the SAT: A Brief History of the ACT | BestColleges, 2022; Saxena, 2019). However, unlike the SAT, which evaluates a student's ability to learn, the ACT assesses a student's knowledge of high school curriculum to assess their preparedness for postsecondary education (Adams, 2017; Rivaling the SAT: A Brief History of the ACT | BestColleges, 2022).

In response to concerns regarding the state of education and the need for workforce-ready individuals in the United States, ACT introduced the ACT WorkKeys in the early 1990's

(ACT, 2002; ACT, 2009, p. 88; ACT, 2012). Although the ACT WorkKeys is not currently recognized as a standard postsecondary admissions assessment, colleges widely employ the traditional ACT exam to predict students' academic success (Allen & Sconing, 2005; Belasco et al., 2015).

As technological advancements continue, there is an increasing need for highly skilled jobs that require abstract thinking, contrasting with the routine and tedious tasks prevalent in early industrial jobs (ACT, 2019). Recognizing the lack of communication between educational professionals and employers, the ACT WorkKeys was developed to bridge this gap and convey an individual's job readiness to potential employers (ACT, 2002; ACT, 2009, p. 88).

The ACT WorkKeys assessments are composed of three main subjects, applied math, graphic literacy, and workplace documents, which assess the foundational knowledge an individual possesses (ACT, 2017; ACT, 2014; ACT, 2014b). By completing these three ACT WorkKeys assessments, individuals earn an industry recognized credential known as the National Career Readiness Certificate (NCRC), which demonstrates their proficiency level for specific jobs based on overall scores (ACT, 2017; LeFebvre, 2016; ACT, 2017b).

The ACT WorkKeys assessments serve as a diagnostic tool to identify potential employees who are job-ready for prospective employers (MPR Associates, Inc. & Academy for Educational Development National Institute for Work and Learning, 2006; ACT WorkKeys – Workforce Development Solutions, 2023; ACT, 2019). In certain secondary schools in the United States, the three ACT WorkKeys assessments have been implemented to assess students' general workplace readiness, or as an exit requirement for graduation (Steedle & Girdler, 2020).

Utilizing the ACT WorkKeys assessments to communicate workplace readiness offers numerous benefits for both employers and potential employees. Individuals can effectively communicate their applied academic skills, while employers' benefit by saving time and

resources that would have been otherwise spent on employee training (LeFebvre, 2016; ACT, 2017b). However, further research is necessary to examine the impact of entrance exams in postsecondary CTE centers and evaluate the reliability of the ACT WorkKeys assessments in predicting student success in these settings (Edgerton, 2022; Erwin, 2019).

Historical Development of Career Technical Education

Vocational education has been an important component of the education system for centuries, providing individuals with practical skills and knowledge necessary for employment in various trades and industries (Gordon & Schultz, 2020, p. 2). In colonial America, children learned by working alongside their families (Scott, 2014, p. 174; American Vocational Journal, 1976). Formal apprenticeships later emerged as the primary mode of vocational education, involving a formal agreement between a skilled artisan and an apprentice, which provided necessities such as food, shelter, and education in a specific trade (Gordon & Schultz, 2020, p. 7; Scott, 2014, p. 154, 174; Gray & Herr, 1998, p.10). Indentured servitude served to educate lower class individuals and orphans who lacked access to formal education (Gordon & Schultz, 2020, p. 2; Scott, 2014, p.174; Gray & Herr, 1998, p.10).

The industrial revolution in the 19th century brought unprecedented changes to the labor market, particularly in the manufacturing industry (Gordon & Schultz, 2020, p. 8; Scott, 2014, p. 258). The introduction of mass production techniques reduced the reliance on apprenticeships for vocational education (Scott, 2014, p. 174). The growth of industrial factories reduced the need for skilled workers trained through apprenticeships, and unskilled laborers became more adept at producing goods in factories (Gordon & Schultz, 2020, p. 8; Scott, 2014, p. 259). Furthermore, public education became more prevalent during this period, reducing the number of individuals involved in apprenticeships (Gordon & Schultz, 2020, p. 8; Miller, n.d.).

The industrialization of the manufacturing sector caused turmoil for families reliant on skilled trades for employment (Gordon & Schultz, 2020, p. 13). The availability of cheap mass-

produced goods made it challenging for skilled tradesmen to compete (Gordon & Schultz, 2020, p. 8). Consequently, vocational schools emerged; one such example is the Boston Farm and Trade School, established in 1814 to provide orphans with both education and vocational training (Gordon & Schultz, 2020, p. 13; American Vocational Journal, 1976). In 1826, small associations formed to enhance the social, intellectual, and moral competencies of adult learners through lectures and public discussion, but these associations were short-lived due to funding constraints (Gordon & Schultz, 2020, p. 13, 14).

During the industrial revolution, adults worked long hours in factories, and thus some of the children were often left unattended (Scott, 2014, p. 258, 176). In response, charity schools were created as a means of keeping these children out of trouble and improving their moral values (Scott, 2014, p. 176; Kober & Rentner, 2020). This paved the way for the creation of the historical one-room schoolhouse, or common schools, where all attending children are taught by one teacher (Kober & Rentner, 2020; Scott, 2014, p. 177). Concerns for equality caused charity schools to evolve into the public school system as we know it today, driven by the belief that a prosperous democratic system requires an educated population (Hersperger et al., 2013; Kober & Rentner, 2020). However, educational inequality remains a significant challenge, particularly for minority and low-income students (Gamoran & Murnane, 2023).

Vocational education has historically been associated with low-income individuals (Brand et al., 2013). In the 1800's, affluent families sent their children to private schools or hired tutors, while lower-income children learned skilled trades or agriculture skills within their immediate family (Scott, 2014, p. 174; Kober & Rentner, 2020). After the Revolutionary war, education for all children became popular; however, the same social divide emerged, with wealthier children attending well-funded private schools and poor children attending charity schools (Scott, 2014, p. 176). These charity schools, supported by wealthier communities, aimed to keep underprivileged children away from criminal activity while their parents worked

long hours in factories (Scott, 2014, p. 176; Reform Schools and Charity Schools | Encyclopedia.com, 2023). Children in such schools were often taught in a manner that emphasized obedience and tedious work, mimicking the factory job they were destined to have as adults due to their social status (Scott, 2014, p. 177).

Postsecondary CTE has long been stigmatized as an alternative education for students who are academically under prepared for college (Scott, 2014, p. 9; Gordon & Schultz, 2020, p. 354; Brand et al., 2013; Gauthier, 2021). Postsecondary CTE programs were initially seen as the educational pathway for disadvantaged groups, such as orphans during the colonial period and African Americans following the Civil War (Gray & Herr, 1998, p.10.; Ladson-Billings, 2006), which led to low skilled employment for these individuals (Brand et al., 2013; Carlson, 2017). The federal government began funding vocational schooling with the Smith-Hughes Act of 1917, but this unintentionally led to tracking students based on academic ability (Gordon & Schultz, 2020, p. 98; Malkus, 2019). This caused further segregation of students, although it was meant to increase the equality of individuals through education (Lauzon, 2019; Malkus, 2019). Research on student tracking has shown that predetermined tracks increase the achievement gap between college-bound and non-college bound students (Fletcher, 2012; Varlas, 2010).

In the 1970's, the 'college-for-all' mentality gained popularity in the United States, advocating that attaining a college degree should be the aspiration of all high school graduates (Rosenbaum, 1997; Malkus, 2019). This ideology resulted in a substantial increase in college enrollment rates, as 70% of high school graduates now enroll in college, up from 50% of high school graduates in 1975 (Avery et al., 2019). However, it is worth noting that a significant portion of students enrolling in college lack academic preparation, as evidenced by the alarmingly low graduation rate of many postsecondary institutions, which currently stands around 46% (Domina et al., 2011; Avery et al., 2019; Hanson, 2023; Mannon, 2018). Moreover, research has demonstrated a correlation between poor academic performance in secondary

education and a decreased likelihood of obtaining a degree from a postsecondary institution (Domina et al., 2011; Ou & Reynolds, 2012).

A student's high school education, including grades, academic rigor, and attitude towards school, have been shown to be positive predictors of success in postsecondary institutions (Domina et al., 2011, Allensworth & Clark, 2020; Woods et al., 2018). However, educational disparities persist; in Ohio, secondary schools are funded primarily through surrounding community property tax dollars, leading to segregation based on socioeconomic status and geographical location (Owens, 2017). Even with state funding to offset the disparities in funding, it is still evident that a large gap remains between the rich and poor student districts (Ohio's New School Funding Formula: An Introduction, 2023; Owens, 2017). Moreover, these issues disproportionately affect low-income and minority students who are born in impoverished areas (Jones et al., 2003). Consequently, these students are often underprepared for postsecondary education due to their family backgrounds and geographical locations, further perpetuating the segregation of academic ability and limiting the achievement of social mobility through education (Byun et al., 2012; Bonitatibus, 2022).

Throughout history, the funding of both secondary and postsecondary CTE has been inconsistent. Federal funding for vocational secondary education was initiated by the Smith-Hughes Act of 1917, which inadvertently established a tracking system that favored academically heavy, college-prep courses, segregating low-income and minority students into low-skilled vocational programs (Lauzon, 2019, p.16; Gordon & Schultz, 2020, p. 98; C. B. Thompson et al., 2022; Brand et al., 2013; Malkus, 2019).

Federal funding for vocational education grew during and after World War II due to the increased demand for skilled workers in factories (Gordon & Schultz, 2020, p. 98; Conner & Bohan, 2014). This incentivized the federal government to expand funding with the Vocational Education Act of 1963, aimed to improve vocational programs by focusing on marginalized and

disadvantaged groups (Malkus, 2019; Lauzon, 2019, p.23). However, postsecondary vocational education was mentioned in a later amendment to this act in 1968 (Malkus, 2019). The Carl D. Perkins Vocational and Applied Technology Education Act continued the support for vocational education in the 1980's, which sought to increase accountability of vocational programs and collaboration between secondary high schools and postsecondary institutions (Brand et al., 2013; Sublett & Tovar, 2021).

However, concerns about the economy prompted "A Nation at Risk," a 1983 report calling attention to the risk of a failing economy due to an uneducated population (Swanson & King, 1997, p.74; Hersperger et al., 2013; Malkus, 2019). Subsequent educational policies emphasized standardized coursework and promoted college as the sole option of postsecondary education after graduation (Malkus, 2019). The No Child Left Behind Act, implemented in 2001, also created a major policy shift in education; this act was initiated to increase the educational ability of minority and impoverished students; however, it did not directly include CTE in the legislation (Michaels et al., 2022; Scott, 2014, p. 318).

Research suggests that over 50% of high school graduates will not do well in college due to not having the academic skills needed to succeed in college courses (Scott, 2014, p. 10; Gray & Herr, 1998, p.10; Manley, 2012), resulting in wasted time and financial resources for students who fail to complete a degree program (Scott, 2014, p. 10; Avery et al., 2019). Additionally, the lack of skilled labor has become a concern for many employers, who face difficulties finding qualified job applicants (Scott, 2014, p. 47; Hersperger et al., 2013; Magallanes, 2022; Sublett & Tovar, 2021). Recent research suggests there is a misalignment between enrollment trends in postsecondary CTE centers and college admissions, indicating a disconnect from the labor market's current needs (Manley, 2012).

In response to funding challenges faced by postsecondary CTE centers, the Carl D. Perkins Act (or Perkins IV) was reissued in 2006, which aimed to increase the accountability of

schools and ensure that postsecondary CTE programs aligned with workforce needs (Sublett & Tovar, 2021). The subsequent introduction of Perkins V in 2018 continued the focus on increasing funding, while also promoting partnerships between schools and potential employers, and providing postsecondary CTE programs that are current and relevant to the modern labor market (Sublett & Tovar, 2021; CAREER AND TECHNICAL EDUCATION, 2022). Despite these efforts, postsecondary CTE funding still falls short due to discrepancies in postsecondary CTE centers requirements and terminology, which makes research challenging, and the financial burdens of technology costs exceed schools' capacities (Aliaga et al., 2014; CAREER AND TECHNICAL EDUCATION, 2022). Additionally, postsecondary CTE centers receive much less research attention compared to K-12 education, resulting in a limited understanding of long-term outcomes and best practices for postsecondary CTE graduates (Haviland & Robbins, 2021; CAREER AND TECHNICAL EDUCATION, 2022). Persistent achievement gaps in postsecondary CTE centers among different racial and socioeconomic status groups call attention to the need for further research and advocacy for improvements in postsecondary CTE program funding (Ladson-Billings, 2006; CAREER AND TECHNICAL EDUCATION, 2022).

Historical Development of ACT and ACT WorkKeys

Since its inception in 1926, entrance examinations for postsecondary institutions have played a prominent role in the college admissions process (Adams, 2017; Saxena, 2019). With the intention of equalizing opportunities for disadvantaged students, the College Board created the SAT, also known as the Scholastic Aptitude Test (Adams, 2017; Geiser, 2009). Designed to assess students' logical reasoning skills and predict their likelihood of success in college, the SAT evaluated students' readiness for college (Adams, 2017; Saxena, 2019). In 1959, the American College Testing Program, or ACT, positioned itself as a more comprehensive assessment of high school curriculum knowledge and emerged as an alternative to the SAT (Adams, 2017; ACT, 2009, p. 87; Saxena, 2019).

Initially, the choice between the SAT and ACT largely depended on students' geographical location, with more coastal students taking the SAT and those from the Midwest and Southern regions opting for the ACT (Adams, 2017). As the SAT encountered public scrutiny due to scoring errors and concerns about test duration, the ACT gained prominence as a leading college entrance exam (Adams, 2017; Mathews, 2010).

Both the SAT and ACT were designed to facilitate social mobility by providing a standardized test that demonstrates students' abilities, thereby mitigating disparities in grading policies and standards across schools nationwide (Geiser, 2009; Adams, 2017). However, research consistently indicates that grades accumulated over the course of a students' high school career are more accurate predictors of student success in postsecondary education compared to ACT or SAT scores (Geiser, 2009; Adams, 2017). While incorporating ACT and SAT scores can enhance the predictive accuracy of student success, evidence suggests that the SAT test disproportionately disadvantages low-income and minority students during the college application process (McClurg et al., 2021; Geiser, 2009). Consequently, the utilization of both exams as predictors of student success is often seen as a cost-effective strategy rather than one that provides substantial benefits for students (Adams, 2017). However, other research indicates that these tests hold validity and do predict student success as designed (Sackett et al., 2008).

In response to the increasing number of students attending college despite being better suited for positions in skilled trade careers, ACT introduced the ACT WorkKeys in 1986 to bridge the gap between education and employment (ACT, 2009, p. 88, 93). The development of the ACT WorkKeys assessments involved training job profilers to determine the essential skills that potential employees need for success in various careers (ACT, 2009, p. 88; LeFebvre, 2016; Clark, 2013). Advisory panels composed of industry veterans, human resource departments, managers, and educators collaborated to ensure the ACT WorkKeys assessment

aligned with employer expectations (ACT, 2009, p. 89; LeFebvre, 2016). Three main assessments emerged from job profilers' workplace observations: applied mathematics, graphic literacy, and workplace documents, which collectively assess both an individual's foundational knowledge and non-academic skills, such as analytical skills, abstract thought, and collaboration (ACT, 2014; ACT, 2014b; Clark, 2013).

The National Career Readiness Certificate (NCRC) is earned after an individual achieves the required cut scores on the applied math, graphic literacy, and workplace documents sections of the ACT WorkKeys assessments. This certificate communicates their workplace readiness to potential employers (Radunzel & Fang, 2018; ACT, 2017; LeFebvre, 2016; ACT, 2017b). The NCRC certification is categorized into different levels of achievement; individuals that earn a gold, silver, or bronze level are more likely to secure and retain employment and earn higher wages than if they only had earned a high school diploma (ACT, 2017b). Consequently, the ACT WorkKeys assessments have been widely utilized by employers and educational institutions to evaluate the employability and preparedness of job applicants (Steedle & Girdler, 2020; National Career Readiness Certificate - ACT Workkeys, 2023).

Escaping Poverty Through Education

The link between poverty and limited educational opportunities has been thoroughly researched. Defined by the U.S. Census Bureau, poverty status is dependent on an individual's income and the number of family members in the home (Laine, 2016). Poor students often encounter many barriers in education due to many factors, such as inability to finance their education, limited knowledge concerning financial aid, lack of positive adult role models, or geographical disadvantages (Thompson et al., 2016; Bonitatibus, 2022; ACT, 2012; Duncan, 2021). The increasing cost of postsecondary education further intensifies challenges towards obtaining a postsecondary education (Avery et al., 2019). However, recent data analysis shows

that post-COVID 19, the cost of postsecondary education has decreased after adjusting for inflation (Ma & Pender, 2022).

Policy makers, media, educators, and the general public often blame the correlation between underperformance in education and poverty on the ideology known as the poverty mentality, or the deficit theory (Gorski, 2008). This perspective shifts the blame onto the individual, portraying those in poverty as lazy or indifferent towards education, which is a largely false generalization (Thompson et al., 2016; Laine, 2016; Gorski, 2008; Morgen & Maskovsky, 2003). Moreover, such perceptions can significantly impact the educational trajectory of students living in poverty, leading to issues of tracking and teacher misconceptions concerning economically disadvantaged students (Gorski, 2008).

Poverty can have a profound impact on limiting life opportunities (Laine, 2016; Duncan, 2021). Many individuals in poverty either aspire to join the workforce or are in the workforce but not earning a livable wage; a lack of education and foundational workplace skills prevent the achievement of this goal (Laine, 2016; Finley, 2023). Dealing with concerns about food and housing expenses, it can be extremely difficult, if not impossible, for individuals living in poverty to prioritize their own or their children's educational needs (Woodford & Mammen, 2010; Laine, 2016). Moreover, students living in poverty are more susceptible to depression, feelings of hopelessness, and behavior and mental health problems (Yoshikawa et al., 2012).

While living in poverty reduces the educational opportunities for an individual, obtaining an education can contribute to lifting people out of poverty by providing further educational options (Swanson & King, 1997, p.5). Postsecondary CTE programs provide a pathway for adults to escape poverty and achieve financial stability (Ohio Board of Regents, 2014; Lefebvre & Steedle, 2019). Education provides students with essential workforce skills such as analytical thinking, communication, and cooperation among peers, thereby increasing their chances of securing employment and expanding their future earning potential (Swanson & King, 1997, p.5;

Sublett & Tovar, 2021; ACT, 2012; Kuchinke, 2013). Perkins V legislation emphasizes the importance of postsecondary CTE programs aligning with the current job market, ensuring that these programs prepare students for employment that is in demand, and will provide financial security and stability (Sublett & Tovar, 2021).

Obtaining an education not only impacts the individual acquiring it, but also influences future generations. Research conducted by Patrick Sharkey in 2013 demonstrated that a parent's educational background during childhood significantly influences their own children's cognitive abilities. Furthermore, research suggests that cognitive skills decline after two consecutive generations of living in a poor community (The Racial Achievement Gap, Segregated Schools, and Segregated Neighborhoods – a Constitutional Insult, 2014). Achieving a stable and livable income allows parents to allocate more resources to their children, providing adequate food, clothing, shelter, and parenting skills due to reduced overall stress (Owens, 2017). The limitations of segregated schools and neighborhoods that contribute to the declines in cognitive abilities are the result of racially biased legislation created in the 1900s (The Racial Achievement Gap, Segregated Schools, and Segregated Neighborhoods – a Constitutional Insult, 2014; Owens, 2017; Siegel-Hawley et al., 2023; Saxena, 2019; Gorski, 2008). Thus, providing equal education to promote social mobility among marginalized groups is crucial for achieving equality for all individuals.

Educational Inequality

Educational inequality continues to persist due to socioeconomic disparities, discrimination, and biased educational policies (Thompson et al., 2016; C. B. Thompson et al., 2022; Siegel-Hawley et al., 2023). An analysis of the history of education and educational policies reveal a consistent pattern of disadvantage for students of low-socioeconomic and minority backgrounds when compared to their wealthier peers (Ladson-Billings, 2006). Historically, postsecondary CTE centers have primarily targeted low-income, rural, special

needs, and minority students, often reinforcing the stigma of these individuals working in low-skilled jobs (C. B. Thompson et al., 2022; Sublett & Tovar, 2021; Kuchinke, 2013). However, successfully graduating from a postsecondary CTE program can provide individuals an opportunity to break the cycle of poverty (Ohio Board of Regents, 2014; Lefebvre & Steedle, 2019).

Over time, postsecondary CTE center program offerings have expanded to include occupations that offer viable career paths capable of providing financial stability and upward social mobility (Kuchinke, 2013). Research suggests that individuals who graduate from postsecondary CTE centers, along with earning industry recognized credentials, can earn significantly higher wages compared to if they had only received a high school diploma (ACT, 2012; Steedle et al., 2019; Royster et al., 2015). Successfully completing a postsecondary CTE program also provides more opportunities for a career that aligns with the students' strengths and interests, promoting autonomy over job choice and increased pay (Kuchinke, 2013).

However, other studies suggest that lower-income and minority students are more likely to enroll into lower wage postsecondary CTE programs (C. B. Thompson et al., 2022; Anderson et al., 2021). Black, Latinx and other minority groups face educational inequalities starting in elementary school, along with barriers caused by racist and biased policies (Anderson et al., 2021; Ladson-Billings, 2006). These students face many challenges in both education and the workplace, as systemic racism, developed over centuries, continues to contribute to the educational achievement gap, or the disparities between the level of educational and income attainment between racial minority groups compared to their white peers (Ladson-Billings, 2006). Even as the United States has moved away from blatant racism, educational and workplace inequities for minority groups continue to exist through previous and current policy barriers, color blindness, and a lack of cultural understanding (C. B. Thompson et al., 2022; Anderson et al., 2021).

Education has been regarded as an equalizer, thought to level the playing field for lower income and disadvantaged individuals, providing opportunities to obtain employment that can lift them out of poverty and into the middle or upper class. However, to secure such employment, students should possess essential workplace skills (Kuchinke, 2013; Clark, 2013). These skills include foundational academic abilities, such as reading and math proficiency, along with other foundational skills, such as problem solving, integrity, job-specific skills that target specific occupations, and soft skills including communication, collaboration, and dependability (Clark, 2013).

The ACT WorkKeys assessments offers a standardized assessment designed to measure employability skills and ensure students have sufficient preparation for workplace tasks (ACT, 2017b). These assessments also address the communication gap between educators and employers (ACT, 2002; ACT, 2009, p. 88). Individuals demonstrate their understanding of essential knowledge that is required by employers, which enables them to obtain and find success in a career, as well as improve their ability to increase their wages over their lifetime (Steedle & LeFebvre, 2018).

Test Optional Policies and CTE Admissions Requirements

In recent years, test optional policies have been implemented in college admissions, addressing concerns associated with excessive testing and removing a barrier for minority and low-income students to enter postsecondary education (Rosinger et al., 2021; Belasco et al., 2015). These policy changes reflect a shift toward a more holistic approach to evaluating potential students and treating them as individuals rather than mere statistics (Saxena, 2019). Additionally, schools have adopted test optional policies to increase their student applicant numbers and become more competitive, which is necessary for meeting enrollment goals to maintain funding to continue operating (Ma & Pender, 2022). Public postsecondary schools have become more reliant on tuition revenues due to reduced funding from state subsidies,

making enrollment critical to continue operating (Avery et al., 2019), although subsidies have started increasing since 2017 (Ma & Pender, 2022).

In Ohio, postsecondary CTE centers are accredited by either the Council on Occupational Education, also known as COE, or the Accrediting Commission of Career Schools and Colleges, also known as ACCSC (Partners – Ohio Technical Centers, n.d.; THE OHIO DEPARTMENT OF HIGHER EDUCATION, 2021). Accreditation ensures that postsecondary CTE centers adhere to standards that promote quality educational practices and measures the success of students who enroll into postsecondary CTE programs (ACCSC, n.d.). Furthermore, attending a non-accredited school may render earned degrees or certificates invalid by a potential employer (EDsmart, 2023). Accreditation communicates to employers and licensing agencies that the program completed by the student meets industry standards (EDsmart, 2023; The Accrediting Commission of Career Schools and Colleges, 2019). When determining accreditation of schools, one of ACCSC's main priorities is to determine the effectiveness of the educational institution by examining the outcomes of the students served (The Accrediting Commission of Career Schools and Colleges, 2019). Thus, researching the prediction of student success based on the ACT WorkKeys assessments is an important measure for this indicator.

Title IV funding was developed under the Higher Education Act of 1965, giving students the ability to receive financial aid to attend schools with a Title IV status (Bouchrika, 2024). Title IV requires schools to meet specific standards associated with teaching and educational resources, ensuring that schools provide quality programs (Bouchrika, 2024). Schools who achieve Title IV status must be legally authorized postsecondary educational institution in the state the school resides in and are meticulously evaluated by the U.S. Department of Education and an independent accrediting agency recognized by the Department of Education (Bouchrika, 2024).

C-TEC Postsecondary is currently accredited by ACCSC and receives Title IV funding. Therefore, C-TEC Postsecondary is authorized to provide financial aid to students who qualify under the Higher Education Act (C-TEC of Licking County, 2022; Hegji, 2023). Title IV funding eligibility is largely dependent on the accreditation status of the school, as well as eligibility of the different programs the postsecondary CTE center provides, state authorization, and certification by the U.S. Department of Education (Hegji, 2023). Both ACCSC and the Ohio Department of Higher Education require that postsecondary CTE centers enroll students who demonstrate readiness to complete a program (The Accrediting Commission of Career Schools and Colleges, 2019; THE OHIO DEPARTMENT OF HIGHER EDUCATION, 2021). Section IV, A.1 in the ACCSC Standards of Accreditation document states the importance of enrolling students who have the prerequisite skills needed to graduate from postsecondary CTE centers (The Accrediting Commission of Career Schools and Colleges, 2019), while Chapter 3, section 5 of the OTC Program Operations and Approval Manual, located in section 5 emphasizes the need for an assessment as a prerequisite for enrollment (THE OHIO DEPARTMENT OF HIGHER EDUCATION, 2021).

To meet these standards, C-TEC Postsecondary utilizes the ACT WorkKeys assessments, specifically evaluating student abilities in the applied math, graphic literacy, and workplace documents assessments. Prospective students need to achieve minimum scores on these three ACT WorkKeys assessments to enroll in specific programs at C-TEC Postsecondary, and these minimum cut scores vary depending on the complexity and rigor of the program (C-TEC of Licking County, 2022). Although not explicitly mentioned in the C-TEC student catalog, these scores are developed using the O*NET codes of various jobs, minimum ACT WorkKeys assessments scores given by O*NET codes, and job profiling conducted by a trained C-TEC employee (Clark, 2013; S. Thompson, personal communication, April 2023).

Assessing a student's academic ability before enrollment is important because some students might not be prepared for postsecondary level course work. Notably, the establishment of proprietary schools have gained notoriety for enrolling students in postsecondary programs without ensuring students are academically prepared for postsecondary level courses. Proprietary schools, typically for-profit institutions that offer specialized vocational or career training, allocate a significant portion of their revenue on marketing to increase student enrollment, taking advantage of the decreased regulation on federally funded grants that occurred after 1986 (Zamani-Gallaher, 2004; Tucker, 2021). These schools primarily target and enroll marginalized groups, low-income individuals, and single parents, who are more likely to rely on federal financial aid through grants and loans (Tucker, 2021; Zamani-Gallaher, 2004). Research suggests that students attending proprietary schools are more likely to default on student loans and suffer unemployment (Tucker, 2021; Zamani-Gallaher, 2004). Requiring students to take and achieve minimum cut scores on the three ACT WorkKeys assessments in applied math, graphic literacy, and workplace documents as a prerequisite for postsecondary admission helps ensure that students entering C-TEC Postsecondary programs possess the necessary foundational academic skills to be successful in their chosen program.

Traditionally, postsecondary CTE centers have maintained low barriers to entry, with minimal evidence indicating the existence of entrance exams to assess students' readiness for chosen programs (Edgerton, 2022; Erwin, 2019). A review of the literature suggests that average grades received in high school is more representative of a students' ability to succeed in postsecondary education than their SAT or ACT scores (Allensworth & Clark, 2020; Woods et al., 2018). However, HSGPA requirements may pose challenges for some students enrolling in postsecondary CTE centers, due to their wide variations in educational backgrounds and experiences, family circumstances, geographical locations, age, and gender (NAPE, n.d.). Thus,

incorporating formal educational backgrounds as an enrollment requirement would be incredibly difficult for postsecondary CTE centers.

As an entrance exam, the ACT WorkKeys assessments are considered a high stakes exam; thus, it may be a barrier to postsecondary education for some individuals. Therefore, it is important to validate this requirement or explore alternate enrollment criteria. Testing, despite being a topic of controversy, has demonstrated validity in predicting work and educational outcomes (Sackett et al., 2008). Nevertheless, admissions to postsecondary might benefit by complementing entrance exams with other predictive measures, such as non-cognitive based assessments. Notably, ACT recommends utilizing the ACT WorkKeys assessments scores along with other methods of selection for employment purposes, such as interviews (LeFebvre, 2016). Other prerequisites that could be considered as an admissions requirement include allowing individuals to present prior work accomplishments or portfolios that demonstrate their abilities. Moreover, utilizing informal performance assessments aligned with tasks relevant to the prospective career could provide evidence that an individual is prepared to perform specific job tasks well (Sackett et al., 2001).

Conclusion

The objective of this chapter was to investigate the historical development of both postsecondary CTE centers and postsecondary entrance exams. A review of relevant literature examined how both postsecondary CTE centers and entrance exams have served as both barriers and facilitators for student progress, enabling social and economic mobility. However, existing research fails to explore the utilization of prerequisite entrance exams within the context of postsecondary CTE programs, as well as the extent to which these exams predict student success in such programs. Given the increasing adoption of test-optional policies in traditional four-year college programs and the persistent educational achievement gap among minority groups, it is imperative to determine whether the ACT WorkKeys assessments contributes to the

success of students. Thus, this study seeks to improve upon the apparent gap in the research and provide insights into the role of entrance exams in postsecondary CTE centers. Chapter 3 will focus on detailing the methodology used in this study.

CHAPTER III: METHODOLOGY

This study aims to examine the effectiveness of the ACT WorkKeys assessments as an entrance exam in determining the success of students who enroll in postsecondary CTE centers. This study seeks to investigate if the ACT WorkKeys assessments are effective predictors of student graduation success, attainment of industry recognized credentials that align with the program career field, and successful job placement in that field. Furthermore, this study aims to investigate whether retaking any part of the ACT WorkKeys assessments has a significant impact on student success. Additionally, further analysis will examine whether factors such as economically disadvantaged status, age, race, ESOL status, out of work status, and gender contribute to predicting student success. This chapter outlines the methodology of the study. This chapter discusses the participants and geographics of the study's population, data collection instruments, the procedure for how the data used in this study was collected, and an explanation on how the data for the study will be processed and examined.

Setting and Participants

The study focuses on previously enrolled students who have either withdrawn or graduated from a postsecondary program at C-TEC Postsecondary during the 2015, 2016, 2017, 2018, 2019, 2020, 2021, and 2022 fiscal years. C-TEC Postsecondary is one of 50 public Ohio Technical Centers (OTC's) in Ohio (Ohio Technical Centers (OTC), n.d.). C-TEC Postsecondary offers the following programs: Healthcare fields, including Medical Coding Specialist, Registered Medical Assistant, Phlebotomy, State Tested Nurse Aide; Information Technology through the Cyber Security program; Public Safety fields, including Emergency Medical Technician, and Professional Firefighter; Personal Services, including Cosmetology, Manicurist, and Licensed Massage Therapy; and Skilled Trades, including Advanced CNC & Robotic Integration, HVAC, Heavy Truck Technician, Multicraft Maintenance, Power Lineman, and Structural and Pipe Welding/ Fabrication (C-TEC of Licking County, n.d.).

This study will be conducted in a suburban city inside of Newark, Ohio, that has a predominantly Caucasian population (U.S. Census Bureau, 2022). However, many students who enroll at C-TEC Postsecondary live in surrounding areas, including Columbus, Ohio's capital, which has a large immigrant and refugee population (U.S. Census Bureau, 2022a; New Americans in Columbus, 2023). Columbus has a population that is largely Caucasian, but notably has more diversity in their community than Newark; 53.6% of the population identifies as 'White alone, not Hispanic or Latino', 29.4% of the population identifies as 'Black or African American', and the other remaining percentage of citizens identify as other races (U.S. Census Bureau, 2022a). The majority of the CTEC Postsecondary student population is composed of students who identify as white; for the fiscal years (FY) 16 - 23, data shows that of students who identified their race, 87% of students identified as white, 6% identified as African American, 4% identified as multiracial, 2% identified as Asian, 1% identified as Hispanic or Latino, and .50% identified as American Indian or Alaskan Native (S. Thompson, 2022). Furthermore, student commutes collected using reported home zip codes during the time of enrollment show that during FY16 - FY23, 22% of students enrolled commuted within 10 miles of C-TEC Postsecondary, 34% of students commuted within 25 miles of C-TEC Postsecondary, and 44% of students commuted within 25-50 miles of C-TEC Postsecondary (S. Thompson, 2022). Students within 25 miles of C-TEC Postsecondary reside within Licking County, while the students within 25-50 miles of C-TEC Postsecondary reside outside of Licking County (S. Thompson, 2022).

C-TEC Postsecondary serves on average about 479 students every year (C-TEC Enrolled Students FY 17-22, 2023). For FY16 - FY23, of those students who provided their age, 47% of the student population were between the ages of 25-34, 27% were ages 25 and under, 15% of students were between the ages of 35-44, and 11% of students were ages 45 and older (S. Thompson, 2022). Furthermore, during FY16 - FY23, for students who reported their gender,

58% of students identified as female and 42% of students identified as male (S. Thompson, 2022).

The target population for this study are adults who intend on pursuing postsecondary education through postsecondary CTE programs. There are currently 50 public OTCs in Ohio, and many of them utilize the ACT WorkKeys assessments as an entrance exam required before enrolling in a program (S. Thompson, personal communication, April 2023). However, the required cut off scores for similar programs throughout the state are not standardized, as each public OTC chooses their own minimum cut off scores for their programs (S. Thompson, personal communication, April 2023). For example, Eastland-Fairfield Career Center, a public OTC located in the south-east region of Columbus, Ohio, requires cut off ACT WorkKeys assessment scores of 3 or higher for all programs (2022-23 Eastland-Fairfield Adult Workforce Development Catalog, 2022), while C-TEC Postsecondary has a wide range of scores specific to each program offered. There are also many more postsecondary CTE centers that operate in the United States that may or may not implement an entrance exam, as there is minimal evidence indicating the existence of entrance exams to assess students' readiness for chosen programs in adult trade programs (Edgerton, 2022; Erwin, 2019). This study will determine the effectiveness of the ACT WorkKeys assessments as an entrance exam requirement to further guide entrance requirements of postsecondary CTE centers.

Since the sample data was collected from one postsecondary CTE center, the suburban and rural geographical area C-TEC Postsecondary serves, as well as the overwhelming lack of racial diversity within the school and surrounding locations, generalizability is limited. Testing anxiety may also propose a threat to generalizability, as many students struggle with testing anxiety, which impacts scoring results of tests (Cassady, 2004).

To evaluate the statistical power of the study, G*Power was used. Using G*Power, a z-test logistic regression test was utilized. The odds ratio computation involved an initial

calculation of the odds of student status as a completer versus a leaver, given a score of 3 in the applied math ACT WorkKeys assessment. Additionally, the odds of student status as a completer versus a leaver, given a score of 4 in the applied math ACT WorkKeys assessment was calculated. Consequently, the odds of being a completer for a student with an ACT WorkKeys applied math score of 4 is .55 times higher than the odds for a student with an ACT WorkKeys applied math score of 3. The desired power for the study is 0.80, or 80%, with a pre-determined alpha level of .05. The R^2 other than x value was estimated at 0.5. The outcome of the G*Power analysis indicated that a sample size of 286 participants would be required to reach the desired power of 80%. Notably, the sample size of the study is 1825, so adequate power is not a concern.

Instrumentation

This research study utilized student scores received on the three ACT WorkKeys assessments, which is an entrance exam required by C-TEC Postsecondary as an effort to ensure students are academically prepared for enrollment into programs offered by C-TEC Postsecondary. In response to concerns regarding the state of education and the need for workforce-ready individuals in the United States, ACT introduced the ACT WorkKeys in the early 1990's (ACT, 2002; ACT, 2009, p. 88; ACT, 2012). As technological advancements continue, there is a growing demand for highly skilled employees, emphasizing abstract thinking, which contrasts with the routine and tedious tasks prevalent in early industrial jobs (ACT, 2019). Recognizing the lack of communication between educational professionals and employers, the ACT WorkKeys assessments were developed to bridge this gap and convey job readiness of individuals to potential employers (ACT, 2002; ACT, 2009, p. 88).

The ACT WorkKeys assessments evaluate students' competencies in three foundational subject areas: applied math, graphic literacy, and workplace documents (ACT, 2017; ACT, 2014; ACT, 2014b). To develop the ACT WorkKeys assessments, ACT hired job profilers to

determine the skills needed by employees for the 21st-century (ACT, 2017a). Through a comprehensive review of literature spanning various businesses and industries, extensive workplace assessments, and the collection of guidance and recommendations from experts in education, business, human resources, and state workforce development, job profilers working to develop the ACT WorkKeys assessments determined that the content included in the applied math, graphic literacy, and workplace documents assessments effectively evaluate the fundamental academic skills necessary for workforce success (ACT, 2017a). This analysis, completed for each industry and occupational category by job profilers, demonstrates ACT's effort of completing validity testing on the content of the ACT WorkKeys assessments (LeFebvre, 2016).

Successfully meeting the minimum scores for each of the three foundational subject areas (applied math, graphic literacy, and workplace documents) of the ACT WorkKeys assessments enables students to earn the National Career Readiness Certificate (NCRC), which demonstrates a proficiency level for specific jobs based on the overall scores (ACT, 2017; LeFebvre, 2016; ACT, 2017b). There are four levels of the NCRC, which corresponds to scores an individual receives on the assessments. Individuals who take the ACT WorkKeys applied math, graphic literacy, and workplace documents assessments can earn a level 3, 4, 5, 6, or 7 on each assessment (LeFebvre, 2016). A Bronze level NCRC demonstrates that an individual earned at least a 3 on each of the three assessments; a Silver level NCRC demonstrates that an individual earned at least a 4 on each of the three assessments; a Gold level NCRC demonstrates that an individual earned at least a 5 on each of the three assessments; and a Platinum level NCRC demonstrates that an individual earned at least a 6 on each of the three assessments (LeFebvre, 2016). Performing well on the applied math, graphic literacy, and workplace documents sections of the ACT WorkKeys assessments have been shown to predict employee success and favorable outcomes for businesses and educators (ACT, 2017b).

Each of the ACT WorkKeys assessments is structured with multiple choice questions, spanning proficiency skills from level 3 through level 7, progressively incorporating skills acquired from foundational to advanced stages (ACT WorkKeys – Workforce Development Solutions, n.d.; LeFebvre, 2016). While all three foundational ACT WorkKeys assessments are available in both online and paper formats, prospective students at C-TEC Postsecondary are only offered the online version (ACT WorkKeys for Workforce Developers - Workplace Documents, n.d.). The applied math assessment, lasting 55 minutes with 34 questions, evaluates students' proficiency in critical thinking, mathematical reasoning, and problem-solving techniques relevant to real-world employment scenarios (ACT WorkKeys Assessments - Applied Math, n.d.). This assessment permits the use of a calculator and a formula sheet (ACT WorkKeys Assessments - Applied Math, n.d.). Similarly, the workplace documents assessment, also 55 minutes long with 35 questions, evaluates students' abilities in comprehending and utilizing information from simulated workplace documents for job-related decision making and problem-solving skills (ACT WorkKeys for Workforce Developers - Workplace Documents, n.d.). Lastly, the graphic literacy assessment, which is 55 minutes long with 38 questions, measures students' aptitude to comprehend and apply various styles of graphics in the workplace to follow instructions or make decisions based on data (ACT WorkKeys for Workforce Developers - Graphic Literacy, n.d.).

Numerous studies have been conducted to establish the validity of the ACT WorkKeys assessments to determine job-readiness of potential students and employees. In these studies, the workplace documents, applied math, and graphic literacy ACT WorkKeys assessments were shown to have a modest correlation with positive employee job performance (LeFebvre, 2016). Furthermore, the workplace documents and applied math assessments were associated with a positive relationship between educational GPA and persistence, while the graphic literacy assessment only displayed a modest relationship between educational GPA and persistence

(LeFebvre, 2016). Additionally, research indicates a modest relationship between earning the ACT NCRC and obtaining and retaining employment, as well as a moderate association with an employee's capacity to increase their wages over time (LeFebvre, 2016).

Procedure

Data for the study will be collected from C-TEC Postsecondary. Data involving graduation status (completed or withdrew from a program), industry recognized credential attainment as reported by C-TEC Postsecondary instructors (earned at least one industry recognized credential or not earned) which excludes the obtainment of the ACT WorkKeys NCRC, and post-graduation student employment data collected by instructors (employed related and/or pursuing related education, employed non-related and/or pursuing non-related education and/ or not working, or unknown). Additional demographic data, including age, race, ESOL (English for Speakers of Other Languages) status, gender, economically disadvantaged status (yes or no), and out of work status (yes or no) will be collected. Furthermore, data of student scores received on the ACT WorkKeys applied math, graphic literacy, and workplace documents assessments (levels earned range from 3 to 7) and retake status (did not retake or did retake) will be collected from C-TEC Postsecondary.

To ensure data integrity and protect personal identifying information, a C-TEC Postsecondary employee will merge and clean the data by removing students' names and replacing them with unique identification numbers. Subsequently, the data will then be distributed to the researcher by the C-TEC Postsecondary employee. This approach ensures the protection of student identity and maintains the confidentiality of each participant in the study.

This study received approval from the Institutional Review Board (IRB) at Shawnee State University on December 5th, 2022. IRB approval was needed prior to collecting the data needed for this study. A copy of the IRB approval is located in the Appendix. The researcher

also received permission to utilize C-TEC Postsecondary data for this study by the Director of C-TEC on October 18th, 2022.

Data Processing and Analysis

After discussions with the research advisor, the primary research questions were revised as the following:

1. Are scores earned on the three ACT WorkKeys assessments (applied math, workplace documents, and graphic literacy), retake status on the ACT WorkKeys assessments (had to retake or did not retake), economically disadvantaged status at time of enrollment (yes or no), employment status at time of enrollment (yes or no), ESOL status (yes or no), age at time of enrollment, gender (male or female), and race (non-minority or minority) significant predictors of completion (completer or leaver) for students' chosen postsecondary program at C-TEC?

2. Are scores earned on the three ACT WorkKeys assessments (applied math, workplace documents, and graphic literacy), retake status on the ACT WorkKeys assessment components (had to retake or did not retake), economically disadvantaged status at time of enrollment (yes or no), employment status at time of enrollment (yes or no), ESOL status (yes or no), age at time of enrollment, gender (male or female), and race (non-minority or minority) significant predictors of successfully obtaining at least one industry recognized credential (earned at least one credential or did not earn credential) in the students' chosen program field of work?

3. Are scores earned on the three ACT WorkKeys assessments (applied math, workplace documents, and graphic literacy), retake status on the ACT WorkKeys assessment components (had to retake or did not retake), economically disadvantaged status at time of enrollment (yes or no), employment status at time of enrollment (yes or no), ESOL status (yes or no), age at time of enrollment, gender (male or female), and race (non-minority or minority)

significant predictors of successfully obtaining a job in the students' chosen program field after graduating the program?

After receiving the cleansed data from a C-TEC Postsecondary employee, participants with missing data will be removed. Additionally, study participants that are listed more than once will also be removed from the study. Additional variables, including the age of the participant at the time of enrollment and cumulative scores for all three ACT WorkKeys assessments (applied math, graphic literacy, and workplace documents) will be added to the data set. The analysis of the research questions will involve logistic regression, discriminant function analysis, and non-parametric data analysis techniques.

These methodologies have been employed in similar studies. For example, Elaine M. Allensworth and Kallie Clark utilized non-parametric tests and log linear analysis to examine the relationship between ACT scores, student high school GPA, and college completion. Their study concluded that a student's high school GPA was a superior predictor of college readiness and success compared to using a student's ACT scores (Allensworth & Clark, 2020). Additionally, Saul Geiser and Maria V. Santelices employed logistic regression to analyze students' high school GPA and entrance testing in regard to predicting graduation status for college students. Their research revealed that high school GPA was a more effective predictor of graduation status than entrance testing (Geiser & Santelices, 2007).

Summary

Chapter 3 outlined the methodology used for this study. This chapter provided an overview of both the participants and the setting of the study, focusing on the graduates from C-TEC Postsecondary. Furthermore, the chapter discussed the data instrumentation that was utilized, described the dataset received from C-TEC Postsecondary and the C-TEC Postsecondary testing center, and gave through descriptions of the applied math, graphic literacy, and workplace documents sections of the ACT WorkKeys assessments. This chapter

discussed the validity of the ACT WorkKeys assessments through previous research studies regarding the assessment's reliability. Additionally, this chapter described the procedure utilized to collect the data used in this study. Finally, the procedure and analysis of the data were examined, as logistic regression and discriminant function analysis will be used to determine the results. Chapter four will examine the results of this study.

CHAPTER IV: RESULTS

The central focus of this study is to examine the effectiveness of the ACT WorkKeys assessments as an entrance exam in determining the success of students who enroll in postsecondary CTE centers. This study seeks to investigate if the ACT WorkKeys assessments are effective predictors of both student graduation success and attainment of industry recognized credentials that align with the chosen program career field. Furthermore, this study aims to investigate whether retaking any of the three ACT WorkKeys assessments has a significant impact on student success. Additionally, further analysis will examine whether factors such as age, race, economically disadvantaged status, and gender contribute to predicting student success.

Descriptive Statistics

One thousand, eight hundred and twenty-five subjects were included in this study. The descriptive information about the students is included in Table 1. The participants selected were students enrolled at C-TEC Postsecondary during the fiscal years between $2015 - 2022$. The mean age of the students was 27.63 with a range of 15 to 74 years. The total number of students who graduated (completers) from their program at C-TEC Postsecondary was $1525\ (83.56\%)$, while the total number of students who did not graduate from their program (leavers) was $300\ (16.44\%)$. The total number of students who earned at least one industry recognized credential was $1279\ (70.08\%)$, while the total number of students who did not earn an industry recognized credential was $546\ (29.92\%)$.

Approximately fifteen percent of the sample $(n = 281, 15.40\%)$ had to retake at least one of the three ACT WorkKeys assessments to meet the minimum required cut scores for enrollment, while nearly eighty-five percent $(n = 1544, 84.60\%)$ did not need to retake any of the ACT WorkKeys assessments. ESOL status and out of work at time of enrollment status were removed from the study due to the lack of representation in the study.

Table 1

Participant Descriptive Information

Age (years)	Mean: 27.63 ± 10.26 Range: $15 - 74$
Completer (graduated)	1525 (83.56%)
Leaver (withdrew)	300 (16.44%)
Student did not have to retake an ACT WorkKeys assessment	1544 (84.60%)
Student had to retake at least one ACT WorkKeys assessment	281 (15.40%)
Student earned at least one industry recognized credential	1279 (70.08%)
Student did not earn an industry recognized credential	546 (29.92%)
Total	1825 (100%)

Table 2

Result, Average ACT WorkKeys Score
Mean (Standard Deviation)

	Applied Math	Workplace Documents	Graphic Literacy
Result (Completer)	5.33 (0.99)	5.27 (0.86)	4.80 (0.92)
Result (Leaver)	5.17 (0.93)	5.25 (0.92)	4.69 (0.89)

Table 3

Credential Attainment, Average ACT WorkKeys Score
Mean (Standard Deviation)

	Applied Math	Workplace Documents	Graphic Literacy
Earned at least one industry recognized credential	5.41 (0.97)	5.31 (0.87)	4.90 (0.93)
Did not earn an industry recognized credential	5.05 (0.98)	5.16 (0.88)	4.51 (0.81)

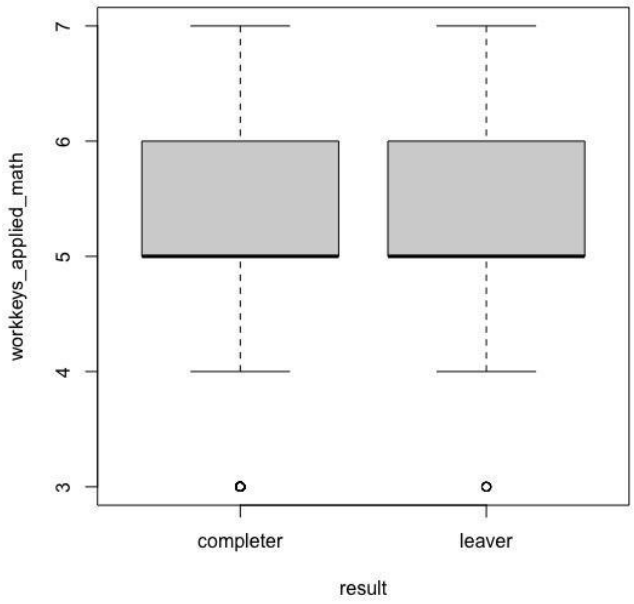
Data analysis - Results

An independent samples t-test examined the mean difference in the ACT WorkKeys applied math score across result status (completer or leaver). A box plot of ACT WorkKeys applied math score over result is presented in Figure 1. The box plot revealed outliers in the

dataset.

Figure 1

Result (Completer vs Leaver), Average ACT WorkKeys Applied Math Score



Since the samples were collected randomly from each population, independence may be assumed; however, the results from Shapiro-Wilk test indicated possible threats to the normality assumption (Completer: $W = 0.91,\ p < .001$; Leaver: $W = 0.9,\ p < .001$). The results from Levene's test also indicated concerns with the equal variance assumption, $F = 4.47,\ p < .05$. To address these concerns, the t-test uses the Welch adjustment for unequal variances.

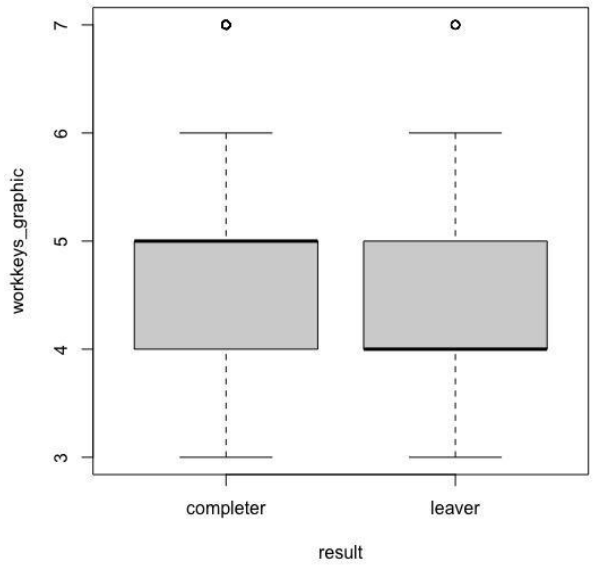
On average, ACT WorkKeys applied math scores for students who completed their program $(M = 5.33, SD = 0.99)$ were significantly higher than students who did not complete their program $(M = 5.17, SD = 0.93)$, $t(443.10) = 2.65,\ p < .01$, with a 95% *CI* around the difference between means $[0.04, 0.27]$. A small effect size was represented, $d = 0.16$.

An independent samples t-test also examined the mean difference in the ACT WorkKeys graphic literacy score across result status (completer or leaver). A box plot of ACT WorkKeys

graphic literacy score over result is presented in Figure 2. The boxplot revealed outliers in the dataset.

Figure 2

Result (Completer vs Leaver), Average ACT WorkKeys Graphic Literacy Score



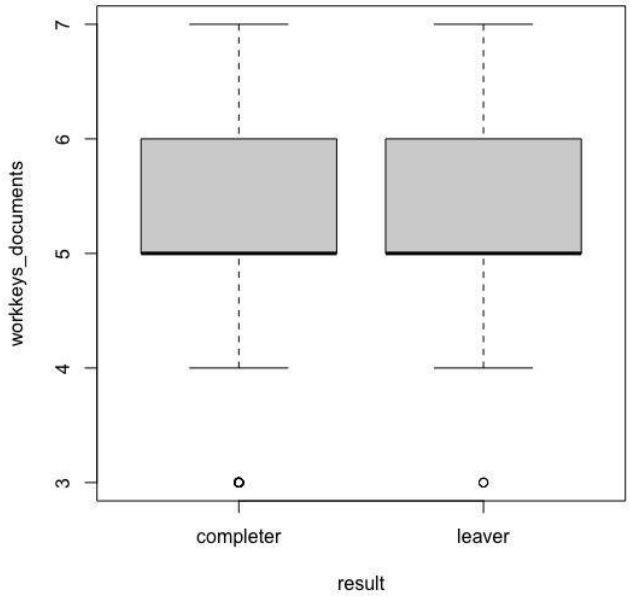
Since the samples were collected randomly from each population, independence may be assumed; however, the results from Shapiro-Wilk test indicated possible threats to the normality assumption (Completer: $W = 0.85,\ p < .001$; Leaver: $W = 0.81,\ p < .001$). The results from Levene's test indicated no concerns with the equal variance assumption, $F = 0.13,\ p = .72$.

On average, ACT WorkKeys graphic literacy scores for students who completed their program $(M = 4.80, SD = 0.92)$ were only slightly higher than students who did not complete their program $(M = 4.69, SD = 0.89),\ t(434.01) = 1.96,\ p = .05$, with a 95% *CI* around the difference between means $[0.001, 0.221]$. A small effect size was represented, $d = 0.12$.

An independent samples t-test also examined the mean difference in the ACT WorkKeys workplace documents score across result status (completer or leaver). A box plot of ACT WorkKeys workplace documents score over result is presented in Figure 3. The boxplot revealed outliers in the dataset.

Figure 3

Result (Completer vs Leaver), Average ACT WorkKeys Workplace Documents Score



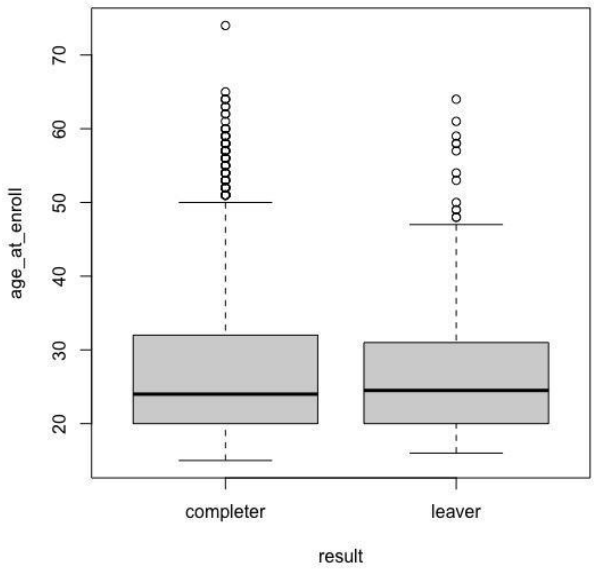
Since the samples were collected randomly from each population, independence may be assumed; however, the results from Shapiro-Wilk test indicated possible threats to the normality assumption (Completer: $W = 0.88, p < .001$; Leaver: $W = 0.89, p < .001$). The results from Levene's test indicated no concerns with the equal variance assumption, $F = 3.39,\ p = .07$.

On average, ACT WorkKeys workplace documents scores for students who completed their program $(M = 5.27, SD = 0.86)$ did not differ from students who did not complete their program $(M = 5.25, SD = 0.92,\ t(408.82) = 0.43,\ p = .067$, with a 95% *CI* around the difference between means $[-0.09, 0.14]$. A small effect size was represented, $d = 0.03$.

An independent samples t-test also examined the mean difference in age across result status (completer or leaver). A boxplot of age over result is presented in Figure 4. The box plot revealed outliers in the dataset.

Figure 4

Result (Completer vs Leaver), Student Age at Time of Enrollment



Since the samples were collected randomly from each population, independence may be assumed; however, the results from Shapiro-Wilk test indicated possible threats to the normality assumption (Completer: $W = 0.83,\ p < .001$; Leaver: $W = 0.86,\ p < .001$). The results from Levene's test indicated no concerns with the equal variance assumption, $F = 1.88,\ p = .17$.

On average, the mean age for students who completed their program $(M = 27.17, SD = 10.05)$ did not differ from students who did not complete their program $(M = 27.10, SD = 27.10)$, $t(458.29) = 0.12,\ p = .91$, with a 95% *CI* around the difference between means $[-1.07, 1.21]$. A small effect size was represented, $d = 0.01$.

A Chi-square test of independence examined the relationship between economically disadvantaged status and result. The result status (completer or leaver) is presented across economically disadvantaged status (yes or no) in Table 4. The associations between result status and economically disadvantaged status were statistically significant, $\chi^2 = (1, N = 1825) = 8.714,\ p < .01$. Based on the odds ratios, the odds of an economically disadvantaged

student leaving a program is $1.549\ [1.157, 2.092]$ times higher than a non-economically disadvantaged student leaving a program.

Table 4

Economically Disadvantaged Status (yes vs no), Result (completer vs leaver)

	Result (Completer)	Result (Leaver)	Total
Economically Disadvantaged (no)	501 (27.45%)	72 (3.95%)	573 (31.40%)
Economically Disadvantaged (yes)	1024 (56.11%)	228 (12.49%)	1252 (68.60%)
Total	1252 (83.56%)	300 (16.44%)	1825

Another Chi-square test of independence examined the relationship between ACT WorkKeys retake status and result. The result status (completer or leaver) is presented across ACT WorkKeys retake status (had to retake or didn't have to retake) in Table 5. The associations between result status and retake status were statistically significant, $\chi^2 = (1, N = 1825) = 8.144,\ p < .01$. Based on the odds ratios, the odds of a student who had to retake at least one of the ACT WorkKeys assessments leaving a program is $1.593\ [1.146, 2.195]$ times higher than a student who passed the ACT WorkKeys assessments with the minimum required cut scores the first time.

Table 5

ACT WorkKeys Retake Status (Had to Retake or Did not Have to Retake), Result (Completer vs Leaver)

	Result (Completer)	Result (Leaver)	Total
Had to Retake	218 (11.95%)	63 (3.45%)	281 (15.40%)
Did not Have to Retake	1307 (71.62%)	237 (12.99%)	1544 (84.60%)
Total	1525 (83.56%)	300 (16.44%)	1825

Another Chi-square test of independence examined the relationship between gender and result. The result status (completer or leaver) is presented across gender (male or female) in Table 6. The associations between result status and gender were not statistically significant, $\chi^2 = (1, N = 1825) = 2.913,\ p = .089$. Based on the odds ratios, the odds of a male student leaving a program is $1.257\ [0.969, 1.636]$ times higher than a female student.

Table 6

Gender (Male vs Female), Result (Completer vs Leaver)

	Result (Completer)	Result (Leaver)	Total
Gender (female)	669 (36.66%)	115 (6.30%)	784 (42.96%)
Gender (male)	856 (46.90%)	185 (10.14%)	1041 (57.04%)
Total	1525 (83.56%)	300 (16.44%)	1825

A final Chi-square test of independence examined the relationship between race and result. The result status (completer or leaver) is presented across race (non-minority or minority) in Table 7. The associations between result status and race were not statistically significant, $\chi^2 = (1, N = 1825) = 3.162,\ p = .075$. Based on the odds ratios, the odds of a minority student leaving a program is $1.448\ [0.955, 2.153]$ times higher than a non-minority student.

Table 7

Race (Non-Minority vs Minority), Result (Completer vs Leaver)

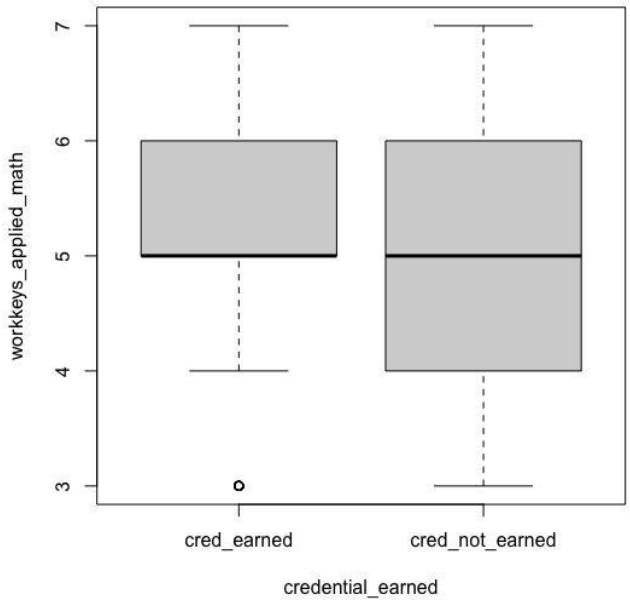
	Result (Completer)	Result (Leaver)	Total
Race (minority)	135 (7.40%)	37 (2.03%)	172 (9.42%)
Race (non-minority)	1390 (76.16%)	263 (14.41%)	1653 (90.58%)
Total	1525 (83.56%)	300 (16.44%)	1825

Data Analysis - Industry Recognized Credentials Earned

An independent samples t-test examined the mean difference in the ACT WorkKeys applied math score across industry recognized credential attainment status (earned at least one credential or did not earn a credential). A boxplot of ACT WorkKeys applied math score over credential attainment is presented in Figure 5. The box plot revealed outliers in the dataset.

Figure 5

Industry Recognized Credential Attainment, Average ACT WorkKeys Applied Math Score



Since the samples were collected randomly from each population, independence may be assumed; however, the results from Shapiro-Wilk test indicated possible threats to the normality assumption (Earned Credential: $W = 0.90,\ p < .001$; Did not Earn Credential: $W = 0.91,\ p < .001$). The results from Levene's test also indicated no concerns with the equal variance assumption, $F = 3.62,\ p = .06$.

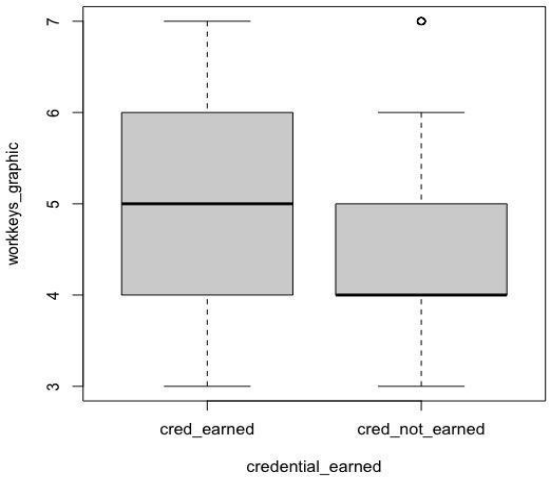
On average, ACT WorkKeys applied math scores for students who earned at least one industry recognized credential $(M = 5.41, SD = 0.97)$ were significantly higher than students

who did not earn an industry recognized credential $(M = 5.05, SD = 0.98)$, $t(1015.3) = 7.15,\ p < .001$, with a 95% *CI* around the difference between means $[0.30, 0.47]$. A small effect size was represented, $d = .34$.

An independent samples t-test also examined the mean difference in the ACT WorkKeys graphic literacy score across industry recognized credential attainment status (earned at least one credential or did not earn a credential). A box plot of ACT WorkKeys graphic literacy score over credential attainment is presented in Figure 6. The box plot revealed outliers in the dataset.

Figure 6

Industry Recognized Credential Attainment, Average ACT WorkKeys Graphic Literacy Score



Since the samples were collected randomly from each population, independence may be assumed; however, the results from Shapiro-Wilk test indicated possible threats to the normality assumption (Earned Credential: $W = 0.86,\ p < .001$; Did not Earn Credential: $W = 0.78,\ p < .001$). The results from Levene's test also indicated concerns with the equal variance assumption, $F = 21.85,\ p < .001$.

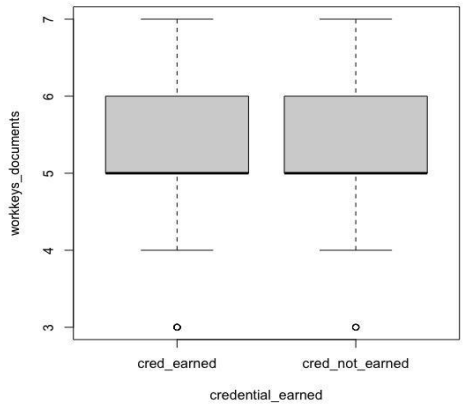
On average, ACT WorkKeys graphic literacy scores for students who earned at least one industry recognized credential $(M = 4.90, SD = 0.93)$ were significantly higher than students

who did not earn an industry recognized credential $(M = 4.51, SD = 0.81),\ t(1175.80) = 9.02,$ $p < .001,$ with a 95% *CI* around the difference between means $[0.30, 0.47]$. A small effect size was represented, $d = 0.45$.

An independent samples t-test also examined the mean difference in the ACT WorkKeys workplace documents score across industry recognized credential attainment status (earned at least one credential or did not earn a credential). A box plot of ACT WorkKeys workplace documents score over credential attainment is presented in Figure 7. The box plot revealed outliers in the dataset.

Figure 7

Industry Recognized Credential Attainment, Average ACT WorkKeys Workplace Documents Score



Since the samples were collected randomly from each population, independence may be assumed; however, the results from Shapiro-Wilk test indicated possible threats to the normality assumption (Earned credential: $W = 0.88,\ p < .001$; Did not earn credential: $W = 0.88,\ p < .001$). The results from Levene's test indicated no concerns with the equal variance assumption, $F = 0.09,\ p = .77$.

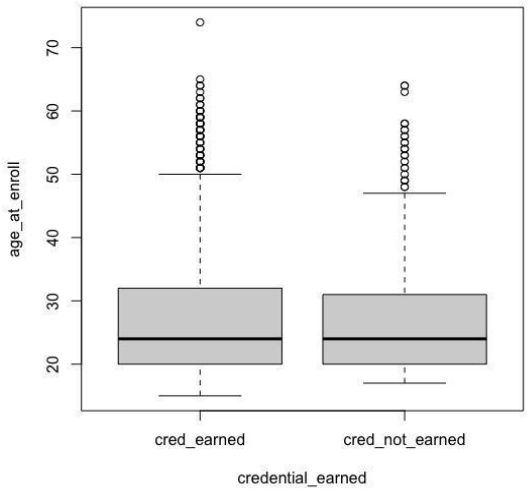
On average, ACT WorkKeys workplace documents scores for students who earned at least one industry recognized credential $(M = 5.31, SD = 0.87)$ were significantly higher than

students who did not earn an industry recognized credential ($M = 5.16, SD = 0.88$), $t(1012.2) = 3.38,\ p < .001$, with a 95% *CI* around the difference between means $[0.06, 0.24]$. A small effect size was represented, $d = 0.17$.

An independent samples t-test also examined the mean difference in age across industry recognized credential attainment status (earned at least one credential or did not earn a credential). A boxplot of age over credential attainment is presented in Figure 8. The boxplot revealed outliers in the dataset.

Figure 8

Industry Recognized Credential Attainment, Student Age at Time of Enrollment



Since the samples were collected randomly from each population, independence may be assumed; however, the results from Shapiro-Wilk test indicated possible threats to the normality assumption (Earned credential: $W = 0.84,\ p < .001$; Did not earn credential: $W = 0.84,\ p < .001$). The results from Levene's test indicated no concerns with the equal variance assumption, $F = 1.67,\ p = .20$.

On average, the mean age for students who earned at least one industry recognized credential ($M = 27.82, SD = 10.50$) were only slightly higher than students who did earn an

industry recognized credential $(M = 27.18, SD = 9.68)$, $t(1110.2) = 1.27,\ p = .21$, with a 95% *CI* around the difference between means $[-0.35, 1.64]$. A small effect size was represented, $d = 0.06$.

A Chi-square test of independence examined the relationship between economically disadvantaged status and industry recognized credential attainment status. Industry recognized credential attainment status (earned at least one credential vs did not earn a credential) is presented across economically disadvantaged status (yes or no) in Table 8. The associations between credential attainment status and economically disadvantaged status was not statistically significant, $\chi^2 = (1, N = 1825) = 1.768,\ p = .184$. Based on the odds ratios, the odds of an economically disadvantaged attaining a credential is $0.860\ [0.691, 1.072]$ times higher than a non-economically disadvantaged attaining a credential.

Table 8

Economically Disadvantaged Status (yes vs no), Industry Recognized Credential Attainment Status (earned at least one credential vs did not earn a credential)

	Earned a Credential	Did not Earn a Credential	Totals
Economically Disadvantaged (no)	389 (21.32%)	184 (10.08%)	573 (31.40%)
Economically Disadvantaged (yes)	890 (48.77%)	362 (18.20%)	1252 (68.60%)
Totals	1279 (70.08%)	546 (29.92%)	1825

Another Chi-square test of independence examined the relationship between ACT WorkKeys retake status and industry recognized credential attainment status. Industry recognized credential attainment status (earned at least one credential vs did not earn a credential) is presented across ACT WorkKeys retake status (had to retake or didn't have to retake) in Table 9. The associations between industry recognized credential attainment status

and retake status was statistically significant, $\chi^2 = (1, N = 1825) = 6.815,\ p < .01$. Based on the odds ratios, the odds of a student who had to retake at least one of the ACT WorkKeys assessments not earning an industry recognized credential is $1.437\ [1.090, 1.891]$ times higher than a student who passed the ACT WorkKeys assessments the first time.

Table 9

ACT WorkKeys Retake Status (had to retake or didn't have to retake), Industry Recognized Credential Attainment Status (earned at least one credential vs did not earn a credential)

	Earned a Credential	Did not Earn a Credential	Totals
Had to Retake	178 (9.75%)	103 (5.64%)	281 (15.40%)
Did not Have to Retake	1101 (60.33%)	443 (24.27%)	1544 (84.60%)
Totals	1279 (70.08%)	546 (29.92%)	1825

Another Chi-square test of independence examined the relationship between gender and industry recognized credential attainment status. Industry recognized credential attainment status (earned at least one credential vs did not earn a credential) is presented across gender (male or female) in Table 10. The associations between industry recognized credential status and gender was not statistically significant, $\chi^2 = (1, N = 1825) = 0.673,\ p = .41$. Based on the odds ratios, the odds of a male student leaving a program is $0.914\ [0.743, 1.125]$ times higher than a female student.

Table 10

Gender (Male vs Female), Industry Recognized Credential Attainment Status (earned at least one credential vs did not earn a credential)

	Earned a Credential	Did not Earn a Credential	Totals
Gender (Female)	541 (29.64%)	115 (6.30%)	656 (35.95%)
Gender (Male)	738 (40.44%)	185 (10.14%)	923 (50.56%)
Totals	1279 (70.08%)	300 (16.44%)	1825

A final Chi-square test of independence examined the relationship between race and industry recognized credential attainment status. Industry recognized credential attainment status (earned at least one credential vs did not earn a credential) is presented across race (non-minority or minority) in Table 11. The associations between industry recognized credential status and race were not statistically significant, $\chi^2 = (1, N = 1825) = 3.087,\ p = .08$. Based on the odds ratios, the odds of a minority student not earning an industry recognized credential is $1.361\ [0.963, 1.911]$ times higher than a non-minority student.

Table 11

Race (Non-Minority vs Minority), Industry Recognized Credential Attainment Status (earned at least one credential vs did not earn a credential)

	Earned a Credential	Did not Earn a Credential	Totals
Race (Minority)	110 (6.03%)	62 (3.40%)	172 (9.24%)
Race (Non-Minority)	1169 (64.05%)	484 (26.52%)	1653 (90.58%)
Totals	1279 (70.08%)	300 (16.44%)	1825

Logistic regression analysis I

A direct logistic regression analysis was performed on graduation status as outcome and eight predictors: economically disadvantaged status (eco_disadvantaged), ACT WorkKeys

applied math score (workkeys_applied_math), ACT WorkKeys graphic literacy score (workkeys_graphic), ACT WorkKeys workplace documents score (workkeys_documents), ACT WorkKeys assessment retake status (overall_retake_status), gender (gender), race (race), and age at enrollment (age_at_enroll).

After deletion of 70 cases with missing values, data from $n = 1757$ students were available for analysis: 1462 (83.21%) students classified as a completer and 295 (16.79%) students classified as a leaver. Additionally, the ESOL (esol) and out of work at time of enrollment (out_of_work) predictors were omitted from the study, and race was dichotomized as non-minority/minority, as each of these predictors had inadequate representation in the dataset. For example, only 6 of the 1757 participants were labeled as an ESOL student and only 62 out of 1757 participants were labeled as out of work during time of enrollment. Missing data appeared to be scattered randomly across categories of outcome and predictors and did not significantly change the percentage of students classified as a completer or leaver. Analysis was performed using R (R Core Team, 2015).

A test of the full model with all eight predictors against a constant-only model was statistically reliable, $\chi^2 = (8, N = 1757) = 33.21,\ p < .001$, indicating that the set of predictors reliably distinguished between students being either completers or leavers. The variance in the result status accounted for is small, with McFadden's rho $= .02$. *AIC* for the full model (1575) was lower than the constant only model (1592.2), indicating a slightly better fit. Prediction success (using 0.5 as the threshold) was consistent with the overall level of completion with 1462 cases (83.21%) accurately classified or predicted correctly with sensitivity and specificity values of 0 and 1, respectfully.

Table 12 shows regression coefficients, Wald statistics, odds ratios, and 95% confidence intervals for odds ratios for each of the eight predictors. According to the Wald criterion, five predictors reliably predicted result status; economically disadvantaged (yes), $z = 2.944,\ p < .01$;

ACT WorkKeys applied math score, $z = -2.615,\ p < .01$; ACT WorkKeys workplace documents Score, $z = 2.055,\ p < .05$; ACT WorkKeys retake status (had to retake), $z = 2.186,\ p < .05$; and gender (male), $z = 2.178,\ p < .05$. The odds ratio for economically disadvantaged(yes) shows that the likelihood of an economically disadvantaged student leaving a program is 1.565 times higher than for a student who is not economically disadvantaged. The odds ratio for ACT WorkKeys applied math score shows that the likelihood of a student leaving a program is 0.798 times higher for each 1 point change in the ACT WorkKeys applied math score. The odds ratio for ACT WorkKeys workplace documents score shows that the likelihood of a student leaving a program is 1.201 times higher for each 1 point change in the ACT WorkKeys workplace documents score. The odds ratio for retake status (had to retake) shows that the likelihood of a student leaving a program is 1.449 times higher than for a student who did not have to retake any of the ACT WorkKeys assessments. The odds ratio for gender (male) shows the likelihood of a male student leaving a program is 1.361 times higher than a female student. ACT WorkKeys graphic literacy score, race, and student age at enrollment were not statistically significant in the model.

Variance Inflation Factors (VIF) values ranged from 1.024 (race) to 1.692 (workkeys_applied_math), indicating that multicollinearity is not a concern. Examination of the significance levels of the additional predictors created by examining the interaction between each predictor and the log of itself (Hosmer & Lemeshow, 1989) showed statistical significance with the interaction of both the age_at_enroll and workkeys_documents predictors, which indicates that the assumption of the linearity of the logit has been violated. In “Applied Logistic Regression” (3rd Edition), Hosmer, Lemeshow, and Sturdivant argue that interaction terms that violate the linearity of the logit may be retained if they are significant to the study (Hosmer et al., 2013). Consequently, both age_at_enroll and workkeys_documents predictors will be retained in the model due to the importance of these variables in the research study.

Table 12

Logistic Regression Analysis of Result Status as a Function of Student Information

Variables	*B*	Wald (*z*-ratio)	*p*	OR	95% *CI* Lower, *OR*	95% *CI* Upper, *OR*
eco_dis(yes)	0.448	2.944	.003 *	1.565	1.167	2.121
retake_status (had_to_retake)	0.371	2.186	.029 *	1.449	1.034	2.013
workkeys_applied_math	−0.225	−2.615	.009 *	0.798	0.674	0.945
workkeys_documents	0.183	2.055	.040 *	1.201	1.009	1.430
gender (male)	0.309	2.178	.029 *	1.361	1.033	1.801
workkeys_graphic	−0.077	−0.911	.362	0.926	0.783	1.091
race (minority)	0.350	1.742	.082	1.419	0.947	2.085
age_at_enroll	−0.006	−0.840	.401	0.994	0.981	1.007
(Constant)	−1.469	−2.781	.005 *	0.230	0.081	0.646

Upon conducting diagnostic evaluations involving standardized residuals, DFBETAS, DFFITS, and leverage values, 56 instances have been identified as problematic. Therefore, these observations will be deleted from the dataset. After the deletion of 56 observations from the dataset, data from $n = 1701$ students were available for analysis: $1460\ (85.83\%)$ students classified as a completer and $241\ (14.17\%)$ students classified as a leaver. Analysis was performed using R (R Core Team, 2015).

A test of the full model with all eight predictors against a constant-only model was statistically reliable, $\chi^2 = (8, N = 1701) = 77.58,\ p < .001$, indicating that the set of predictors reliably distinguished between completers and leavers. The variance in the result status accounted for is larger than the previous model but still small, with McFadden's rho = $.056$. *AIC* for the full model (1328.4) was lower than the constant only model (1390), indicating a slightly better fit. Prediction success (using 0.5 as the threshold) increased from the first model with

1460 cases (85.83%) accurately classified or predicted correctly with sensitivity and specificity values of 0 and 1, respectfully.

Table 13 shows regression coefficients, Wald statistics, odds ratios, and 95% confidence intervals for odds ratios for each of the eight predictors. According to the Wald criterion, six predictors reliably predicted result status; economically disadvantaged (yes), $z = 4.668,\ p < .001$; ACT WorkKeys applied math score, $z = -4.396,\ p < .001$; ACT WorkKeys workplace documents Score, $z = 3.404,\ p < .001$; ACT WorkKeys graphic literacy Score, $z = -2.416,\ p < .05$; gender (male), $z = 4.298,\ p < .001$; and student age at enrollment (age_at_enroll), $z = -2.769,\ p < .01$. The odds ratio for economically disadvantaged(yes) shows that the likelihood of an economically disadvantaged student leaving a program is 2.359 times higher than for a student who is not economically disadvantaged. The odds ratio for ACT WorkKeys applied math score shows that the likelihood of a student leaving a program is 0.650 times higher for each 1 point change in the ACT WorkKeys applied math score. The odds ratio for ACT WorkKeys workplace documents score shows that the likelihood of a student leaving a program is 1.407 times higher for each 1 point change in the ACT WorkKeys workplace documents score. The odds ratio for ACT WorkKeys graphic literacy score shows that the likelihood of a student leaving a program is 0.790 times higher for each 1 point change in the ACT WorkKeys graphic literacy score. The odds ratio for student age at enrollment shows that the likelihood of a student leaving a program is 0.977 times higher for each 1 point change in student age. The odds ratio for gender (male) shows the likelihood of a male student leaving a program is 2.011 times higher than a female student. Retake status and race were not statistically significant in the model.

Variance Inflation Factors (VIF) values ranged from 1.016 (race) to 1.677 (workkeys_applied_math), indicating that multicollinearity is not a concern. Examination of the significance levels of the additional predictors created by examining the interaction between

each predictor and the log of itself (Hosmer & Lemeshow, 1989) showed statistical significance with the interaction of the age_at_enroll, workkeys_documents, and workkeys_applied_math predictors, which indicates that the assumption of the linearity of the logit has been violated. In "Applied Logistic Regression" (3rd Edition), Hosmer, Lemeshow, and Sturdivant argue that interaction terms that violate the linearity of the logit may be retained if they are significant to the study (Hosmer et al., 2013). Consequently, both age_at_enroll, workkeys_documents, and workkeys_applied_math predictors will be retained in the model due to the importance of these variables in the research study.

Table 13

Logistic Regression Analysis of Result Status as a Function of Student Information

Variables	*B*	Wald (*z*-ratio)	*p*	OR	95% *CI* Lower, *OR*	95% *CI* Upper, *OR*
eco_dis(yes)	0.858	4.668	< .001 *	2.359	1.661	3.421
workkeys_applied_math	−0.431	−4.396	< .001 *	0.650	0.535	0.787
workkeys_documents	0.341	3.404	.001 *	1.407	1.157	1.714
gender (male)	0.698	4.298	< .001 *	2.011	1.468	2.777
retake_status (had_to_retake)	0.316	1.688	.091	1.372	0.944	1.969
workkeys_graphic	−0.236	−2.416	.016 *	0.790	0.650	0.954
race (minority)	−0.225	−0.848	.397	0.799	0.462	1.313
age_at_enroll	−0.023	−2.769	.006 *	0.977	0.961	0.993
(Constant)	−0.757	−1.257	.209	0.469	0.143	1.524

The standard logistic regression analysis was followed up with a backward elimination logistic regression analysis. Beginning with the full set of predictor variables, after 5 Fisher Scoring iterations a reduced model emerged that is not statistically significant from the full model, $\chi^2 = (8, N = 1701) = 0.749,\ p = .387$, with seven predictors: economically

disadvantaged status, ACT WorkKeys applied math score, ACT WorkKeys workplace documents score, ACT WorkKeys graphic literacy score, retake status, gender, and age at enrollment. The variance accounted for in result status remains very small with McFadden's rho $= .055$. Prediction success remained the same with 1460 of 1701 cases (85.83%) accurately classified or predicted correctly. Table 14 shows regression coefficients, Wald statistics, odds ratios, and 95% confidence intervals for odds ratios for the remaining seven predictors. According to the Wald criterion, economically disadvantaged (yes), $z = 4.663,\ p < .001$; ACT WorkKeys applied math score, $z = -4.361,\ p < .001$; ACT WorkKeys workplace documents score, $z = 3.445,\ p < .001$; ACT WorkKeys graphic literacy score, $z = -2.415,\ p < .05$; gender (male), $z = 4.305,\ p < .001$; and student age at enrollment (age_at_enroll), $z = -2.747,\ p < .01$ emerged as significant predictors of result status (leaver). Sensitivity and specificity values remained the same at 0 and 1, respectively.

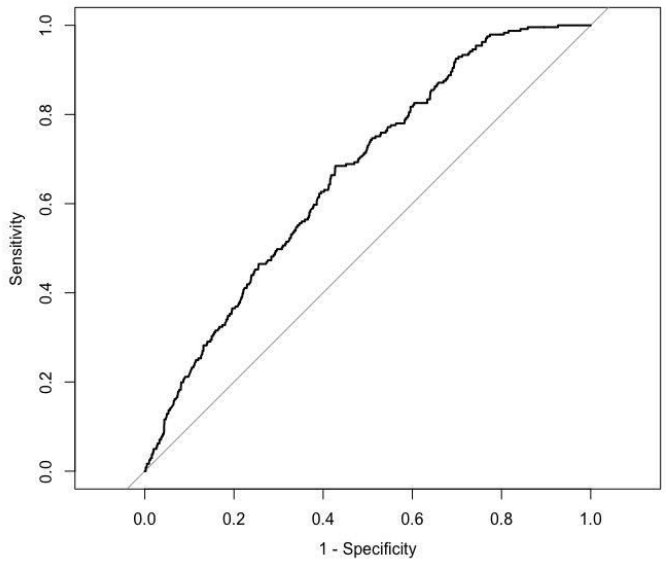
Table 14

Logistic Regression Analysis of Result Status, Reduced Model

Variables	*B*	Wald (*z*-ratio)	*p*	OR	95% *CI* Lower, *OR*	95% *CI* Upper, *OR*
eco_dis(yes)	0.857	4.663	< .001 *	2.355	1.659	3.414
workkeys_applied_math	−0.427	−4.361	< .001 *	0.652	0.538	0.790
workkeys_documents	0.345	3.445	.001 *	1.412	1.161	1.720
gender (male)	0.699	4.305	< .001 *	2.012	1.469	2.779
retake_status (had_to_retake)	0.308	1.646	.100	1.360	0.936	1.951
workkeys_graphic	−0.236	−2.415	.016 *	0.790	0.650	0.954
age_at_enroll	−0.023	−2.747	.006 *	0.977	0.961	0.993
(Constant)	−0.820	−1.373	.170	0.440	0.136	1.416

Since the eight-predictor model was statistically reliable, the percentage of accurately classified cases remained the same, but the backwards model had a slightly lower *AIC* (1327.2) than the full model (1328.4), the backwards model was used to determine cut off points to create adequate sensitivity and specificity. A receiver operating characteristics graph (ROC), which has been shown to be a reliable technique for visualizing, organizing, and selecting classifications based on performance, is presented in Graph 1. Swets (1988) found that ROC analysis could be extended for use in visualizing and analyzing behavior of diagnostic systems and for determining accuracy of a test using the area under the curve. For the set of predictors, the area under the curve was found to be 0.665, which indicates a poor accuracy classification for this diagnostic (Tape, 2015). Graph 1 shows a plot of model sensitivity and specificity for various cutoffs.

Graph 1.



Logistic regression analysis II

A direct logistic regression analysis was performed on student industry recognized credential attainment status as outcome and eight predictors: economically disadvantaged status (eco_disadvantaged), ACT WorkKeys applied math score (workkeys_applied_math), ACT WorkKeys graphic literacy score (workkeys_graphic), ACT WorkKeys workplace documents score (workkeys_documents), ACT WorkKeys assessment retake status (overall_retake_status), gender (gender), race (race), and age at enrollment (age_at_enroll).

After deletion of 70 cases with missing values, data from $n = 1757$ students were available for analysis: $1462\ (83.21\%)$ students classified as earning at least one industry recognized credential and $295\ (16.79\%)$ students classified as not obtaining an industry recognized credential. Additionally, the ESOL (esol) and out of work at time of enrollment (out_of_work) predictors were omitted from the study, and race was dichotomized as minority/non_minority as each of these predictors had inadequate representation in the dataset. For example, only 6 of the 1757 participants were labeled as an ESOL student and only 62 out of 1757 participants were labeled as out of work during time of enrollment. Missing data appeared to be scattered randomly across categories of outcome and predictors and did not significantly change the percentage of students classified as obtaining an industry recognized credential and not obtaining an industry recognized credential. Analysis was performed using R (R Core Team, 2015).

A test of the full model with all eight predictors against a constant-only model was statistically reliable, $\chi^2 = (8, N = 1757) = 107.85,\ p < .001$, indicating that the set of predictors reliably distinguished between students who obtained at least one industry recognized credential and students who did not obtain an industry recognized credential. The variance in not earning an industry recognized credential status accounted for is small, with McFadden's rho $= .051$. *AIC* for the full model (2039.3) was lower than the constant only model (2131.2),

indicating a slightly better fit. Prediction success (using 0.5 as the threshold) was not impressive with only 1240 cases (70.57%) accurately classified or predicted correctly with sensitivity and specificity values of 0.048 and 0.980, respectfully.

Table 15 shows regression coefficients, Wald statistics, odds ratios, and 95% confidence intervals for odds ratios for each of the eight predictors. According to the Wald criterion, four predictors reliably predicted result status; ACT WorkKeys applied math score, $z = -3.946,\ p < .001$; ACT WorkKeys workplace documents score, $z = 2.098,\ p < .05$; ACT WorkKeys graphic literacy score, $z = -6.564,\ p < .001$; and student age at enrollment, $z = -2.539,\ p < .05$. The odds ratio for ACT WorkKeys applied math score shows that the likelihood of a student not obtaining an industry recognized credential is 0.754 times higher for each 1 point change in the ACT WorkKeys applied math score. The odds ratio for ACT WorkKeys workplace documents score shows that the likelihood of a student not obtaining an industry recognized credential is 1.171 times higher for each 1 point change in the ACT WorkKeys workplace documents score. The odds ratio for ACT WorkKeys graphic literacy score shows that the likelihood of a student not obtaining an industry recognized credential is 0.611 times higher for each 1 point change in the ACT WorkKeys graphic literacy score. The odds ratio for student age at enrollment shows that the likelihood of a student not obtaining an industry recognized credential is 0.985 times higher for each 1 point change in student age. Economically disadvantaged status, retake status, gender, and race were not statistically significant in the model.

Variance Inflation Factors (VIF) values ranged from 1.024 (race) to 1.630 (workkeys_applied_math), indicating that multicollinearity is not a concern. Examination of the significance levels of the additional predictors created by examining the interaction between each predictor and the log of itself (Hosmer & Lemeshow, 1989) showed statistical significance with the interaction of the age_at_enroll predictor, which indicates that the assumption of the linearity of the logit has been violated. In “Applied Logistic Regression” (3rd Edition), Hosmer,

Lemeshow, and Sturdivant argue that interaction terms that violate the linearity of the logit may be retained if they are significant to the study (Hosmer et al., 2013). Consequently, the predictor age_at_enroll will be retained in the model due to the importance of this variable in the research study.

Table 15

Logistic Regression Analysis of Credential Status as a Function of Student Information

Variables	*B*	Wald (*z*-ratio)	*p*	OR	95% *CI* Lower, *OR*	95% *CI* Upper, *OR*
eco_dis(yes)	-0.229	-1.922	$.055$	0.795	0.630	1.005
retake_status (had_to_retake)	0.105	0.709	$.478$	1.110	0.829	1.480
workkeys_applied_math	-0.283	-3.946	$< .001$ *	0.754	0.654	0.867
workkeys_documents	0.158	2.098	$.036$ *	1.171	1.011	1.358
gender (male)	0.197	1.677	$.094$	1.217	0.968	1.534
workkeys_graphic	-0.493	-6.564	$< .001$ *	0.611	0.526	0.706
race (minority)	0.255	1.439	$.150$	1.290	0.908	1.819
age_at_enroll	-0.006	-2.539	$.011$ *	0.985	0.974	0.996
(Constant)	2.493	5.558	$< .001$ *	12.097	5.052	29.342

Upon conducting diagnostic evaluations involving standardized residuals, DFBETAS, DFFITS, and leverage values, 16 instances have been identified as problematic. Therefore, these observations will be deleted from the dataset. After the deletion of 16 observations from the dataset, data from $n = 1741$ students were available for analysis: 1236 (70.99%) students classified as a student who earned at least one industry recognized credential and 505 (29.01%) students classified as a student who did not earn an industry recognized credential. Analysis was performed using R (R Core Team, 2015).

A test of the full model with all eight predictors against a constant-only model was statistically reliable, $\chi^2 = (8, N = 1741) = 138.47,\ p < .001$, indicating that the set of predictors reliably distinguished between students who earned at least one industry recognized credential and students who did not earn an industry recognized credential. The variance in not earning an industry recognized credential status accounted for is larger than the previous model but still small, with McFadden's rho $= .066$. *AIC* for the full model (1976.4) was lower than the constant only model (2098.9), indicating a slightly better fit. Prediction success (using 0.5 as the threshold) slightly increased from the first model with 1253 cases (71.97%) accurately classified or predicted correctly with sensitivity and specificity values of 0.103 and 0.972, respectfully.

Table 16 shows regression coefficients, Wald statistics, odds ratios, and 95% confidence intervals for odds ratios for each of the eight predictors. According to the Wald criterion, six predictors reliably predicted not earning an industry recognized credential status; economically disadvantaged (yes), $z = -2.138,\ p < .05$; ACT WorkKeys applied math score, $z = -4.292,\ p < .001$; ACT WorkKeys workplace documents score, $z = 2.147,\ p < .05$; ACT WorkKeys graphic literacy score, $z = -7.632,\ p < .001$; gender (male), $z = 2.024,\ p < .05$; and student age at enrollment (age_at_enroll), $z = -2.877,\ p < .01$. The odds ratio for economically disadvantaged(yes) shows that the likelihood of an economically disadvantaged student not earning an industry recognized credential is 0.771 times higher than for a student who is not economically disadvantaged. The odds ratio for the ACT WorkKeys applied math score shows that the likelihood of a student not earning an industry recognized credential is 0.730 times higher for each 1 point change in the ACT WorkKeys applied math score. The odds ratio for ACT WorkKeys workplace documents score shows that the likelihood of a student not obtaining an industry recognized credential is 1.180 times higher for each 1 point change in the ACT WorkKeys workplace documents score. The odds ratio for ACT WorkKeys graphic literacy score shows that the likelihood of a student not obtaining an industry recognized credential is 0.548

times higher for each 1 point change in the ACT WorkKeys graphic literacy score. The odds ratio for student age at enrollment shows that the likelihood of a student not obtaining an industry recognized credential is 0.983 times higher for each 1 point change in student age. The odds ratio for gender (male) shows the likelihood of a male student leaving a program is 1.274 times higher than a female student. Retake status and race were not statistically significant in the model.

Variance Inflation Factors (VIF) values ranged from 1.021 (race) to 1.587 (workkeys_applied_math), indicating that multicollinearity is not a concern. Examination of the significance levels of the additional predictors created by examining the interaction between each predictor and the log of itself (Hosmer & Lemeshow, 1989) showed statistical significance with the interaction of the age_at_enroll predictor, which indicates that the assumption of the linearity of the logit has been violated. In “Applied Logistic Regression” (3rd Edition), Hosmer, Lemeshow, and Sturdivant argue that interaction terms that violate the linearity of the logit may be retained if they are significant to the study (Hosmer et al., 2013). Consequently, the age_at_enroll predictor will be retained in the model due to the importance of this variable in the research study.

Table 16

Logistic Regression Analysis of Credential Status as a Function of Student Information

Variables	*B*	Wald (*z*-ratio)	*p*	OR	95% *CI* Lower, *OR*	95% *CI* Upper, *OR*
eco_dis(yes)	−0.261	−2.138	.033 *	0.771	0.607	0.979
workkeys_applied_math	−0.315	−4.292	< .001 *	0.730	0.632	0.842
workkeys_documents	0.165	2.147	.032 *	1.180	1.015	1.372
gender (male)	0.242	2.024	.043 *	1.274	1.009	1.612
retake_status (had_to_retake)	0.126	0.843	.399	1.134	0.844	1.516
workkeys_graphic	−0.602	−7.632	< .001 *	0.548	0.468	0.638
race (minority)	0.223	1.222	.222	1.250	0.870	1.782
age_at_enroll	−0.018	−2.877	.004 *	0.983	0.971	0.994
(Constant)	3.158	6.734	< .001 *	23.523	9.453	59.490

The standard logistic regression analysis was followed up with a backward elimination logistic regression analysis. Beginning with the full set of predictor variables, after 4 Fisher Scoring iterations a reduced model emerged that is not statistically significant from the full model, $\chi^2 = (2, N = 1741) = 2.352,\ p = .309$, with six predictors: economically disadvantaged status, ACT WorkKeys applied math score, ACT WorkKeys workplace documents score, ACT WorkKeys graphic literacy score, gender, and age at enrollment. The variance accounted for in earning an industry recognized credential status remains very small with McFadden's rho = .065. Prediction success decreased with 1247 of 1741 cases (71.63%) accurately classified or predicted correctly. Table 17 shows regression coefficients, Wald statistics, odds ratios, and 95% confidence intervals for odds ratios for the remaining six predictors. According to the Wald criterion, economically disadvantaged (yes), $z = -2.147,\ p < .05$; ACT WorkKeys applied math score, $z = -4.592,\ p < .001$; ACT WorkKeys workplace documents score, $z = 2.018,\ p < .05$; ACT WorkKeys graphic literacy score, $z = -7.590,\ p < .001$; gender (male), $z = 2.044,\ p < .05$;

and student age at enrollment (age_at_enroll), $z = -2.879,\ p < .01$ emerged as significant predictors of students not earning an industry recognized credential. Sensitivity and specificity values were 0.093 and 0.971, respectively.

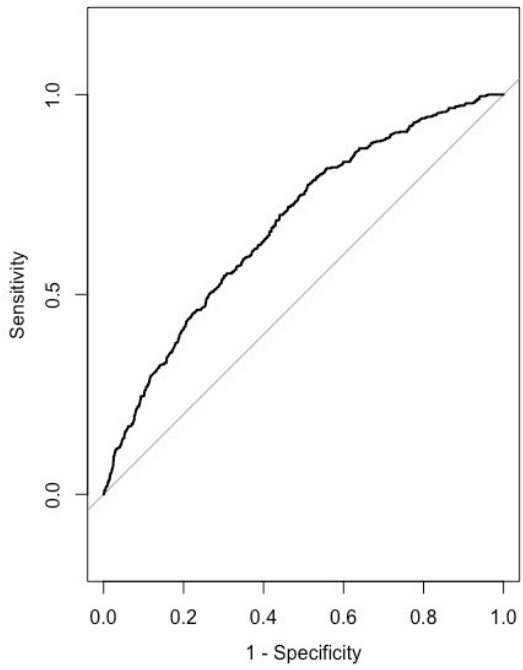
Table 17

Logistic Regression Analysis of Credential Status, Reduced Model

Variables	*B*	Wald (*z*-ratio)	*p*	OR	95% *CI* Lower, *OR*	95% *CI* Upper, *OR*
eco_dis(yes)	-0.262	-2.147	$.032$ *	0.770	0.607	0.978
workkeys_applied_math	-0.330	-4.592	$< .001$ *	0.719	0.624	0.827
workkeys_documents	0.155	2.018	$.044$ *	1.167	1.005	1.357
gender (male)	0.244	2.044	$.041$ *	1.276	1.011	1.614
workkeys_graphic	-0.597	-7.590	$< .001$ *	0.550	0.471	0.641
age_at_enroll	-0.018	-2.879	$.004$ *	0.983	0.971	0.994
(Constant)	3.315	7.295	$< .001$ *	27.531	11.391	67.723

Since the eight-predictor model was statistically reliable, the percentage of accurately classified cases remained the same, but the backwards model had a slightly lower *AIC* (1974.8) than the full model (1976.4), the backwards model was used to determine cut off points to create adequate sensitivity and specificity. A receiver operating characteristics graph (ROC), which has been shown to be a reliable technique for visualizing, organizing, and selecting classifications based on performance, is presented in Graph 2. Swets (1988) found that ROC analysis could be extended for use in visualizing and analyzing behavior of diagnostic systems and for determining accuracy of a test using the area under the curve. For the set of predictors, the area under the curve was found to be 0.673, which indicates a poor accuracy classification for this diagnostic (Tape, 2015).

Graph 2.



CHAPTER V: SUMMARY

The purpose of this study was to examine the effectiveness of the ACT WorkKeys assessments as an entrance exam in determining the success of students who enroll at C-TEC Postsecondary. This study sought to investigate if the ACT WorkKeys assessments are effective predictors of student graduation success and attainment of industry recognized credentials that align with the program career field. Furthermore, this study sought to investigate whether retaking any part of the ACT WorkKeys assessments has a significant impact on student success.

This chapter includes a discussion on the findings as it relates to the history and development of postsecondary career technical education (postsecondary CTE), and postsecondary CTE's role in providing practical skills for stable employment. This chapter also discusses the ACT WorkKeys assessments as a tool that can be utilized by postsecondary CTE centers, including the challenges and benefits of implementing the ACT WorkKeys assessments as an entrance exam for postsecondary CTE programs. This chapter will also discuss the connections between the results of this study and both the correspondence principle and the theory of investment in human capital. This chapter ends with a discussion of the limitations of the study, ideas for future research studies, and a final summary.

This chapter provides a discussion and considers potential future research questions based on the following research questions:

1. Are scores earned on the three ACT WorkKeys assessments (applied math, workplace documents, and graphic literacy), retake status on the ACT WorkKeys assessments (had to retake or did not retake), economically disadvantaged status at time of enrollment (yes or no), age at time of enrollment, gender (male or female), and race (non-minority or minority) significant predictors of completion (completer or leaver) for students' chosen postsecondary program at C-TEC?

2. Are scores earned on the three ACT WorkKeys assessments (applied math, workplace documents, and graphic literacy), retake status on the ACT WorkKeys assessment components (had to retake or did not retake), economically disadvantaged status at time of enrollment (yes or no), age at time of enrollment, gender (male or female), and race (non-minority or minority) significant predictors of successfully obtaining at least one industry recognized credential (earned at least one credential or did not earn credential) in the students' chosen program field of work?

Chapter 4 provided a comprehensive analysis of the effectiveness of the ACT WorkKeys assessments as predictors of student success at C-TEC Postsecondary center. Chapter 4 utilized various aspects of student performance and demographic factors to determine the implications on student graduation success, credential attainment, and the overall predictive validity of the ACT WorkKeys assessments.

Interpretation of the Findings

The purpose of this study was to examine the effectiveness of the ACT WorkKeys assessments as an entrance exam in determining the success of students who enroll at C-TEC Postsecondary. The interpretation of this study is discussed in the following sections, examining the results of the effectiveness of the ACT WorkKeys assessments as predictors of student graduation success, as well as predictors of students attaining industry recognized credentials that align with their program career field. Additionally, this section will discuss whether retaking any part of the ACT WorkKeys assessments has a significant impact on student success, and the study's findings of the impact of socioeconomic status on student success. Furthermore, these findings will be connected to the current literature on the ACT WorkKeys assessments and entrance exams in postsecondary CTE centers.

It is important to recognize postsecondary CTE as a valid pathway for education after high school, giving students the option of entering the workforce and allowing them enhanced economic stability. With the growing demand of skilled labor globally, postsecondary CTE centers can meet this need by training and educating students to be successful in the workforce. As entrance assessments continue to undergo further investigation and scrutiny in traditional college settings, it is critical to recognize how entrance exams not only affect traditional four-year college students, but also postsecondary CTE students. Utilizing entrance exams to predict educational and occupational outcomes is essential to recognize where student support falls short so that educational policy can be changed to reflect this need.

Predictive Value of ACT WorkKeys Scores

The focus of this study was to examine the role of the ACT WorkKeys assessments and five other predictors and the likelihood of student program completion as well as industry recognized credential attainment. Each variable was first examined independently across the dependent variables. The analysis suggests that the ACT WorkKeys applied math assessment scores is both a statistically significant predictor of student program completion and industry recognized credential attainment. Furthermore, the analysis suggests that the ACT WorkKeys graphic literacy and workplace documents assessments scores are statistically significant predictors of credential attainment. A full logistic regression model analysis also reflected the results of the independent data analyses, as all three of the ACT WorkKeys assessments were found to be statistically significant predictors of both successful program completion and credential attainment.

The current literature analyzing entrance assessment requirements for postsecondary education suggests that many colleges are removing entrance assessment requirements for incoming students by implementing test optional policies. These policies remove the entrance

assessment boundary for students, making postsecondary education more accessible for minority and low income students (Rosingeret al., 2021; Belasco et al., 2015). Literature suggests that postsecondary education institutions should utilize alternative metrics to entrance admissions requirements, such as high school GPA, which research has suggested to be more representative of a students' ability to succeed (Allensworth & Clark, 2020; Woods et al., 2018).

Notably, ACT also recommends that businesses and educational institutions should use the ACT WorkKeys assessments scores alongside other measures, including prior work performance reviews or reviewing a student's portfolio that indicates a balanced picture of the students' capabilities (LeFebvre, 2016). However, this study's findings support the argument that entrance assessments are a reliable predictor of a students' likelihood to complete a postsecondary program as well as a students' likelihood to earn industry recognized credentials in their programs career field. This aligns with previous research studies which concluded that testing has been demonstrated to predict both work and educational outcomes (Sackett et al., 2008).

This study's findings also contribute to the current literature that suggests the ACT WorkKeys assessments are reliable in evaluating a student's job readiness. A previous research study suggested that scores received on all three of the ACT WorkKeys assessments had a modest correlation with improved performance for educational institutions (ACT, 2017b, LeFebvre, 2016). Furthermore, the ACT WorkKeys workplace documents and applied math assessments were associated with a positive relationship between educational GPA and persistence, while the ACT WorkKeys graphic literacy assessment only displayed a modest relationship between educational GPA and persistence (LeFebvre, 2016). This study's findings complement these findings, as this study suggested that there was a positive relationship with student persistence and the ACT WorkKeys applied math assessments. However, this study's

findings contrast with the literature, as the findings suggested that the ACT WorkKeys graphic literacy assessment had a positive relationship with student persistence and the ACT WorkKeys workplace documents assessment had a negative relationship with student persistence. Thus, more research should be conducted to gain clarity on these three assessments.

Impact of Economically Disadvantaged Status

According to the Perkins V report on definitions of special populations, postsecondary students in Ohio are labeled as economically disadvantaged if their income and household size qualifies them to receive the Pell grant or if they are at or below specific federal poverty threshold and qualify for SNAP benefits (Ohio Postsecondary institutions, 2020). These students often face many challenges in education that are beyond financial scarcity. These factors include a lack of accessible information about financial aid, absence of positive adult role models, and geographical disadvantages, all of which compound the difficulty of navigating and attaining success in postsecondary education (Thompson et al., 2016; Bonitatibus, 2022; ACT, 2012; Duncan, 2021).

The value of postsecondary education impacts not only the individual who receives it, but also significantly affects later generations and societal equity. Current literature suggests that a parent's educational attainment significantly impacts their children's cognitive abilities. This impact is incredibly profound, as research suggests that living in poverty causes cognitive skills to decline after only two generations (The Racial Achievement Gap, Segregated Schools, and Segregated Neighborhoods – a Constitutional Insult, 2014). To overcome the barrier of poverty, current literature suggests that postsecondary CTE programs are essential pathways for providing economically disadvantaged students opportunities, both academically and securing future employment (Advance CTE, 2020; Gordon & Schultz, 2020). However, the findings of this study suggest that economically disadvantaged students are more likely to withdraw from their

prospective program. Therefore, there is a need for more comprehensive support systems within postsecondary CTE programs to increase the likelihood of success of these students.

Retake Status

Retake status as defined by this study indicates that a student did not meet the minimum ACT WorkKeys assessments cut scores for their desired programs. This study found that when analyzed individually, a student who had to retake one or more of the ACT WorkKeys assessments indicated they were more likely to withdraw from a program and less likely to earn an industry recognized credential. However, when analyzed with other predictors in the full logistic regression model, retake status was not a reliable predictor of a student completing a program or a student earning an industry recognized credential.

Educational equity and standardized testing have been an important topic in the current literature, suggesting that standardized testing is a barrier for certain student populations (Rosinger et al., 2021; Belasco et al., 2015). The finding that “retake status” loses its predictive power once analyzed in a full model with other predictors in a logistic regression analysis suggests that more research is needed to establish a clear understanding of equity in entrance assessments and student support services. These findings support the current literature, suggesting that focusing solely on the outcome of entrance exam assessments without considering a broader context may perpetuate inequalities in postsecondary education. Moreover, these findings align with the idea that if postsecondary CTE centers utilize entrance assessments as a barrier to enrollment, there should be discussion of the need for more equitable and inclusive entrance exam assessment policies.

The complex findings related to “retake status” also contribute to the discussion in the current literature that explores the validity of standardized assessments as predictors of student

success, illustrating that the predictive validity of these assessments is not straightforward. The findings of this study in terms of “retake status” support perspectives in the literature that postsecondary CTE education should examine their reliance on standardized entrance exams if they use them to make admission decisions, and consider implementing other methods of admissions requirements (LeFebvre, 2016, Rosinger et al., 2021; Belasco et al., 2015). However, as previously discussed, the findings of this study in regards to the ACT WorkKeys assessments suggested that these assessments do predict student success and should be utilized to ensure a student is ready for their program enrollment. Therefore, more research needs to be conducted to determine what policy reforms can best support students while also removing barriers to postsecondary CTE enrollment.

This study’s findings suggest that utilizing the ACT WorkKeys assessments as an entrance assessment for postsecondary CTE, specifically in the subject areas of applied math, graphic literacy, and workplace documents, provides valuable insights into a potential student’s ability to succeed in a given program. However, this contrasts with the current literature on postsecondary entrance assessments, which suggests that current policies should be revised to make these assessments optional in order to decrease barriers to postsecondary education. Given the mixed results regarding the individual ACT WorkKeys assessments’ ability to predict success, future research is essential in understanding how these assessments are best utilized in postsecondary CTE. Furthermore, the lack of predictability of “retake status” indicates that remediation might be an effective option to serve students who are not academically prepared for these programs. The results of this study also align with the current literature on student socioeconomic status, recognizing the correlation between poverty and a student’s ability to succeed in postsecondary education. Therefore, further research should be conducted to determine how to best serve these students and support them through the entirety of their program.

Implications for Theory and Research

Presented in Chapter 1, the theoretical frameworks utilized by this study were the theoretical framework of human capital, developed by Gary S. Becker, and the correspondence principle, developed by Bowles and Gintis. The human capital theoretical framework describes the importance for individuals to invest in their own education, as education is a tool to improve quality of life as well as improve the economic outcome of their communities. The correspondence principle rebuttals the ideals of the human capital framework by elaborating on how educational systems fail individuals, keeping them trapped in a workplace model that values obedience and hierarchy rather than developing an individual's skills. The connection between these theoretical frameworks and the results of this study are discussed in the following sections.

Human Capital

The human capital theoretical framework states that the foundation of economic growth relies on individuals to invest in their own education (Hao et al., 2023). This investment considerably increases the productivity of the individual, thus driving the growth and success of the business, which then furthers the economic growth of the nation (Hao et al., 2023). Students who enroll in programs at C-TEC Postsecondary embody this theory, as they pursue education with the goal of improving their livelihoods and striving for a more secure financial future.

The results of this study suggest that students who are economically disadvantaged are more likely to withdraw from a program. This aligns with the human capital theory, which emphasizes the need for policy changes that would empower lower socioeconomic and minority groups to increase their human capital through education (Hao et al., 2023). Therefore, creating accessible and supportive educational environments for these students would foster their skill development necessary for economic growth.

This study found an inverse relationship between student ACT WorkKeys assessment scores in the applied math and graphic literacy assessments and the likelihood that a student would withdraw from a program at C-TEC. That is, receiving higher scores on these assessments indicated that a student was less likely to withdraw from a program. The human capital theory focuses on individual skill development as a catalyst of economic growth. Students who received higher scores on these assessments were able to persist through their program, which is critical for increasing their future income potential and growing the economy.

Correspondence Principle

The correspondence principle states that the current design of the education system in the United States was built to produce employees that would not question the hierarchy of upper management and blindly accept workplace policy. This theory suggests that education in the United States exacerbates segregation between social classes and minority racial groups, inhibiting any real movement between classes, regardless of an individual's hard work (Arum et al., 2010, Swartz, 2003). This study revealed higher withdrawal rates among students who are economically disadvantaged and among female students. These findings resemble the correspondence's principle argument concerning the structure of educational programs and policy and the disadvantages that could be experienced by groups who have historically experienced oppression.

Educational inequalities created by the educational systems can also be examined through the impact of the ACT WorkKeys assessments scores on student enrollment. ACT WorkKeys Applied Math and Graphic Literacy assessments were associated with higher withdrawal rates of students, which suggests that methods used to assess and teach students these skills may reinforce current social and economic inequalities. Furthermore, students may

not learn these skills in the current educational system, which would inhibit them from making any upward social or economic mobility.

Implications for Practice

The findings of this study provided insight into critical aspects of postsecondary CTE policies, emphasizing the importance of the ACT WorkKeys assessments as an entrance exam for postsecondary CTE programming, identifying barriers to enrollment, and suggesting policy change that would improve postsecondary CTE practices. These findings identified key predictors of student success, supporting the utilization of the ACT WorkKeys assessments to measure a student's academic and job readiness. Furthermore, the conclusions gathered by the findings of this study align with existing literature and research studies, encouraging policy reforms that would further support the success of postsecondary CTE students.

Enhancing Admission Processes

The findings of this study suggest that utilizing the three ACT WorkKeys assessments in admissions processes could significantly benefit postsecondary CTE centers by effectively screening students' level of academic preparedness and their potential to succeed in their chosen program. However, considering the recommendations proposed by ACT, postsecondary CTE centers should also consider implementing further application requirements to better understand the students' abilities and qualities they possess that would not otherwise be captured by a standardized exam. These requirements could include personalized counseling sessions to help students understand their unique strengths and how they connect to their future career aspirations, or interviews conducted by staff to evaluate the student's current skill set and future goals. Additionally, including financial aid counseling prior to a student taking the ACT WorkKeys

assessments could prepare students with financial literacy skills necessary for postsecondary enrollment.

Support for Retaking the ACT WorkKeys Entrance Assessments

This study indicates that retaking the ACT WorkKeys assessments does not significantly predict whether a student will withdraw from a program or fail to earn at least one industry recognized credential. Therefore, postsecondary CTE centers should consider developing preparatory programs, aimed to support student success and increasing enrollment. These programs could offer study plans, tutoring, and practice assessments to help students improve their assessment scores. This support should be accessible both in-person and online to increase accessibility for students who lack transportation or have other time-restraints.

At C-TEC, students are referred to the Aspire class, which provides ACT WorkKeys remediation services. Aspire is a grant funded program, supporting students' academic goals and helping students transition into postsecondary programs. With additional funding, Aspire services could expand, as more instructors could be hired on and offer more classes or tutoring support for students. Utilizing local community businesses to increase the funding support could help the Aspire services achieve this goal.

Inclusivity and Accommodations

Ensuring access for all students is imperative for postsecondary CTE centers, including those requiring accommodations for learning disabilities or testing anxiety. Postsecondary CTE centers should evaluate and possibly expand their current support services for students. This could include establishing a larger student services center and training additional staff to better identify and meet the needs of these students. Moreover, reevaluating current policies regarding

student IEPs, such as extending the validity time frame and implementing flexible accommodation practices, could foster a learning environment that serves students of all abilities.

Future Directions in Vocational Education

Due to the constant change and evolution of the labor and job market, postsecondary CTE centers need to remain adaptable and responsive to these changes. This includes conducting frequent curriculum reviews and ensuring alignment with current industry demands, as well as partnering with industry professionals that can forecast future skill requirements. Furthermore, policymakers should also prioritize research studies focused on postsecondary CTE centers, given the significant impact postsecondary CTE has on the economy and the lives of the students who graduate from these programs. Research dedicated to analyzing pedagogical strategies, student support services, and necessary academic skills could offer more insight into factors that impact student success and inform policy changes to reflect these insights.

Limitations and Threats to Generalizability

Limitations

Although this research utilized quantitative methods for this study, a study that combines a quantitative and qualitative approach would create a better understanding of predicting if a student will withdraw from a program or not earn a credential. There are many factors in every level of education, including postsecondary CTE. Extenuating life events can influence student success, which is not recorded quantitatively.

Although this study assumes data collected on students is accurate, this study recognizes that there are limitations in tracking student outcomes. Student's ACT WorkKeys assessment scores are entered into a database, which could be a potential source of inaccuracies caused by

human error. Similarly, student information is collected during the enrollment process after a student has passed the three ACT WorkKeys assessments, which could also be a potential source of human error. Additionally, this study recognizes that the rigor and complexity of both academic and hands-on abilities required by different programs within CTEC Postsecondary may contribute to variations in student outcomes.

Some of the students selected for this study were enrolled during the COVID-19 pandemic. This limits this study's ability to conduct a more comprehensive analysis. For example, several programs had to stop and restart classes a few months later, which possibly impacted completion rates. Furthermore, students who contracted COVID-19 or whose families were impacted by COVID-19 could have also impacted completion rates.

Threats to Generalizability

It is important to consider the potential threats to generalizability of this study in order to apply these findings to other postsecondary CTE centers. This study was conducted at a single postsecondary CTE center, located in a suburban area with a predominantly Caucasian population. Therefore, the results of this study might not be relevant for other postsecondary CTE centers located in urban areas with a more diverse surrounding community. Additional research studies should be conducted in urban settings with a more diverse student body.

Due to the size of the student body at C-TEC Postsecondary, students enrolled do not have access to a large student services center. However, students can make appointments with a student services individual, and tutoring options are mostly limited to working with the student's direct instructor. However, other postsecondary CTE centers might have a wider range of support services and resources for students to access when needed. This discrepancy of student support services could potentially impact the success of students completing a program or receiving the

tutoring services they need to earn their industry recognized credential, and therefore could be a possible limitation in generalizing the results of this study to other postsecondary CTE centers.

The labor market is constantly changing and evolving; creating and eliminating jobs and forcing individuals to learn new skills to be hirable. This constant change and the need for new skill sets could impact the relevance of the ACT WorkKeys assessments and the generalizability this study could have on the outcome of future studies. Similarly, as the job market changes, specific program curriculums at C-TEC Postsecondary and requirements for industry recognized credentials could also change, which would also impose a threat to generalizability of the findings of this study and outcomes of future studies.

Recommendations for Future Research

Due to time constraints, this study did not explore the third research question presented in earlier chapters. Thus, further research should be conducted to analyze the impact of the predictors utilized in this study and if any are significant indicators of students attaining employment in the program career field after graduating from their program. Title IV federal funding eligibility for educational institutions requires a certain percentage of students to be employed in the career field after completion of a program. Therefore, given the significance of Title IV funding, it is important to understand how these results can impact policy compliance and support the success of graduates.

Further research into inclusiveness within postsecondary CTE centers should also be considered, particularly regarding accommodations for students living with learning disabilities or students who struggle with testing anxiety. Unlike larger postsecondary educational institutions, C-TEC Postsecondary lacks extensive resources for students with disabilities, which could potentially put many adult learners at a disadvantage. Since C-TEC Postsecondary policy only

recognizes Individualized Education Programs (IEPs) within three years of issuance, there is a serious gap in support for these students in both the classroom and with the ACT WorkKeys assessments. Furthermore, instructors of postsecondary CTE classes potentially have limited training in educational methodologies for students who have learning disabilities, due to their non-educational, industry focused background. This suggests that there is a critical need for future research into how more training could be incorporated to support instructors, which could further support the success of their students.

The data for this research study was limited to students who had taken the ACT WorkKeys assessments, achieved the minimum cut scores for their chosen programs, and subsequently enrolled into a program at C-TEC Postsecondary. Exclusion of data regarding students who do not achieve the minimum cut scores represents a deficit towards understanding barriers to postsecondary CTE and program enrollment at C-TEC. Further analysis of students referred to the Aspire program, which assists students with study skills and content knowledge of the ACT WorkKeys assessments, could provide information on the effectiveness of the remediation provided by Aspire. Moreover, investigating whether these efforts positively influence student success could improve strategies to prepare students for success in postsecondary CTE programs.

Conclusion

This research study provides a comprehensive analysis of the ACT WorkKeys assessments as an entrance exam at C-TEC Postsecondary Center, evaluating the assessments' effectiveness in predicting student success in postsecondary CTE programs and attainment of industry recognized credentials. The findings suggest that the ACT WorkKeys assessments are significant predictors of success, supporting both the necessity of entrance exams in postsecondary CTE centers and their predictive validity.

Additionally, challenges associated with socioeconomic status, retaking the ACT WorkKeys assessments, race, age, and gender, was also analyzed as potential predictors of student success. Based on the results of this study, it is recommended that policy changes in postsecondary CTE centers are needed to ensure educational equity. This includes increasing support services for students who are economically disadvantaged and students requiring accommodations. Furthermore, these analyses addressed the limited research on entrance exams in postsecondary CTE and advocates for further research studies that would focus on improving student outcomes. Continuing these research efforts is essential for increasing the effectiveness of postsecondary CTE programs and supporting these programs as an important potential postsecondary educational pathway.

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Appendix A

IRB Approval, 12/5/2022

Research Summary

I. Summary of Research Questions:

Prior research has shown that the ACT WorkKeys test can be beneficial to both employers and post-secondary schools to determine the likelihood that an individual will perform well in a job or in an educational setting. There are not many studies concerning the ACT WorkKeys and its ability to predict the success of individuals, so it is important to examine these prerequisite tests as they are imperative to an individual's level of success in a potential job or educational pathway. A large number of high school graduates are choosing vocational schooling over a traditional college pathway due to flexible scheduling, cost, shorter program time frames, and the potential to work in the career field of their choice immediately following graduation. While the ACT, SAT and the ACT WorkKeys all act as entrance exams for students, only the ACT and SAT have been studied at nauseum to predict the success of traditional college students. This study seeks to investigate if the ACT WorkKeys test predicts student success in the Postsecondary classroom and beyond to their chosen career field.

Primary Research Question: Do Work Keys prerequisite tests predict success of students attending adult postsecondary education?

II. Methodology, Research Design, and Procedures:

The theoretical framework chosen for this study is Bowles and Gintis Correspondence Principle, which describes the educational system as a replication of the workplace by incorporating the same norms and values seen within a capitalist society.

The research design will include data from graduated and non-graduated students attending the Career and Technical Education Center - Postsecondary Center (C-TEC Postsecondary

Center). Students will be divided into groups based on if they had to retake any portion of the ACT WorkKeys tests; Workplace Documents, Graphic Literacy, and Applied Mathematics. The student's ACT WorkKeys level score and scale score will be collected as well as graduation status (graduated or withdrawn) including the program the student was enrolled in, the length of the program, percentage of student attendance hours, the existence of a work internship within the program and if the student participated in the work internship, if an industry credential was earned or not earned, and the student's current job status (no job, job within the career path of program (related employment), or job not within the career path of program) will be collected. Additionally, data collected will include the student's age, gender, race, ESOL status, and ethnicity (Hispanic or not Hispanic), if the student is a single parent, the student's previous educational level before enrollment at C-TEC (GED, high school diploma, or Postsecondary Degree), if C-TEC is the student's first postsecondary experience, and number of industry credential testing attempts (passed on first attempt or passed after first attempt). All data will be cleansed of identifying information by C-TEC Postsecondary Center prior to release for analysis.

III. Data Analysis and Reporting:

With the data from C-TEC Postsecondary Center, I will be able to conduct an ANOVA analysis to identify if there is a difference between students based on remediation status pertaining to the ACT WorkKeys. A linear regression will also be performed to identify the factors that predict student success, both educationally and obtaining a job after graduation.

The results of this study will be included in a thesis paper to fulfill the requirements for the Masters of Science in Mathematics program for Shawnee State University. In addition, we will likely publish the results.

There is no risk of privacy or confidentiality breach in the reported results since the data will contain no identifying information when received from C-TEC Postsecondary Center.

IV. Timeline:

Data collection will begin December 1, 2022 or when IRB approval is gained from Shawnee State University. All data will be collected by May 15, 2023.

Career & Technology Education Centers Licking County

October 18, 2022

Brooklyn Bowers is a current employee at C-TEC's Postsecondary Center. Brooklyn will be using data concerning students that have already exited our school for her research dissertation. The data set that Brooklyn will be using for her research dissertation will be cleansed and all student identifiers will be deleted by an administrator before the data set is released to her. Therefore, student anonymity will be protected.

Sincerely,

Lauren Massie

Lauren Massie
Postsecondary Center Director

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BIBLIOGRAPHY[1]

Brooklyn Nicole Bowers

Candidate for the Degree of

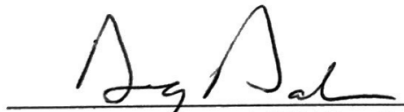
Master of Science Mathematics

Thesis: EFFICACY OF THE WORKKEYS ACT ASSESSMENTS IN PREDICTING STUDENT SUCCESS IN POSTSECONDARY CAREER TECHNICAL EDUCATION AND INDUSTRY RECOGNIZED CREDENTIAL ATTAINMENT

Major Field: Mathematics

Education: Bachelor of Science in Mathematics

Completed the requirements for the Master of Science in Mathematics, Portsmouth, Ohio in April 2024.



ADVISER'S APPROVAL: Dr. Douglas Darbro

4/25/2024