IS THERE A PREDICTIVE RELATIONSHIP BETWEEN PERCEPTION OF CAREER AND TECHNICAL EDUCATION AND GPA?

by

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ABSTRACT

Despite the continued research into Career and Technical Education (CTE) program expansion in public schools and the relationships surrounding student success, educational leaders are in growing need of empirical evidence to justify the continued funding of such programs and to support reform movements associated with educational policies. The main hypotheses included testing for statistical significance in the predictive relationships between final high school cumulative Grade Point Average (GPA) and both, "Instructional" and "Non-Instructional" factors related to Science-based CTE courses completed while enrolled in high school. The study population was comprised of high school graduates in the years of 2013 -2017 from a single participating school district in Colorado Springs, Colorado. The quantitative research method included a predictive correlational design using Likert-type survey instrument, administered through SurveyMonkey, to collect numeric data from 97 participating subjects. The results of the study showed that a moderately negative predictive relationship exists between graduates' perception of instructional factors related to Science-based CTE courses and their final cumulative high school GPA. A predictability of 4.1% between the criterion and the predictor variable, identified as the "Instructional Factor", while no statistically significant relationship was found to exist between the criterion and the predictor variable, identified as the "Non-Instructional Factor". Implications from the findings of the study suggested that educational leaders should pay more attention to promoting a positive perception among students towards CTE course instruction, rather than non-instructional factors related to their educational experience.

DEDICATION

I dedicate this dissertation to my family, Kim, Alana, Kimmy, Katie, and Taylor, who have given me the unconditional support to finish the race and who provide the motivation for all of my decisions. I am thankful for the continued love and support of my mother and father; no one could ever ask for a more loving family. I would also like to dedicate this dissertation to the CTE community throughout Colorado and the United States. Sparking an interest in students for a variety of career opportunities, while connecting them to the resources that align with the career pathways that most interest them is our ultimate goal. I hope this dissertation serves to answer some of the relevant questions that we as educational leaders often ask and promotes the continued growth of CTE programs in American high schools.

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Chapter 1

Introduction

The global community is aware of the inherent value of education and science; however, in spite of the evolution in contemporary affairs to include a transnational mantra, national and local forces drive the progression of both science and education (Simon, 2013). The American educational system is now witnessing the evolution of Career and Technical Education (CTE) programs to support technology driven curriculum and promote higher-order thinking in our students competing in the global economy (Johnson-Martin, 2012).

CTE programs offer high school students a focused curriculum that promotes academic rigor aligned with postsecondary expectations and workforce readiness skills (Johnson-Martin, 2012). Educational leaders have a responsibility to ensure current academic programs are actually promoting an increase in self-efficacy among graduating students and data-driven research can provide empirical evidence to help leaders make decisions.

Chapter 1 introduces the stated problem, the purpose of the current study, research questions and hypotheses, as well as the significance of the study in regards to educational research, theory, practice, and leadership. Additional sections are provided to describe the nature of the study, theoretical framework, scope, assumption, limitations, and delimitations.

Background of the Problem

Legislation passed in the early twenty first century has attempted to increase the academic rigor taught and consequently improve the levels of student engagement, with the goal of increasing preparation of American high school students for the demands of the workforce (Friedel, 2011; Plank, DeLuca, & Estacion, 2008; Snow & Okojie, 2013). The No Child Left Behind (NCLB) Act of 2001 proposed that the national education system in the United States was responsible for all students' education (Wallace, 2012). The NCLB Act, went into effect without clear understandings of the role and effectiveness of CTE programs at the high school level. In 2010, President Obama approved a plan to commission new STEM high schools despite the substantial financial investment needed to fund STEM schools; funding was provided although insufficient documentation of the curriculum taught, instructional methods used, or effectiveness of the programs existed (Tofel-Grehl & Callahan, 2014).

Confounding arguments regarding the value of CTE programs exist in the literature. Arguments made by Silverberg, Warner, Fong and Goodwin (2004) suggested that test scores indicate educational reforms and higher academic requirements for graduation resulted in improvements in academic performances, while vocational programs, such as CTE, do not themselves add value to student achievement. However, in 2008, statistics reported by the U.S. Department of Education suggest, CTE programs offered in secondary school systems involved over 9.2 million of the 14.9 million students enrolled.

Another point of concern, for educational leaders and legislators alike, is whether or not the students' perception of the effectiveness of CTE programs directly contribute to improvements in academic performance. Transitioning of secondary students into the labor market is an important factor of the nation's education system and CTE programs have played a significant role in the process (Levesque, Wun, & Green, 2010). Time specific influences on self-perceptions of ability in academic achievement are evident during adolescent schooling transitions, while prior achievements in academics were found to have little significance in secondary students' self-efficacy towards science and math content (Silverthorn, DuBois, & Crombie, 2005). Several published studies investigated the impact of transitional programs such as school-to-work or CTE (Bersudskaya & Chen, 2011; Packard, Leach, Ruiz, Nelson, & DiCocco, 2012; Venezia & Jaegar, 2013).

The influence of career pathway and postsecondary transitional programs on American students is a driving factor in their individual perspective of life after high school. Hutchins and Akos (2013) found that students who attend schools that offer comprehensive career development, or transitional, programs have a higher likelihood of experiencing a more positive and realistic expectation of their future.

Contemporary high school students are given the flexibility to choose from the traditional courses and the CTE courses aligned with specific career interests. In 2011, the National Center for Education Statistics prepared a report that identified 12 broad occupational areas for statistical tracking purposes; among those 12 occupational categories, agriculture and natural resources, computer and information sciences, and

health sciences are options for students to focus their studies (Bersudskaya & Chen, 2011). The largest groups of CTE graduates employed full time in their field of training were Medical/Health/Social Service professionals, accounting for nearly 70% of the population studied (Tillman & Tillman, 2008).

Colorado Community College Systems (2014) defined the ultimate goal of CTE programs as the preparation of students for workforce demands and the connection of students to employment opportunities. Students in CTE programs that gain technical skills during their high school instruction will make successful career choices and experience smooth transitions from the high school level to the workforce or into post-secondary programs (Loera, Nakamoto, Joo Oh, & Rueda, 2013).

Designing an engaging curriculum, employing instructional strategies that prepare students for rigorous coursework, and developing academic assessments aligned with workforce expectations and the subject matter, is a fundamental focus of CTE instruction (Wilkin & Nwoke, 2011). Determining whether students' perception regarding the effectiveness of the CTE courses they completed can predict their academic success, as measured by GPA, will serve educational leaders to continue the progressive movement to improve CTE pathways.

The success of high school CTE programs currently involves measuring how many students that graduate from said programs eventually gain full-time employment in their trained field or enroll in related postsecondary programs. Despite efforts by CTE program directors and legislators, Tillman and Tillman (2008) found that out of 1,066 recently graduated CTE students, only 40% were identified as being employed full-time

in a field related to their technical training and education programs. An examination of students' perception of the effectiveness of their science-based CTE programs during high school and whether they were adequately prepared for their post-high school transitions lacks presence in the current literature (Aliaga, Kotamraju, & Stone, 2014; Castellano, Stringfield, & Stone, 2003; Hirschy, Bremer, & Castellano, 2011; Plank, Deluca, & Estacion, 2008; Snow & Okojie, 2013).

Statement of the Problem

The general problem is that despite heavy financial investment and the growing popularity of CTE and Science, Technology, Engineering, and Math (STEM) programs little evidence exists related to the effectiveness of these programs (Tofel-Grehl & Callahan, 2014). The effectiveness of academic programs is linked to the instructional methods employed to produce specific results and the non-instructional factors that promote a sense of preparedness among students graduating from the programs. Nearly one-quarter (25%) of the graduated high school CTE students surveyed felt ill prepared for college due to a lack of advanced math and science classes during high school (Packard, et al., 2013). CTE educators have a growing concern about the decline in the number of CTE credits earned by high school students over the last two decades (Hudson, 2013).

The most fundamental component of CTE programs include exposing students to instructional and non-instructional factors that will provide them with employability and technical skills during adolescent years to help with the transition into adulthood (Loera, Nakamoto, Joo Oh, & Rueda, 2013). Researchers have previously investigated the

effectiveness of the school-to-work transition and the perception of individuals who completed transitional programs (Miller & Gray, 2002; Packard, et al., 2012; Venezia & Jaeger, 2013).

The specific problem is that insufficient empirical evidence exists regarding whether there is a predictive relationship between final cumulative high school GPA and graduates' perception of the effectiveness of the CTE programs they completed. Educational leaders cannot continue to push a reform movement within CTE programs without empirical evidence to predict relationships between either instructional or non-instructional factors and students' academic success.

A driving issue in current high school reform is a growing need to evaluate how CTE contributes to the overall purpose of high school programs to prepare students for the rigors of postsecondary education or the workforce (Aliaga, Kotamraju, & Stone, 2014). Students' perceptions on how instruction is presented and assessed are related to their efficacy in performing various tasks (Alkharusi et al., 2014). By using statistical techniques to examine data gathered from surveys completed by former high school CTE students in Colorado, educational leaders gain empirical evidence to better understand and predict the strength of relationships between academic success, measured by cumulative final GPA, and the perceived effectiveness of CTE instructional or non-instructional factors related to science-based pathways.

Purpose of the Study

The purpose of the current quantitative predictive correlational study was to identify whether there is a predictive relationship between instructional and non-instruction factors of Science-based CTE courses and final cumulative GPA in high school students.

This study employs a five point Likert-type survey instrument to collect numeric data aligned with the variables identified in this study. A Likert-type survey instruments provides an ordered range of responses, measuring the magnitude of responses to various factors (Croasmun & Ostrom, 2011). Collection of numeric data, using a structured survey design from a post-positivists worldview provides the researcher an opportunity to perform statistical analysis to predict the strength of relationships among the research variables. Regression analysis provides researchers an equation that would optimally predict future relationships between identified variables aligned with a particular phenomenon in the professional community targeted (Osborne, 2000).

The research population targeted by the current study includes high school graduates, from 2013-2017, who were categorized as "Occupational Concentrators" by completing a minimum of two science-based CTE courses, while enrolled in high school. Research subjects are chosen based on specific inclusion criteria from the identified population, in and around the Colorado Springs Metro Area, within the state of Colorado.

Significance of the Study

Significance of the Study for Research

This study is significant for research because it is an attempt to fill a gap in the

existing literature regarding the use of empirical research to predict correlational relationship between the identified variables, among high school graduates who completed a minimum of two CTE courses and are identified as "Occupational Concentrators". Despite current research into academic programs at various levels, limited research exists on the factors that influence perceived effectiveness of CTE programs on students' academic success and their preparation for postsecondary transitions (Loera, Nakamoto, Joo OH, & Rueda, 2013). The results of this study builds on the research already conducted by Loera, Nakamoto, Joo OH, and Rueda, (2013); Hirschy, et al., (2011); and Aliaga, Kotamraju, and Stone, (2014).

Significance of the Study for Theory

This study is significant from a theoretical perspective in that the research uses the Social Cognitive Theory (SCT), and the philosophical viewpoint of Constructivism as a conceptual framework. The intent is to expand our knowledge on the strength of relationships between students' academic success and their perception of program effectiveness. Constructivist believe learning is an active process that requires individuals create their own perspective, or viewpoint, regarding where new information fits or builds upon previous information (Martinez, 2010). Social Cognitive Theory (SCT) subscribes to causal structures of human functioning related to interpersonal influences, behavioral and environmental forces (Bandura, 1986). SCT has its roots and connection to human perception of the world around them and their established self-efficacy. Self-efficacy is rooted with Albert Bandura who, in 1963, emphasized learning through social context and observations of behaviors, or interactions in others (Gredler,

2009). SCT does not postulate a single self-efficacy effect and accepts a variety of conditions that may be unrelated, or negatively related, to human psychosocial behaviors (Bandura, 2012).

Significance of the Study for Practice

This study is significant for practice in the education community because the research provides data-driven evidence into the magnitude of relationships that exists between student success and their perception on the effectiveness of various instructional practices employed by CTE educators or non-instructional factors associated with CTE programs. Research conducted by Israel, Myers, Lamm and Galindo-Gonzalez (2012) found that students who were identified as CTE program completers or "Occupational Concentrators" at the secondary level, particularly those involved in science pathways, performed significantly better on standardized tests than their traditional counterparts.

Secondary school achievements have historically been measured through standardized test scores, grade point average, and involvement in extracurricular activities or clubs (Israel, Myers, Lamm & Galindo-Gonzalez, 2012). Even though research conducted by Hsieh, Sullivan, and Guerra (2007) found motivation towards learning and active participation in instructional activities were the strongest predictors of student achievement.

Promoting instruction of workforce skills, career specific content knowledge, and postsecondary preparedness is the primary goal of CTE programs (Aliaga, Kotamraju, & Stone, 2014). High school educators and educational leaders might use the empirical evidence resulting from the current study to design, or improve current, CTE programs

that promote both instructional and non-instructional factors that best aligned to the students perceived effectiveness and academic success.

Significance of the Study to Leadership

This study is significant for leadership because educational leaders have pushed a reform movement within CTE programs to incorporate a broader context of traditional academic subject knowledge aligned with the career specific skills already taught (Spindler & Greiman, 2013). Legislative funding under the Carl D. Perkins Act emphasizes academic rigor and relevance for CTE courses to promote student readiness for the workforce or postsecondary programs (Threeton, 2007). Exploring relationships that may exist between cumulative high school GPA and former students' perception on the effectiveness of both instructional and non-instructional factors related to the CTE programs they completed fills a void in the existing literature. The goal of the study was to support educational leaders, science educators, and industry experts by providing a framework to predict relationships between academic success and the perceived effectiveness of science-based CTE programs, supporting the reform movement.

Nature of the Study

Overview of Research Approach

The approach of the current study was to employ quantitative methodology to investigate the specific problem that educational leaders need empirical evidence that is data-driven to identify and predict relationships between academic success and the perceived effectiveness of CTE programs. A quantitative methodology provides the

researcher an opportunity to examine trends within a specific population, using numeric data that can be examined using statistical techniques (Vogt, 2007).

Qualitative research designs are inductive in nature and are most often utilized when developing a new description or theoretical understanding of a poorly understood phenomenon. Qualitative research is most appropriate when little or nothing is known about the aspect of the study, when the aim is to generate words to understand a phenomenon, rather than numeric data, and when the researcher is attempting to form a new theory (McCusker & Gunaydin, 2015).

The current study is not intended to form any new theories on social interactions or philosophical constructs. Rather, the intent of the current study was to provide empirical evidence, supported by inferential statistics, allowing education professionals a means of predicting future relationships between the identified variables.

Rationale for Research Approach

The rationale for the study and the employment of the survey instrument served to describe data-driven evidence regarding the magnitude of relationships between the identified variables in an efficient and cost-effective manner, while removing potential research bias. Surveys are used as the primary data collection method for research designs with the purpose of describing or predicting relationships among defined variables within a specific population (Knipe & Bottrell, 2015). Quantitative surveys administered online allow research subjects to sit in the comfort of his or her own home, in a time of their own choosing, and without the influence of the researcher promoting any bias into the responses provided (Barnham, 2012).

Quantitative research allows for the collected data to be quantified and subjected to statistical analyses to identify potential relationships, predict future relationships, and support the validity of results when generalized to larger populations (Williams, 2007). Regression approaches to research designs provide a more versatile option for statistical analyses than ANOVA or t-tests (Vogt, 2007). The sample, high school graduates who completed a minimum of two science-based CTE courses, must be considered carefully to insure the external validity and to help the researcher draw conclusions that might extend to other populations (Black, 1999).

Overview of Research Design

Following a quantitative research methodology, the current study uses a predictive correlational survey design as the preferred method to collect data and regression analysis as the preferred means to examine the resulting numeric data. Research designs that employ a Likert-type survey instrument offer researchers an acceptable tool to collect numeric data on a variety of educational factors (Maurer & Pierce, 1998).

Quantitative research designs can include experimental, quasi-experimental, correlational, ex post facto and meta-analyses (Vogt, 2007). Experimental studies involve the assignment of specific treatment and control groups, and typically serve researchers in examining cause and effect (Levin, 1999). Quasi-experimental research designs are used when researchers isolate the effect of one variable after controlling as many other variables without random assignment (Levin, 1999). *Ex post facto* research involves an approach to look back in time through the retroactive analysis of archival

data to identify cause and effect relationships (Silva, 2010). The focus of the current study is on predictive correlational relationships, not on examining cause and effect. Correlational research consists of measuring two or more variables to determine the degree of relationship that may exists between them (Christensen, Johnson, & Turner, 2014).

Research Questions and Hypotheses

The primary research question in the study is:

Does the perception of CTE program effectiveness predict academic success, as measured by final cumulative high school GPA?

RQ1. Is there a predictive relationship between instructional factors of Science-based CTE courses and final cumulative GPA in high school students?

$H1_0$. There is no statistically significant predictive relationship between perceived sense of effectiveness towards instructional factors employed within the science-based CTE courses and final cumulative high school GPA.

$H1_A$. There is a statistically significant predictive relationship between perceived sense of effectiveness towards instructional factors employed within the science-based CTE courses and final cumulative high school GPA.

RQ2. Is there a predictive relationship between non-instructional factors of Science-based CTE courses and final cumulative GPA in high school students?

$H2_0$. There is no statistically significant predictive relationship between perceived sense of effectiveness towards non-instructional factors related to the science-based CTE courses and final cumulative high school GPA.

$H2_A$. There is a statistically significant predictive relationship between perceived sense of effectiveness towards non-instructional factors related to the science-based CTE courses and final cumulative high school GPA.

Theoretical Framework and Philosophy

To provide a backdrop of the current study, the theoretical framework includes social cognitive learning theories, constructivist philosophical viewpoints, and factors related to student perception. The framework presented here is a summary of the major learning theories, philosophies, and educational constructs related to the stated problem of the current study.

Social Cognitive Learning Theory

Social-Cognitive Learning Theory (SCLT), as defined by Bandura (1986), postulates that people learn in a variety of ways, including observing the outright actions of others or observing other individuals interacting in specific environments. The body of knowledge for effecting personal and social change is the central framework of the SCLT (Badura, 1986). Social learning environments play a major role on self-efficacy and self-regulation through direct interactions or observations of how others interact (Gredler, 2009).

Cognitive processes exert determinative influence on human behavior, as subscribed by models of the SCLT (Bandura, 2001). Academic motivation factors into how learning occurs at nearly all levels or stages in human development. SCLT postulates that motivation is dependent upon the individual's own perception of self-efficacy and observations of social behaviors or interactions within their environment

(Burney, 2008). Whether originating from extrinsic factors or intrinsically, motivation is necessary to demonstrate the desired ongoing response for learning to occur. CTE programs encourage social interaction between the learner and partnering professionals in the workplace.

Constructivism

The development and preparation of individual skills and knowledge is an active process where meaning is constructed from choices of vocational personality, values, interests, and life themes (Packard, et al., 2012). From a constructivist point of view, learning is an active process of organizing new information in the network of existing knowledge within the individual's mind (Lew, 2010). CTE programs promote constructive learning through the active engagement of students with professionals in the workforce and the presentation of new information not commonly associated with high school subject matter curricula.

Student Perception

Research over the last few decades found that more than 90 percent of high school graduates have earned credits from CTE courses (Bersudskaya & Chen, 2011). An increased autonomy provided to public high school students in selecting courses aligned with individual career interests promotes a higher satisfaction towards their educational experience. Student satisfaction plays a role in the perception towards the overall educational process and the development of self-efficacy towards specific content and skills learned (Taylor & Porath, 2006). The magnitude of preparedness reported by high

school graduates reflects their perceived satisfaction with their individual high school experiences and the instruction they received.

Individual perception of the world around us can be related to ones' own perceived abilities and experiences. The perception of ones' skills and knowledge is linked to their self-efficacy and constitutes one of four psychological theories that influence student intentions, leading to behavior regarding educational environments (Hirschy, et al., 2011). Research into efficacy is traced to Bandura's theory (1977) on how belief in a person's knowledge or skills influences the amount of effort put forth and self-perception in various social and professional capacities (Lee, Tice, Collins, Brown, Smith & Fox, 2012). Areepattamannil et al., (2011) examined science achievement in relation to student motivation, self-efficacy, and instructional practices of science programs and reported a positive correlation between perceived enjoyment of science and achievement.

Human satisfaction with their educational experience plays a role in various aspects of the human psyche, including educational attainment and career aspirations. Strong personal efficacy beliefs have the potential to create self-directed, lifelong learners, who possess the traits necessary for social, professional, and economic success (Smith, 2002). Perceived effectiveness of educational programs build upon ones' self-efficacy beliefs, and these beliefs have the potential to influence what we think, how we feel, choices we make, and our level of motivation to address problems, complete tasks, and pursue specific goals (Burney, 2008).

Definition of Terms

Career and Technical Education (CTE). Previously referred to as "vocational education", a broad approach by academic institutions to prepare students for workforce and postsecondary expectations aligned with specific careers (Friedel, 2011).

College and Career Ready. The level of preparation a student needs in order to enroll and succeed-without remediation- in a credit-bearing course at a postsecondary institution, or in a high-quality certificate program that enables students to enter a career pathway with potential future advancement (Conley, 2010).

Learning Standards. Guidelines established to align curriculum with content instruction in the American education system (National Center for Education Statistics, 2007).

No Child Left Behind (NCLB). Legislation passed in 2001, bringing about a multitude of policies for educational reform including increased rigor and standards-based curricula (Wallace, 2012).

Occupational Concentrators. Students who have completed at least two CTE courses in any of the 12 occupational areas listed by the U.S. Department of Education, National Center for Educational Statistics (Bersudskaya & Chen, 2011).

Perkins Grant. Federal funding for educational programs that offer at least one program of study aligned with a specific career, or vocational, pathway (Lewis & Stone, 2013).

Perkins Legislation. Federal legislation that provides financial support for educational programs that align instruction with academic standards, technical knowledge, and career specific skills needed to prepare students for postsecondary programs and emerging careers (Friedel, 2011).

School-to-work Transition. Phrase used to associate educational programs, developmental skills, or resources that increase learner exposure to workplace scenarios and facilitate the period of time in which an individual leaves academics and enters the workforce (Hutchins & Akos, 2013).

Self-Efficacy. Foundation of what people think about themselves, how they feel about themselves, how they make choices, and how they motivate themselves (Burney, 2008).

Social Cognitive Learning Theory (SCLT). A learning theory guided by the principle that reciprocity and various interactions among cognitive, behavioral, environmental, and physiological factors influence how an individual learns (Money, 1995).

Science, Technology, Engineering, and Mathematics (STEM). Academic program or curricula that emphasizes content and skills related to applied sciences, technologies, engineering, and mathematics (Tofel-Grehl & Callahan, 2014).

Assumptions

Instrument reliability and the validity of data collected is always a concern in research studies. One assumption is the Likert-type survey instrument employed for data collection purposes proves to be reliable and appropriate to measure the variables identified in the study. Statistical resources, such as Cronbach's alpha coefficients, are available to support arguments of scale reliability. In the same regard, an assumption exists that employment of a Likert-type survey instrument with an option for a neutral response prevents research participants from being forced to either agree or disagree with any of the specific statements posed within the survey. Another assumption is that no unknown variables exist that could influence the outcomes measured by the instrument.

Other assumptions exist regarding the honest completion of survey instruments used for research purposes, providing accurate responses to survey items with no influence of flawed memory, and the willingness of subjects to participate fully. Providing assurances of confidentiality served to support honest responses and an explanation of the purpose of the study justifies the importance of participation.

Scope

The scope of the current study focused the research on a specific population of individuals who have graduated high school after taking a minimum of two science-based CTE courses, while exploring factors related to the perceived effectiveness of CTE programs and the predictive relationship towards students' academic success, as measured by the self-reported final cumulative high school GPA. The quantitative methodology and descriptive survey design employed a Likert-type instrument to collect data to address the specific research questions. A Likert-type scale provides a range of responses to measure outcomes related to a variety of potential factors (Croasmun & Ostrom, 2011).

The narrow scope of the study was limited to science-based high school instruction; however, results can be generalized to larger populations that share similar curricular framework to those mandated by the Colorado Department of Education and CTE guidelines. Participants of the study were selected from a confined geographic area around Colorado Springs; although, CTE programs in high schools across Colorado have gained popularity and funding for such programs has increased in the last decade.

Limitations

Methodological awareness leads the researcher to recognize limitations within a study's design and findings; however, proper management of limitations can lead to extended validity (Reale, 2014). The limitations that existed in the current study are specified here. A priori power analysis was used to insure an adequate sample size was achieved to validate statistical results and research findings. Gathering a sufficient number of volunteer research subjects to complete the survey, from the relatively small geographic range, was a potential limitation. Only electronic surveys that are submitted complete were included for data tabulation and analysis.

Self-reported data presented the possibility for inaccurate or untruthful responses from research participants. The current study design included data obtained through self-reports, potential biases exist regarding the underlying relationships that research subjects align themselves with. Objective verification of underlying relationships that potentially promoted biased responses was not included in the current study design.

Additionally, science-based instruction varies from course to course and among teachers in various settings. Regardless of exposure to CTE instructional courses, the manner by which science-based content is presented and the non-instructional factors that students experience are not universal; thus, measuring the relationships between the perceived effectiveness of factors associated with CTE programs and students' final cumulative high school GPA is difficult to generalize to the larger population.

Delimitations

Only subjects who had graduated from Colorado high schools between 2013 and

2017, in the specified geographic region, and that are at least 18 years of age at the time of the study were candidates for the study. Additionally, only recruited subjects who completed a minimum of two science-based CTE courses, classified as "Occupational Concentrators", while enrolled in high school were candidates for the study. Blanket sampling of all potential subjects who fit the inclusion criteria served to address concerns regarding the potential for limited research data.

Although science instruction may vary from course to course and among various teachers, the State of Colorado Department of Education has established academic standards for science content and CTE courses approved for funding in public high schools are mandated to align instruction with expectations of skills and knowledge advised by local professionals within the workforce community. CTE programs aligned with Colorado Department of Education academic standards require instructors and directors to partner with local professionals who would serve in an advisory capacity. Advisory input limits variations in CTE instruction while ensuring content and skills taught align with industrial policies and workforce expectations.

Summary

Chapter 1 discussed the need to provide educational leaders in high school science programs with clear and descriptive statistical evidence into what factors are most strongly related to students' academic success, as measured by the final cumulative GPA. Failure to conduct the study results in further limiting educational leaders in maintaining the CTE status earned over the last decade as a progressive academic movement that better prepares students for school-to-work or school-to-school transitions. The target

audience for the specified study includes educational leaders, specifically those involved in CTE science curriculum design and instruction.

Chapter 1 outlined the significance of the current study for research, theory, practice, and educational leadership. The nature of the current study and the rationale for the research approach was provided to justify the chosen methodology and design to address the stated problem. Additionally, a theoretical framework was provided to align the study to social cognitive learning theory, a constructivist philosophical viewpoint, and the significance of student perception in education. Chapter 1 concludes with a definition of key terms, assumptions made by the researcher, an explanation regarding the scope of the study, potential limitations identified in the research design, and delimitations.

Outcomes from the study have the potential to provide a better understanding of relationships that exist between both instructional and non-instructional factors related to the effectiveness of CTE programs, as perceived by former students, and their final cumulative high school GPA. Quantitative research using a Likert-type survey instrument provides a cost effective and suitable method for collecting the necessary data to address the stated problem and answer the research questions.

The next chapter provides a thorough review of the literature relevant to the themes aligned with the research problem, methodology, and theoretical framework.

Chapter 2

Review of Literature

The purpose of the current quantitative predictive correlational study was to identify whether there is a predictive relationship between instructional and non-instruction factors of Science-based CTE courses and final cumulative GPA in high school students.

Chapter 1 provided an introduction of the research problem, including a background, a statement of the research purpose, the significance of the study to research, theory, practice, and leadership, a brief overview of the chosen methodology and design with research assumptions, scope, limitations, and delimitations.

Chapter 2 provides an exhaustive review of the current body of literature including a grouping of historical sources (published beyond five years) and modern research findings (published within the last five years). The following literature review provides supportive information on the theoretical framework aligned with the evolution of CTE programs, the significance of student perceptions of high school experience related to their self-efficacy and post-high school transitions, social cognitive learning and constructivism, and quantitative research methodology.

Title Searches, Articles, Research Documents, and Journals

The purpose of the literature review is to expand our understanding of the current literature in the field, set a broad context of the study, and justify the scope of the investigation (Boote & Beile, 2005). A comprehensive search of scholarly databases, such as ProQuest and EBSCOhost, served to identify seminal articles, academic reports,

thesis, dissertations, and books used in this review. Some of the key search phrases used for database searching included, "career and technical education," "student perception", "self-efficacy," "post high school transitions," "Likert-type research instruments", "social-cognitive learning theories," and "science instructional strategies". The literature included in the following review supports the need for the study described in chapter one.

Table 2.1

Identification of Key Search Themes and Number of Sources

Key Themes	Number of Sources
Vocational Education	4
Career and Technical Education	13
Student Perception	4
Self-Efficacy	13
Social Cognitive & Constructivist Learning	10
Post-High School Academic & Workforce Transitions	11
Science Curricula & Teachers' Instructional Practices	11
Leadership in Science Education	8
Research Methodology	11
Likert-type Research Instruments	6
Dissertations	4
Books	4
Total Number of Sources	99

Chapter Organization

The review of literature is organized throughout this chapter to address specific themes identified as essential to this study. A historical overview is provided to examine

the evolution of vocational programs, post-high school transitioning, science curricula and instructional practices, leadership trends in education, and the measurement of self-efficacy in educational settings. Each historical overview is followed by an examination of more current research aligned with the major themes related to the current study. A review of empirical research, current in the literature, aligned with measuring student perception and self-efficacy, and the contemporary status of CTE programs, provides a foundation for the relevance of this study in regards to the applied theoretical framework and contemporary educational practices. The provided literature review culminates with a detailed look into the quantitative research methodology employed in the design of this study and Likert-type surveys as an applicable research instrument.

Vocational Education

Historical Overview. The historic perspective of vocational education can be dated back to the turn of the 20th century as public education became the nation's best mechanism to assure citizens were prepared and motivated to participate in the workforce (Castellano, Stringfield, & Stone, 2003). In the simplest of terms, vocational education was historically focused on career skill instruction and practical education to prepare individuals for entry-level jobs that require less than a baccalaureate degree (Friedel, 2001). Vocational education programs have evolved from what they began as through numerous legislative policy changes and societal shifts.

Public funding for vocational education began with the passage of the Smith Hughes Act of 1917 and the occupational focus was for agricultural and trade occupations, with training for home economics (Lewis & Stone, 2013). Many policy

changes and reauthorizations of the original legislation that funded vocational education programs followed in the decades to come. A major shift occurred with the passage of the Carl D. Perkins Vocational Education Act of 1984. The Perkins Act was written with the intent to organize educational programs to prepare all students, including those with academic, socioeconomic or other handicaps, for paid or unpaid employment in the most needed American work markets (Friedel, 2011). Unlike previous vocational education legislation, a push was made with the passing of the first Perkins Act to ensure equal access to practical educational and vocational training programs, specifically for females, ethnic minorities, and individuals with special needs.

In the 1980s and 1990s, American education was grounded in preparing students for the transition into the workforce and legislation provided flexibility for funding to modernize programs with the focus of integrating academics and vocational prep education (Friedel, 2011). Core academic standards, performance measures, and technical skills were integrated into subject content areas with the purposes of expanding educational pathways. Beginning in the 1990s, federal legislation encouraged states and local education programs to increase student achievement through more rigorous content and career specific skills development for lower achieving CTE students (Levesque, et al., 2010).

As technological applications for learning and working exploded, along with Internet capabilities, societal demands for students leaving high school mandated new skills be integrated into the curricula. The School to Work Opportunities Act of 1994 partnered educational programs and employment opportunities for students acquiring

knowledge and skills in the nation's current skills shortage occupations (Friedel, 2011). After the passing of the School to Work Opportunities Act of 1994, American student attending public schools began gaining knowledge from both educational institutions and from industrial professionals to ensure what they learned was applicable to the real world they were about to enter.

Students who possess a high interest in a vocational program often have previously experienced some level of exposure to that career field or have family members who have been involved in a similar occupation. As a result, vocational programs embraced using broader occupational themes to promote interest, health occupations instead of nursing, or industrial production instead of welding (Plank, DeLuca, & Estacion, 2008).

The popularity of CTE programs in high school curricula has steadily increased over the last two decades. Strengths of modern CTE pathways include real-life connections, active-learning opportunities, repetition of skills development, and teachers with experience and expertise in the specific courses they teach (Casale-Giannola, 2012). Students are attracted to diverse educational opportunities and student interests are typically broader, rather than simply focused on only one occupational option. Research found that 90 percent of high school graduates in the American schools have taken at least one CTE course (Plank, et al., 2008).

At a time when education is the focus of discussion for policy makers and common core standards are pushed to insure graduates have a strong foundation of knowledge, CTE programs must compete for a place within the academic framework.

Educational leaders must ask, why are students choosing these pathways over advanced placed academic courses or general education tracks? Vocational learning settings offer some degree of student autonomy to select tasks and methods of learning to construct meaning and develop skills applicable to them individually (Plank, et al., 2008).

Gentry, Peters, and Mann (2007) examined student perception of individual experiences in both CTE and traditional high school education settings. Participants in Gentry, Peters, and Mann's 2007 study were unique in that they were dually enrolled in a CTE center for vocational education and took courses in a traditional high school setting, as well. Research findings suggest, "students generally spoke positively about their CTE center experiences and negatively about their general high school experience" (Gentry, et al., 2007, p. 382). A positive perception of the CTE setting revolved around student autonomy, self-pace of the curriculum, teachers who exhibited personal interest in the students, and an environment that offered connection to professionals with hands-on learning.

Gentry, et al., (2007) argued that negative views regarding vocational programs from previous studies (Cohen & Besharov, 2002; Gray, 2004; and Stone, 1993) are remnant of past educational policies and that modern perceptions have improved since approximately 60% of CTE students are now entering some form of postsecondary education.

The biggest shift in vocational education came in 2001 after the No Child Left Behind (NCLB) initiative caused major educational reform. Before the NCLB legislation was passed, most programs designed to focus on vocational development did so with the

intent to prepare students to enter the workforce shortly after graduating high school (Plank, et al., 2008). Subsequently, the Carl D. Perkins Act of 1984 was reauthorized in 2006 and renamed the Career and Technical Education Improvement Act (Custable, 2013). Beginning in 2006, the newly renamed Career and Technical Education (CTE) programs were charged with ensuring academic standards were not compromised when vocational skills were established as the foundation of course designs.

Current Literature on CTE Programs. Lower achieving students, or those needing direction into how they might transition into the workforce, typically comprised the highest population of students enrolled in CTE programs (Wallace, 2012). New reform policies forced experts in education and legislators to finally recognized the need to prepare vocationally tracked students for both work and for postsecondary education opportunities (Wallace, 2012). An increased level of academic rigor and the alignment of content in vocational courses to specific postsecondary pathways is now mandated and tracked by program directors to maintain federal funding.

Federal legislation passed after 2010, mandated that states receiving federal funding track the academic achievement, military involvement, and career outcomes for all students enrolled in CTE pathways (Colorado Community College System, 2014). Not all students who take a CTE course while enrolled in high school require tracking. In Colorado, the number of courses high school students enroll in and an expression of occupational interest define the Program of Study (PoS) classification of students exposed to CTE pathways. The Program of Study concept, introduced by the Perkins IV reauthorization in 2006, serves to guide students and educators alike in the specific

technical and academic skill required to obtain credentialing and transition to a postsecondary program (DeFeo, 2015). Defining who is a CTE participant, or "concentrator", in a specific PoS is typically based on the number of CTE courses necessary to build the primary skills required for workforce or postsecondary success in a given career cluster, or pathway (Aliaga, Kotamraju, & Stone, 2014).

Sixteen designated career clusters were nationally recognized within the Perkins IV, 2006 reauthorization legislation (Custable, 2013). Career clusters included studies in architecture, business, education, finance, health services, law, human services, and Science, Technology, Engineering, and Mathematics (STEM), to name a few. Each career cluster focuses on a specific occupational pathway with opportunities for students to pursue career options with a framework to link the knowledge and skills necessary for employment or further education (Jankowski, 2008). Thus, "CTE has evolved from its initial focus on agriculture and trades and industry for boys and homemaking for girls to a broad array of programs of study linking secondary and postsecondary technical programs with current and emerging demands" (Friedel, 2011, p. 51).

Current changes in educational frameworks include the establishment of career and technical schools, career specific student organizations, or clubs, and partnerships with local industries to provide students real-world experience. Career and technical high schools, or votech schools, are designed to assist students who want to focus on specific vocational skills while pursuing the requirements for high school diploma (Casale-Giannola, 2012).

Career and Technical Students Organizations (CTSO), such as Future Business Leaders of America (FBLA), Health Occupation Students of America (HOSA), and Technology Student Association (TSA), provide another way to engage career-focused students while they are pursuing aligned educational knowledge and workforce skills (Colorado Community College System, 2014). Colorado also requires high school programs, that receive federal funding, establish opportunities for students to participate in job shadow, apprenticeship, and internships with local industry experts who partner with CTE educators as program advisors. High school students participating in off-campus opportunities receive relevant information and skills that is otherwise unavailable in traditional classroom learning environments (Alleman & Holly, 2013).

In the early years, vocational courses focused on family and consumer science, and general labor market preparation (Plank, et al., 2008). Currently, the National Center for Education Statistics (NCES) uses the Secondary School Taxonomy to categorize CTE into 3 major categories that are then further divided into 21 different occupational areas (Bersudskay & Chen, 2011). Occupationally focused skills and knowledge taught within high school CTE programs have evolved to include business, communication and design, computer and information sciences, engineering technologies, health sciences, marketing, and public services, to name a few.

The Colorado Department of Education in conjunction with the Colorado Community College System credentials CTE programs and educators in one of 6 different career clusters (Colorado Community College System, 2014). Each career cluster promotes continued preparation of high school students for postsecondary

academic rigor and workforce skills. The most fundamental component of any Career and Technical Education (CTE) program is the development of employability and technical skills to help transition students into adulthood (Loera, Nakamoto, Joo Oh, & Rueda, 2013). Positive and applicable learning that gives students autonomy in the field of study is the current trend in secondary education. Hutchins and Akos (2013) found that students who attend schools where comprehensive career development programs are offered are more likely to experience a positive and realistic expectation about their future.

Motivational factors influencing students to enroll in any of the various CTE pathways have additional influence in individual success. Both intrinsic and extrinsic motivation plays a central role in modern education reforms (Areepattamannil, Freeman, & Klinger, 2011). Individual students' interest in subject content, exposure of students to cognitively engaging activities, and real-world application of skills are all factors that promote motivation in CTE programs.

The National Research Center for Career and Technical Education (NRCCTE) has partnered with the Association for Career and Technical Education and the National Association of State Directors of Career and Technical Education Consortium to help change the perception of CTE and broadened legislators' and educators' perspectives regarding what constitutes "college and career ready" (Lewis & Stone, 2013).

Post-High School Transitions

Historical Overview. Research studies into post-high school transitions are common and extensive in published literature (Bersudskaya & Chen, 2011; Brown &

Hirshman, 2006; Fromme et al., 2008; Miller & Gray, 2002; Packard et al., 2012; Smith & Zhang, 2009; Tillman, 2005; Venezia & Jaegar, 2013). Federal policy makers have historically aligned success at the secondary educational level with the preparation of graduating students for full-time employment in the workforce and postsecondary education (Miller & Gray, 2002). The focus of this particular section within the literature review is on the impact of specific educational programs, like CTE, regarding student transition into adulthood and the various influences on students' sense of preparation after high school.

Performance and outcome measures are mandated to ensure goals and expectations are met for educational programs receiving federal funding (Miller & Gray, 2002). The reauthorization of the Perkins Act in 1990 required states conduct assessments on student performance and outcomes (Friedel, 2011).

Historically, not all students have had equal opportunity to programs that would adequately prepare them for post-high school opportunities. Brown & Hirschman (2006) argued that although official discrimination within public education ended in the 1960s, other subtler discriminatory actions have remained. Many factors play a role in students' self-perception regarding whether or not they are capable to go to college or to pursue a particular career path. Ensuring educational equality in opportunities presented to high school students from the 1950s through the 1970s was hard pressed since most minorities faced deep rooted social and, to some degree, economic disadvantages that could not be addressed by policies such as affirmative action alone (Brown & Hirschman, 2006).

In the 1970s, colleges began collaboration efforts with high school administrators and counselors to offer credit-based transition programs; however, most of these programs were directed towards accelerated students, only (Fowler & Luna, 2009). Credit-based transition programs, or concurrent enrollment courses, were not often offered for vocational students who were not on track to transition into a college program after graduation. Along with concurrent enrollment courses, Advanced Placement (AP) courses and International Baccalaureate (IB) programs have expanded throughout the American educational system over the past few decades as means to promote rigor and preparedness for student preparation and transition into postsecondary courses (Peters & Mann, 2009).

Hattie (1992) and Byrne (1996) found that measures of academic achievement are associated with strong measures of self-belief. Transitions require a level of adaption to new environments and students who have experienced prior success typically have shown to possess strong levels of self-efficacy in performing specific tasks related to those experiences (Silverthorn et al., 2005). High school education has not always placed a priority on developing self-belief in graduating students. However, research has continually shown that students who are transitioning from high school, either into the workforce or into postsecondary programs, must have developed some level of self-belief, or self-efficacy, in order to persevere (Taylor & Porath, 2006).

Career and Technical Education programs provide high school students skills and training necessary to transition into the workforce, active military branches, technical college programs or other postsecondary institutions (Tillman, 2005). Tillman (2005)

conducted a study that investigated employment satisfaction among CTE program graduates in various occupational groups. Reforming academic programs to promote preparation in workforce and postsecondary demands is necessary to ensure student satisfaction with their educational experience.

The 1990s saw reform in education through the passing of federal legislation authorizing more funding for secondary education programs, like CTE, that placed greater emphasis on measuring career-related competencies along with academic achievement in graduating students (Castellano, et al., 2003). Since the turn of the century, funding has continued to increase for various educational programs that focus on increasing rigor and modifying instruction to better prepare students for expectations after high school (Aliaga, et al., 2014).

Miller and Gray (2002) suggested that high school Tech Prep programs are similar to Career and Technical Education programs as it also promotes occupationally driven courses, along with advanced math courses and applied science courses, to prepare students for life after high school. Preparation for technical careers, especially those involving science, often takes the most time and dedication if students wish to transition into these highly competitive programs right out of high school. International Baccalaureate, Advanced Placement, and Concurrent Enrollment programs have a long-standing reputation as options for accelerated high school students to earn college credit and prepare for the postsecondary transition (Peters & Mann, 2009).

Social Influences on Post-High School Transitions. Historically, students who have a strong support system and have developed the necessary coping skills to overcome

stresses and obstacles are likely to better handle the transitions they face after high school (Gredler, 2009). Smith and Zhang (2009) discussed various social influences on the transition from high school to college and concluded that mothers were reported to have the greatest positive influence on students' transition from high school to college; while father, peers, high school guidance counselors, and college academic advisors sequentially providing the least supportive influence. Expectations to succeed, and the value that individuals place on their own success, play an important role on levels of motivation to engage in specific behaviors or activities related to ones' achievement (Gredler, 2009).

Another influence on transition from high school to postsecondary programs has been a growing shift from the traditional seven course day schedule to some form of block scheduling. The last decade has seen an increase in block scheduling instituted in public high schools throughout the United States (Imbimbo & Gilkes, 2009). Block schedules typically consist of class periods lasting from 60-120 minutes each, resulting in fewer classes meeting in a given school day but increasing the amount of time for academic and social engagement within each class. Colleges require students manage instruction that often last for more than 50 minutes and classes typically do not meet every day (Duis, 1995). Familiarization with a similar scheduling format prior to college years has the potential to smooth the high school to college transition. Teachers have more instructional time in a block schedule system and past studies have shown that students establish closer relationships with teachers, make greater academic strides, and

have fewer discipline problems than students in schools using traditional schedules (Imbimbo & Gilkes, 2009).

Current Literature on Post-High School Transitions. President Barack Obama approved a reauthorization of the Elementary and Secondary Education Act, in 2010, in which he argued that the American education system must ensure all students graduating from high school are college or career ready (Custable, 2013). College and career ready is currently a designation associated with students who are equipped with the level of knowledge and skills necessary to succeed in credit-bearing courses at the college level or students who are enabled to enter specific career pathways through the completion of high-quality certificate programs (Conley, 2010). The Bureau of Labor Statistics (2009), reported that projections for science and technology related careers were among the fastest growing in America through 2018. Research conducted by Snow and Okojie (2013) found that when properly implemented, CTE programs help students acquire employability skills and the academic knowledge to make them competitive when transitioning into the American or global workforce.

Whether preparing for the transition into postsecondary institutions or the workforce, high school students must prepare for various obstacles and be willing to experience circumstances beyond what they could have possibly been prepared for. Graduates from families without college experience, or with low-income backgrounds, are less likely to transition into college programs immediately upon graduating high school (Packard, et al., 2012). Perceived deficiencies in post-high school preparation can be overcome through student support systems and alignment with autonomous and

diverse educational program opportunities (Kirby, Sharpe, Bourgeois, & Greene, 2010). Research found that high school students who have experience in relevant work programs prior to graduating possess adaptability towards their school-to-work transitions and ultimately their career goals (Packard, et al., 2012). Community partnerships with education professionals aid in the transition of high school students through services, activities, and social influences that create both formal and informal support networks (Alleman & Holly, 2013).

Science Curricula and Instructional Practices

Historical Overview. High stakes, or standardized, testing has been a part of the American educational system since the 1800s; however, holding schools and teachers accountable was not mandated by federal oversights until the 1970s (Longo, 2010). Educators have long had the challenge of designing instruction that meets the needs of their students and the expectations of our society at large. Lambert (2005) cited a study by Adams (1971), suggesting that the National Education Association recommended high school students take four 1-year science course physical geography, chemistry, biology, and physics in the early 1900s. Throughout the 20th century, testing policies were standardized across America to assess students' knowledge and proficiency in core subject areas (Longo, 2010). However, instructional practices were not significantly influenced by standardized testing practices until the late 1970s (Longo, 2010).

Instructional practices employed in traditional science classes have typically involved the use of teacher-centered practices including lectures, reading assignments from text, and memorization activities for key terms (Corcoran & Silander, 2009).

Progression in teacher professional development and high level educational research into best instructional practices caused changes in the way content was being taught in American schools. Goodnough (1998) explored adoption of multiple intelligence (MI) theory to modify instructional practices for a ninth-grade science class. MI theory represents a stance to science teaching and learning rooted in student-centered practices such as collaborative work and peer feedback (Goodnough, 2001).

In 2002, with the passing of the No Child Left Behind Act, that the standards-based movement began influencing the way curricula was designed and instruction was handled in American school systems (Aydeniz & Southerland, 2012). Whether or not legislative policies are having the desired effect on improving academic achievement throughout our schools has been a continuous and arduous debate for decades. Some researchers support educational initiatives like the standardized testing and curriculum designing. Corcoran and Silander (2009) suggested that the standards-based initiative has forced educators to include more rigorous preparation in their courses, which in turn has resulted in declining dropout rates, has raised academic standards for graduation, and has served to better prepare students for postsecondary level coursework. On the other hand, Aydeniz and Southerland (2012) found that nearly 60.5% of 161 middle and high school science teachers across America, did not support standardization initiatives to improve student learning.

Since the 1990s, the academic achievement, as measured by standardized testing, has increased among students participating in high school CTE programs, such as PLTW (Levesque, et al., 2010). Levels of motivation towards the learning process in various

science courses has historically been influenced by family background and prior academic success in a similar field of study (Nathan et al., 2010). Assessments support students' learning and, when used properly, can aid the teacher in improving instruction (Aydeniz & Southerland, 2012).

The National Science Education Standards (NSES) were designed to address common core courses like biology, chemistry, geology, astronomy and physics, they do not necessarily include measures of learning regarding integrated science course such as biochemistry or genetic engineering (Lambert, 2005). Scientific inquiry is near limitless and the continued expansion of scientific knowledge dictates that standards written in one year will be nearly outdated in the near future. Aydeniz and Southerland (2012) found when schools use standardized test scores as an evaluative tool for science teachers, the practice discouraged the inquiry-based instruction needed to provide instruction for career specific content and skills development.

Current Trends in Curriculum and Instruction. Modern academic programs, specifically involving non-traditional instruction and content now mandate that teachers go through curricula specific training, or professional development. One such program, Project Lead The Way (PLTW), has transformed curriculum to prepare modern students for Science, Technology, Engineering, and Mathematics (STEM) courses in college (Van Overschelde, 2013). The nationally recognized STEM curricula requires instructors to attend course specific credentialing training prior to facilitating the material to students. PLTW has grown into one of the most common pre-college curricula for engineering, technology, and biomedical sciences at the secondary education level (Nathan et al.,

2010). Pre-college programs have continued to increase in popularity with the aim to improve STEM education through the cultivation of effective practices and attractive curricula that traditional academic courses do not provide (Nathan et al., 2010).

Despite the limitations on science content aligned with state and national standards, more and more high schools are offering curricula that goes beyond the content, technological applications, and skills covered in common core courses. CTE curricula are more flexible and these courses are taught with a goal of overall career and college readiness for students rather than specific content that align with standards. College and career integration requires both academic and social adaptation skills (Hirschy, et al., 2011). The necessary skills needed for students to learn persistence and occupational preparation are not part of the normal academic standards commonly taught or assessed in general high school courses. "As the educational needs of our country change, so too must our curriculum in all disciplines" (Flanigan, Becker, & Stewardson, 2012, p. 27).

The National Research Council and the Next Generation Science Standards of 2012 provide clearly ambitious goals for student learning regarding science and engineering (Kloser, 2014). Learning through inquiry teaching practices and the application of technology is common in contemporary science classrooms. Technology is an integral part of modern society and the preparation of students to familiarize themselves with various uses of technologies is far reaching (Flanigan et al., 2012).

The influence of efficacy related to instructional practices and academic achievement has been researched more extensively in the last decade (Ceylan & Akerson,

2013; Corcoran & Silander, 2009; Siwatu & Starker, 2010). Consequently, many factors are now argued to play a role in how instruction is designed, technologies are used, and how information is delivered in academic settings. Kloser (2014) found that both the teacher's and the student's motivation to engage in scientific inquiry, their cultures, and the facilitated environment in which interactions between them takes place, all have influence on the effectiveness of any specific instructional practice.

Standardized testing is now a common approach to measuring student achievement and teacher effectiveness. Proponents of standardized testing argue that equity in learning is more common due to assurances that minimum academic competencies are being taught across the board (Aydeniz & Southerland, 2012). However, many science teachers struggle with the mandated and narrow focus of content within the standards. School systems that strive to hold teachers accountable through standardized testing measures encourage teachers to revert to traditional teaching methods, such as lecturing, which is in conflict with the purpose of achieving equity among diverse learners (Aydeniz & Southerland, 2012).

Ceylan and Akerson (2013) suggested that science teachers who have previous work history in the subject they teach will possess higher levels of efficacy themselves, and are more likely to adopt student-centered and inquiry-based instructional practices which leads to increased achievement in their students.

Science, Technology, Engineering, and Mathematics (STEM) instructors must face the difficult challenge aligning their instruction with outdated standards that are not career specific, popular to the common core. Instruction that focuses on isolated

concepts is no longer considered effective; rather, an integrated curriculum that promotes active cross-curricular and problem-based learning most closely aligns with modern academic standards (Asunda & Mativo, 2016).

Leadership Trends in Education

Historical Overview. Nearly a century ago, John Dewey argued that educational changes were a product of technological changes within society (Kilfoye, 2013). The American education capacity to develop innovative citizens plays a role in how our society competes within the global framework. According to Weber (2008) Dewey's educational theory grounded educational leaders in the notion that closer attention should be paid to the process of cognitive growth rather than subject matter content. The social-cognitive approach to learning emerged from the Deweyan model that considers habits of cognitive, affective, behavioral, and situational elements of growth (Pamental, 2010).

In the 1940s, the term *scientific literacy* began to be used in published literature to express the need of American schools to instill an understanding in our students of how scientific principles apply to economic, political, and social frameworks (Bybee, 2009). Historically, the dissemination of information and the application of knowledge to the larger world have been linked to the expansion of media and the use of technologies inside and outside the educational institution. Leaders in science education programs were charged with looking beyond the national or state standards and make choices based on what is best for preparing students for the societal demands of their time.

In the last decade, soft skills became an integral part of science education programs to prepare high school students for the expectations at the postsecondary level

(Harris & Rogers, 2008). Soft skills, such as individuals' work ethic, positive attitude, social grace, and willingness to learn, are not measured by modern academic assessments and are not aligned to the academic standards.

Bucznski (2010) predicted that future educational leaders in science education will be charged with building instructional capacity, engaging local communities, developing programs that promote 21st century workforce skills, and provide more training to support and retaining strong science teachers. Applications of modern technologies, inquiry-based learning techniques, encouraging public involvement in science programs, and ongoing professional development opportunities to train and retain quality science teachers are all options that educational leaders must consider to meet the ever-changing demands of the scientific community (Stock, 2010).

Current Trends in Educational Leadership. The role of educational leaders and educators alike, specifically in science content, is forced to change more rapidly to keep pace with the evolving demands of the modern workforce and higher academic institutions. School leaders' reaction to emergent technologies typically accompanies new pedagogical approaches (Kilfoye, 2013).

An increasing number of technology driven industries within the American workforce require education and training beyond the high school level (Aliaga, et al., 2014). Wahl et al., (2012) found a growing demand for academic institutions to incorporate soft skills to prepare students for training beyond high school, especially for students coming from technology oriented programs. Educational leaders must look at

pedagogical alignment and soft skills training to continue to adequately prepare students for the advancing societal and technological demands within the workforce.

Empirical Research on Perception and Self-Efficacy

Historical Overview. Over the last two decades, self-perception and efficacy has been extensively researched on individuals in various stages of education and findings continually suggest that a strong perceived sense of preparedness has a positive influence on academic success (Areepattamannil et al., 2011; Duncan, et al., 2013; Fan & Mak, 1998; Hseih et al., 2007; Lee, et al., 2012; Miller & Lambert-Shute, 2009; Phan, 2013; Silverthorn et al., 2005; Spitzer, 2000; Taylor & Porath, 2006).

Historically, as students transitioned from one academic level to the next, more effort and resolve was required to attain individual goals. Students entering college typically associated academic success with one of two goals, academic performance as measured by GPA and career development (Spitzer, 2000). Promoting self-efficacy starts with demonstrating a strong sense of belief, passion for the learning process, ones' ability to self-regulate, and preparation on the part of the instructor. Self-regulation involves control of available resources, such as time and distractions, active engagement in learning strategies, such as processing, organizing and rehearsing knowledge, and awareness of motivational beliefs, such as efficacy (Spitzer, 2000). "Self-regulation refers to the degree to which students are metacognitively, motivationally, and behaviorally active participants of their own learning process" (Kitsantas et al., 2008, p. 42). Both time management and metacognitive learning strategies influence students'

ability to handle workload, pace, and academic rigor, contributing to overall academic success (Kitsantas, et al., 2008).

Positive relationships between the learner and those facilitating knowledge or skills development have long been found to be central to the human condition. Teachers who can establish positive relationships and make learning enjoyable to motivate student participation will have significant influence on student self-efficacy and consequently increase student achievement (Areepattamannil et al., 2011). In (2005) Gaunt and Palmer conducted a study of 451 students from seven different school districts, findings suggested that 80% of CTE students felt their instruction was adequate to prepare them for college. Additionally, educators who promote hope in their students' ability to reach instructional and personal goals will promote motivation that directly aligns with increased success.

Educators wanting to keep their students' attention and promote engagement in course curriculum have always had to find new ways to teach old content. Gentry, et al., (2007) cited the National Research Council as describing the pedagogical strategies used in CTE programs as a method of learning through inquiry with hands-on learning and process skills development that aligns with the National Science Education Standards. CTE educators cannot use textbooks, policy and procedures manuals, or outdated lectures to relay information on job related tasks.

Teaching to the needs of the modern generation requires content and skills be introduced using interactive activities, collaboration, and problem solving components that motivate and challenge the learner. CTE educators need to learn to overcome the

constant barrage of distractions that their students now face. Teaching hands-on learning practices where the content and skills taught are relevant to real-world situations allows the instructor to play a crucial role in promoting productive learning experiences and discourages students from distractions (Areepattamannil et al., 2011).

As diversity among students in the public-school systems and in higher education institutions continued to grow, researchers have continued to examine influences on student achievement and goal attainment (Alkharusi et al., 2014; Hsieh et al., 2007; Kitsantas et al., 2008; Orange & Ramalho, 2013; Spitzer, 2000; Vuong et al., 2010). A range of factors influencing self-efficacy among high school and college students have been researched and identified. Studies by Adelabu (2008) and Phan (2013) argued that an individuals' determination to reach their goals is a stronger predictive factor for academic achievement at the high school level than any other influencing factors. Teacher assessment practices, students' perception of instructional practices, students' GPA, self-regulatory behaviors, class participation, and social support are all positive predictors of academic self-efficacy (Taylor & Porath, 2006).

Current Research on Perception and Self-Efficacy. Phan (2013) reported clear evidence showing a link between efficacy in the teaching style and the effectiveness of the learning processes to reach desired outcomes. CTE educators are now facing an annual shortage and training in the latest technology and pedagogical techniques that current research has shown to be essential to promote self-efficacy in how educators competently engage students (Duncan, Cannon, & Kitchel, 2013). While CTE educators may structure courses in a way to promote self-efficacy in their students, it is the ability

of the instructor to actively engage each unique individual that will determine the overall ability to promote a sense of success when it comes to learning the material. Teachers' perspectives, self-perceptions, and self-beliefs can be a strong predictor as to how successful their instructional practices and classroom management will be (Lee et al., 2012).

Effective instruction is the hallmark of a successful education program and all students deserve effective teaching (Lee et al., 2012). Teaching preparation programs are tasked with preparing educators for the diverse population of students they may encounter. CTE educators are unique in that most have previous experience working in the occupational field they are credentialed to teach. CTE educators must possess the belief that they are capable of helping students prepare for the rigors of the workforce or postsecondary schooling.

The challenge is providing former workplace professionals with knowledge regarding pedagogical techniques to integrate sound teaching practices with their experience and background in workforce skills. Assigning teacher candidates to highly qualified in-service teachers is an integral part of promoting self-efficacy in the teaching profession (Lee et al., 2012). Observing other teachers who have experience in managing classrooms and structuring lessons can benefit new CTE instructors who have little or no experience in a similar setting.

Survey Instruments for Perception and Self-Efficacy. Likert rating scales were developed in 1931 by Rensis Likert as a means of collecting quantitative data to assess attitudes of research subjects (Croasmun & Ostrom, 2011). Likert-type scales

have historically been used with a wide range of responses to any single statement or a series of statements. Typically, Likert scales are used to measure responses in a range from strongly agree to strongly disagree and the inclusion of a neutral response is often debated as beneficial or not. "By giving responders a neutral response option, they are not required to respond one way or another on an issue and this may reduce the chance of response bias" (Croasmun & Ostrom, 2011, p. 20). The number of scale points included can vary greatly depending on the preference of the researcher, structure and number of statements, and the expected outcome, or hypotheses being tested. Matell and Jacoby (1971) found that the number of scale points included in Likert-type instruments did not affect the overall reliability and validity.

Likert surveys follow an ordinal scale structure with resulting data classified in ordered categories (Black, 1999). However, due to the perceived low level of ordinal data for inferential purposes, structuring survey instruments using intervals rather the orders add a level of appropriateness for the use of quantitative studies and statistical inferences.

Bandura (1986) argued that self-efficacy is best measured when it is being assessed for both magnitude and strength of self-perception. Traditional researchers often used focus group interviews from diverse populations to measure social self-efficacy (Fan & Mak, 1998). Traditional researchers were faced with cost and efficiency issues when collecting social data across cultural boundaries and larger geographic boundaries. Classical reliability analysis supported arguments that Likert-type measurement scales and traditional measurement formats for self-efficacy have similar

psychometric properties and Likert scales offer researchers an acceptable alternative to traditional interview formats for studies regarding general academic self-efficacy (Maurer & Pierce, 1998). Likert-type survey questions were adopted by researchers as useful tool to measure items of a single construct due to its' closed question format. However, Maurer and Pierce (1998) found that a properly worded Likert-scales can be used to measure multiple factors and have similar reliability to traditional forms of measurement, specifically for self-efficacy.

Wood and Locke (1987) measured self-efficacy magnitude and strength by simply asking participants to answer yes or no to questions regarding their academic skills or abilities to complete tasks. More modern research found that answering survey questions require a series of processes that involve judgments founded on multiple cognitive decisions and reflections of previous experiences (Shulruf, Hattie, & Dixon, 2008). Respondents to question must understand and be able to make interpretations about what they know or how they feel regarding the content within the specific question or statement. Whether or not statements within any Likert-type items are positively or negatively worded has influence on how the statements are perceived. Alexandrov (2010) found that human research subjects have a tendency to lean towards a higher level of any measured when items within a Likert-type scale are positively worded. Rapid advances in social capital research forced higher education researchers to develop and validate instruments that were more efficient and equally reliable (Wang, Chen, Gong, & Jacquez-Tiura, 2013).

Perception and Self-Efficacy Among Transitioned Students

Historical Overview. Fan and Mak (1998) found that absence of social difficulties, social confidence, shared interests, and friendship initiatives all influence social self-efficacy in undergraduate students. During early college years, students engage in numerous social activities. Postsecondary students learn from a variety of instructional practices and environments. Academic and social programs that employ social learning structures are most effective in supporting positive influence on student social self-efficacy (Money, 1995).

Vuong, Brown-Welty, and Tracz (2010) found a strong correlation between self-efficacy and academic performance at the post-secondary level, as measured by GPA. Additionally, Vuong et al. (2010) argued that self-efficacy serves as a mediator to other influences for academic success; such as, motivation towards learning, class participation, and the establishment of strong social support systems. Educational environments can be designed to promote student motivation and interaction; however, students' belief about their own abilities plays an important role in the level of engagement and persistence towards reaching goals that individual students will exhibit.

Current Research on Transitioned Students. Contemporary students leaving their home environment and transitioning into adulthood face challenges unique to their specific developmental period and the level of self-efficacy they possess has tremendous influence on their ability to handle new challenges presented during this time period. Orange and Ramalho (2013) researched self-efficacy in relation to self-regulatory behaviors and found that postsecondary students who exhibited high self-efficacy tend to

use more self-regulatory skills and have higher achievement; therefore, they decrease the likelihood of needing to take remedial classes. If students have a low sense of preparedness, or low perception of their academic abilities they are likely not to regulate their actions and efforts towards success at the postsecondary level (Orange & Ramlho, 2013).

Modern educational leaders are expecting teachers to develop and employ classroom assessments that are aligned with national or state standards, and recommendations of experts in the field (Alkharusi, Aldhafri, Alnabhani, & Alkabani, 2014). Academic achievement remains linked to student GPA and the variety of means to measures individual achievement is often determined by the preferences of the instructor. Despite efforts by educational leaders, teachers are still employing assessment techniques that are less engaging to students, such as multiple choice tests, while project based assessments have been proven to be more effective at measuring student achievement (Alkharusi et al., 2014). Project based assessments require students to self-regulate and to collaborate with others to reach goals established by the instructor.

Students who possess a higher level of self-efficacy use more self-regulatory skills, in turn promoting higher academic achievement on most assessments (Orange & Ramalho, 2013). Students' belief that they possess a particular skill or degree of knowledge may influence their effort and resolve towards acquiring more knowledge or skills (Gaylon et al., 2012).

Theoretical and Conceptual Framework

Historical Overview of Social-Cognitive Learning Theory. Albert Bandura emphasized learning through social context, observations of behaviors, and interactions that align with the development of self-efficacy, at its' root (Gredler, 2009). Martinez (2010) described learning and the process of gaining knowledge through social, environmental or professional influences. Cognition is the process of thinking to connect the influences, from viewpoints, understand concepts, problem solve and create (Martinez, 2010).

Other influential individuals in the development and understanding of SCLT include Allport (1920), Festinger (1950), Tajfel (1971), and Weiner (1986). The role of cognitive learning takes place in a social context with modifications of ones' own behavior being influenced by both prosocial and antisocial behaviors or interactions being observed (McLeod, 2007). An individuals' moral development, that is how they determine right from wrong, can also be influenced from observations made from a variety of interactions within their environment.

Historical Overview of the Constructivist Learning Philosophy. The principle belief of most constructivist revolves around the notion that learning is an active process that requires individuals create their own perspective, or viewpoint, regarding where new information fits or builds upon previous information (Martinez, 2010). According to Gredler (2009), personal, social, and philosophical are the three major areas of educational constructivism. Personal learning requires self-reflection and internal processing of data, social learning involves the exchange of information and observations

of others in the world around us, and a philosophical learning has no assumptions regarding the nature of knowledge, only that the learner is immersed in activities which promote growth. The most recent decades of research suggest that learning occurs through a series of individual or social constructs by actively organizing information gathered during activities or interactions (Ormrod, 2008). Martinez (2010) suggested that constructivist learning is not necessarily a theory rather it is a form of metacognition, or process of "thinking about thinking".

Educators have begun to recognize the value of collaborative work environments to promote constructive meaning through open discussions, debate, reciprocal teaching peer tutoring, and computer mediated technologies for communicative purposes (Ormrod, 2008). Since interactions and observations of others influence how individuals view the world around them, it is essential that learning environments be structured to promote positive interactions and productive discussions relevant to the content.

Research into SCLT and Constructivism

Historical Overview of Research. Twenty first century learning requires instruction beyond memorization and recalling facts, modern learning requires critical thinking, critical reading, and application of knowledge to real-world problem solving. The application of the Social Cognitive Leaning Theory and a constructivist philosophy to learning in various academic environments has been extensively researched in a variety of studies (Burney, 2008; Clinton & Rieber, 2010; Lew, 2010; Smith, 2002).

Smith (2002) explored the relationship between past performance, computer self-efficacy, outcome expectations, academic grade goal, and academic performance in

undergraduate students taking an information technology course. These variables are aligned with SCLT and the specific learning environment connects theory with a contemporary career. Arguments are made regarding the expansion of Bandura's (1986) social cognitive theory to include academic development related to career goals. Quantitative data collected and statistical interpretations used by Smith (2002) produced results that showed consistency in past performances and computer self-efficacy influences on academic achievement; however, outcomes did not show significant relationships between the other variables and academic achievement.

Burney (2008) examined the implications of SCLT to curriculum design and instructional experience in gifted educational programs. General school curricula is often geared towards the average learner and the effective use of SCT models is dependent on self-efficacy, environment, interactions with others, and reflections upon previous experiences (Burney, 2008). Stages of development influence the learning process as modeling observed behaviors tend to dominate early stages of development and eventually move towards self-regulation of learning through both observations and previous experiences. Like Smith (2002), Burney found that students need a strong academic foundation that promotes social interaction and self-regulatory behaviors to achieve academically.

Constructivist teaching practices are the cornerstone of science education, which do not ascribe to any particular instructional strategy (Lew, 2010). Some of the constructivist teaching practices outlined by Lew (2010), include encouraging and accepting student autonomy, student driven lessons, allowing time to reflect and critically

think through problems, and asking thoughtful open-ended questions. Lew reported on one aspect of a larger study that explored student and teacher perspectives regarding constructivists teaching practices in science courses at the secondary school level. Lew's findings were in contrast with generalized findings from the larger scale study in which it is a part. Reports from the larger scale study found that new science teachers reverted back to teacher directed instruction when encouraged to use a constructivist approach; however, Lew (2010) found that new science teachers participating in teacher preparation programs held on to constructivist instructional practices and expressed comfort with its' applications. Furthermore, science students preferred constructivists teaching practices over the more traditional teacher-driven instruction (Lew, 2010).

Constructivists learning and teaching practices can apply to adult learners, as well. Studio curriculum is an example of a constructivist learning model that has been employed at the university level. Clinton and Rieber (2010) examined the research efforts, student evaluations and comments regarding the unique approach of Studio curricula implemented over 10-years at university in southeastern United States. Studio curriculum promotes multiple course sections taught by a collaborative team of instructors who meet with students successively in the same learning space (Clinton & Rieber, 2010). The constructivist approach to Studio curricula is evident in the increased student autonomy, student driven instruction, and advanced skill applications that progress as students move through the curriculum. Clinton and Rieber (2010) concluded that the constraint of the traditional "one-course/one-instructor model" of learning

prevents innovative applications of more contemporary learning theories using constructivist epistemology for most environments involving adult learners.

Current Research into SCLT and Constructivism. Research into cognitive psychology and disciplined-based education has fueled a growing body of evidence to push a national reform promoting instructional activities that move away from the didactic lecturing approach towards direct engagement that actively constructs knowledge (Hora, 2015). Arguments by Bachtold (2013) suggested the root of constructivism aligns with the psychology of cognitive development and epistemology. Despite the acknowledgement of the relationship between cognitive learning and epistemology, modern researchers often fail to define the instructional behaviors specific to passive versus active learning mechanisms. Hora (2015), defined "active", "constructive", and "interactive" learning modalities to increase the validity of findings, with the aim of advancing the manner in which teaching and learning can be studied in naturalistic settings.

Transformations in the way educators are presenting content and managing social interactions in learning environments can be seen as a driving force to reform the mechanism by which students are assessed. Grounded in a social constructivist point of view, research conducted by St. Onge, Chamberland, Levesque, and Varpio (2016) found that performance based assessments provide evaluators a more flexible means of interpreting cognitive and skills growth.

Studies investigating learning and collective knowledge construction through social media resources has dramatically increased in recently published literature

(Kimmerle, Moskaliuk, Oeberst, & Cress, 2015; Marshall & Thorburn, 2014; Mingle & Adams, 2015). Academically, social media networks serve as a forum for students to delve deeper into content, participate in community discussions, practice communication skills, and aligns with social cognitive learning by providing an opportunity for students to develop an appreciation for other viewpoints (Mingle & Adams, 2015). Marshall and Thorburn (2014) suggested, studies exploring personal and social education modalities follow educational practices that build on previous work done by John Dewey and Paulo Freire. Carefully planned educational activities that involve interaction and collaboration within Internet mediated social networks promote intrinsic motivation and personal interest for a more active and constructive learning process (Kimmerle, et al., 2015).

Review of Methodological Literature

Choosing the appropriate research instrument, or measurement tool, is critical when collecting data to be analyzed for statistical significance. While most qualitative methods deal with exploring phenomena of social patterns and attempting to explain a series of events or occurrences, quantitative research methodology identifies and describes patterns using numeric values and deductive logic (Salehi & Golafshani, 2010). Quantitative tools relevant to comparative analyses reduce complexity in data to allow the target audience to see similarities and differences, as well as improving the ability of researchers to make generalizations in their findings (Reale, 2014). Quantitative research methodology allows for the use of an instrument, or tool, to measure identified variables and perform statistical analyses.

Whether for true laboratory experimental situations, where cause and effect are

measured, or for correlational studies, research into the social sciences most often collect data that is inherently quantitative in nature (Simonton, 2003). According to Barnham (2012), the popularity, or shift, towards online research is now aligned with quantitative methods of collecting data and is quite different than the qualitative research that has continued with conventional face-to-face experiences.

Historically, comparative research has been aligned with a positivists' worldview where empirical evidence is collected using objectivity, rationalism, and causality to verify general laws or evaluate social phenomena (Reale, 2014). Researchers observe phenomena in the world around them and attempt to make sense of their observations based on what is already known, or they attempt to form new theories to attempt to explain what they have observed. Higher education research studies that employ quantitative analysis have steadily increased due to advances in the statistical options available to researchers and the improvements in user efficiency and availability of precise computerized statistical software (Simonton, 2003).

The continued evolution and increased complexity of quantitative research methods employed in the social sciences has forced researchers to carefully consider their sampling technique, research question(s), and the target population they wish to generalize their findings towards. Gorad (2014) suggested that design errors, errors in recording and measuring data, and sample bias out to be considered regardless of how sampling occurred. The original research questions dictate what constitutes an adequate sample size and how difficult the task of contacting and collecting data from research participants was (Black, 1999). More and more researchers are employing ex post facto

designs; thus, it has become more challenging to justify the representativeness of the subject groups to larger target populations. Randomization of any research sample to protect against imbalance and bias is the best approach to promote validity of a study (Gorad, 2014). Black (1999) argued that researchers have the potential to create more valid results from relatively small samples that have been carefully selected, using a random sampling technique, versus a larger sample that is poorly chosen.

Review of Research Design Literature

Two of the most common ways to investigate the relationship between two quantitative variables are regression and correlational analyses (Bewick, Cheek, & Ball, 2003). Although regression and correlational statistics are often used together for quantitative studies, regression coefficients are slightly different than correlational coefficients as regressions imply causation while correlation does not. Researchers use regression to present relationships in the form of an equation and correlational methods measures the magnitude of the relationships between the variables (Bewick, et al., 2003).

Simple regression models, known as ordinary least squares (OLS), often require that the independent variable (x) be fixed values and only the measured criterion, or dependent, variables are free to vary (Ludbrook, 2010). Linear regression models are by nature designed to force a line that best fits the data; however, the independent variable must be fixed if the resulting equation is going to be of significant value.

Regardless of the number of variables identified by a researcher and involved in the design of any study, the main purpose of all regression techniques is to predict the influence or relationship between variables. Regression towards the mean is the original

principle by which Sir Francis Galton had originally described the principle of regression; meaning, the more times a variable is measured the closer the measurements align with the average (mean) score (Vogt, 2007). The idea is that the extreme scores of any data set will eventually move closer towards the mean of that sample if tested on multiple occasions.

Conclusion

CTE educational programs have dramatically evolved since the inception of vocational education programs, nearly 100 years ago, and the diversity of students who benefit from such programs has expanded (Lewis & Stone, 2013). Educators in American high schools are familiar with shifts in practice and policy originating from political, economic, and social factors. Advances in technology have shaped the way American high school leaders have written curriculum and designed professional development to promote specific instructional agendas within the teaching community (Venezia & Jaegar, 2013). The Educational Amendment Act of 1976 provided an avenue for equal opportunity education across all public-school systems with the addition of gender equity and representation to a wide variety of vocational education pathways (Defeo, 2015). All students, regardless of background, are guaranteed equal enrollment opportunity in publicly funded educational programs, such as CTE. Vocationally mindful high school students align their chosen enrollment in available courses with specific career aspirations; however, limited knowledge about career specific expectations confounds student interest (Defeo, 2015).

Students of all ages must develop a self-belief in their knowledge and abilities to navigate through challenges and solve problems, self-efficacy is the level of belief in your own abilities (Areepattamannil, et al., 2011). Self-efficacy governs our individual actions, behaviors, aspirations, and the amount of effort we expend to complete assigned tasks (Phan, 2013). Social cognition is central to understanding self-efficacy and influences on individuals' perception of themselves. The social cognitive career theory (SCCT) emphasizes outcome expectations, self-efficacy and personal goals as influential variables that are relevant to human development (Smith, 2002).

Summary

The literature review provided in chapter 2 outlined the evolution of vocational education in American public school history and into the modern era. Research related to the influence of student perception on self-efficacy and student education towards their post-high school transitions were explored. Additionally, an overview of published literature on both historical and current trends in educational leadership, related to science curricula and instruction was provided. Further literature aligning the Social Cognitive Learning Theory and the philosophical viewpoints of Constructivism related to science-based CTE programs provided a foundation for the theoretical framework. Despite the variety of sources researched relating to the major themes in this literature review, no evidence currently exists in the literature regarding the strength of relationships between final cumulative high school GPA, instructional pace, instructional workload, academic rigor, and technologies employed in CTE courses and graduates' self-reported self-efficacy towards post-high school transitions.

Research into the role of vocational education, or CTE, in modern high school settings is not lacking in recently published literature. CTE courses and programs of study are increasingly popular among students from all backgrounds and at all academic levels. The popularity of science curricula in particular has been influenced through the promotion of occupationally driven courses offered in high schools. The types of CTE courses offered at the high school level continues to expand and can vary greatly from school district to school district. Both quantitative and qualitative research methodology has been applied to numerous studies regarding the effectiveness of CTE programs at various academic levels and survey instruments are commonly employed to collect data in research involving the measurement of student perception.

Chapter 3 follows with a presentation outlining the chosen research methodology and design to address the stated problem and answer the research questions. Specific details regarding the context of the research, research population and sample, ethics and confidentiality, the variables involved, instrumentation used to collect data, and data analysis, are provided in the next chapter.

Chapter 3

Research Methodology

The purpose of the current quantitative predictive correlational study was to identify whether there is a predictive relationship between instructional and non-instruction factors of Science-based CTE courses and final cumulative GPA in high school students.

Chapter 2 provided an exhaustive review of the current body of literature including a grouping of historical sources (published beyond five years) and modern research findings (published within the last five years). The literature review provided supportive information on the theoretical framework aligned with the evolution of CTE programs, the significance of student perception of high school experiences and towards their own self-efficacy, social cognitive learning and constructivism, and quantitative research methodology.

Chapter 3 presents a detailed overview of the research methodology and design, to include arguments supporting the appropriateness of the chosen approach and design. The research variables, population, and sample are described here.

Appropriateness of Research Method

Quantitative research applies to any study in which the goal is to use numeric data to describe or examine relationships among variables (Williams, 2007). Quantitative research methodology uses deductive logic to determine and describe social patterns from numerical values and statistical measurements calculated (Salehi & Golafshani, 2010). Two categories, experimental and nonexperimental, are included in quantitative research

methods (Kerlinger & Lee, 2000). Experimental research often involves the assignment of groups and the application of a specific treatment to examine differences within measured outcomes, while controlling certain aspects of the study (Kerlinger & Lee, 2000). Nonexperimental research does not lend itself to the application of treatments or the assignment of groups; thus, researchers of nonexperimental studies have little to no control over variables and simply make observations to quantify collected data (Kerlinger & Lee, 2000). The current study involves a post hoc treatment (exposure to science-based CTE courses while enrolled in high school) and control over the predictor variables aligned with the research problem and questions. However, the current study involves no comparison or assignment of groups or control over the manner in which the treatment was delivered.

The sample chosen for any study employing a quantitative approach must be carefully selected to insure validity of the results (Black, 1999). Priori power analysis provides a framework to insure the sample size included in the current study is adequate to correctly make assessments regarding the rejection of the null hypotheses. The statistical power reports the likelihood of a researcher to find a statistically significant relationship between the variables, if such a relationship actually exists (Balkin & Sheperis, 2011). Osborn (2013) suggested, a statistical power of .80 or higher is necessary to minimize the probability of a Type I error (failure to reject the null when no significant difference actually exists between the variables studied for the population). The effect size, alpha level, and sample size, all have influence on the resulting power of the study; therefore, a priori power analysis provides assurance that a sufficient number

of research participants are surveyed to provide an adequate amount of data to answer the research questions.

Researchers utilizing quantitative methodology are forced to consider bias in sampling, design errors of their study, errors in measuring and recording data (Gorard et al., 2014). Posttest only designs serve to remove arguments of reactivity among the subjects involved in the study and participants are typically grouped through an easily defined pre-existing circumstance. History, maturation of research subjects, and test effects are potential biases that arise from using pre- and post-test designs (Marsden & Torgerson, 2012). Collection of data from a carefully defined group and blanket sampling of all potential subjects at one point in time serves to remove some research bias and is consistent with a cross-sectional research approach.

Multiple regression analysis is a recommended technique for examining the strength of relationships that might exist between three or more variables (Gelman & Hill, 2007). Regression is an inferential technique commonly employed when researchers aim to answer questions related to what is the best predictor of Y, given the potential relationship to X_1, X_2, X_3 (Lofton, 2012).

Given the purpose of the study, the specific population, and the multiple variables involved, a quantitative approach, using regression techniques, is the most appropriate fit for examining the relationships the may exist between the identified predictors and self-reported final cumulative high school GPA (criterion variable).

Appropriateness of Research Design

The current study follows a predictive correlational design using a Likert-type survey instrument to collect numeric data from participating subjects, within a controlled population. Correlational research designs provide a benefit to researchers wishing to identify the level of relationships that may or may not exist between variables (Triola, 2013). A predictive correlational research design that uses regression analysis allows the researcher an opportunity to determine the strength of relationships that may exist and an equation that might optimally predict future relationships related to a particular phenomenon (Osborn, 2000).

Quantitative research surveys have increasingly become an online process where respondents complete the survey on their own time and in a comfortable environment, such as their home, where they are more likely to possess a positive attitude and more stable state of mind (Barnham, 2012). Commonly used in social and psychological science studies, Likert-type surveys help the researcher understand tendencies within a population (Black, 1999). Likert-type survey instruments have been extensively researched and literature exists to support this method of numeric data collection as an effective instrument in social science and self-efficacy related research studies (Croasmun & Ostrom, 2011). Surveys serve to describe the strength of natural occurring relationships between identified variables (Raines, 2013). Educational research employs survey instruments to examine relationships with the intent of improving instructional practices and informs professionals within the community (Knipe & Bottrell, 2015).

Research Context

The defined research context includes high school graduates from CTE programs within the Colorado Springs Metro Area. The geographic area of the study is defined as the region surrounding the city limits of Colorado Springs, including all school districts within El Paso County, Colorado. The geographic borders include Woodland Park to the west, Monument to the north, Fountain to the south, and Peyton to the east. Research participants must be 18 years of age or older and have graduated from the defined geographic region between 2013 and 2017. Additionally, the research population is limited to subjects who are categorized as "Occupational Concentrators" by completed a minimum of two science-based CTE courses while enrolled in high school. Obtaining permission for participants contact information (name and email address) from the participating school districts, located within the defined geographic range, is necessary and a signed PRN Permission form is maintained among other mandatory documentation for this study.

Population and Samples

Population

The population involved in this study included high school graduates, between the years of 2013-2017, who were categorized as "Occupational Concentrators" by completed a minimum of two CTE courses in a given pathway to meet Colorado graduation requirements. In the state of Colorado, any high school student who completes at least two courses within a single occupational program qualify as CTE students and are classified as "Occupational Concentrators" (Colorado Community

College Systems, 2014). High school graduates from the participating school district, who are 18 years of age or older, regardless of gender or ethnicity, could potentially have been sampled. CTE courses offered in public high schools align with the Colorado Department of Education (CDE) standards for graduation and count as content electives on student transcripts. A level above the population defined in this study would include all Colorado high school students enrolled in CTE programs.

Research participants were recruited from a list of graduates from a single organization, located in the Northeast corner of Colorado Springs, Colorado. Based on the inclusion and exclusion criteria, the total population of CTE students graduating between 2013-2017, from the participating school district, was 2,679. Among the total population, 1,491 graduates were classified as "Occupational Concentrators" in a science pathway.

Research Sample

The sample size was calculated using G*Power software whose advantage is that it takes into consideration the effect size and the power. A good estimate of the effect size results in the researcher being able to use a power analysis to support an adequate sample size (Osborne, 2010). G*Power yielded a sample size of 68 research participants as suggested for linear multiple regression with an effect size of 0.15, a power of 0.80, and two predictors. Therefore, a minimum of 68 research subjects from the specific population, graduating from a high school in the defined geographic range, would have met the sample size requirement of the study.

Contact information of potential subjects were obtained using an IRB approved form. The request form was sent to senior school district administrators within the defined geographic range, which included, but was not limited to, High School Principals, CTE Directors, Chief Education Officers, and Human Resource Officers.

The initial contact to solicit, or recruit, research participants from the systematically sampled list was made using subjects' last known email from their student file. The recruitment email contained a variety of information related to the study and a link to access the online survey instrument through SurveyMonkey, after reading and agreeing to the "Informed Consent".

The recruitment statement provided an introduction to the researcher, information about the study; to include the purpose and the nature of the study, and expectations of those who volunteer to participate. The "Informed Consent" was accessible on the first page of the SurveyMonkey link to ensure all participants were exposed to its' content prior to proceeding to the survey instrument.

The unit of analysis for this study is the individual participants, limited to only those members of the identified population, who completed a minimum of two science-based CTE courses while enrolled in high school and who graduated from the participating school district between the years of 2013-2017. Verification of the unit of analysis were made by employment of a filter question found in the introductory section of the survey, asking the participants of the study their history regarding CTE course completion during their high school careers.

Ethics and Confidentiality

Protecting the rights and personal data of all research participants is of utmost importance in social research studies. Confidentiality and privacy of research subjects are paramount in maintaining an ethical approach and meeting strict standards established by the U.S. Department of Health and Human Services and Institutional Review Boards (IRBs). "Confidentiality involves expectations of control over the dissemination of information about a person, whereas privacy involves avoidance of an invasion the person's body, space, or liberty" (Stiles & Petrila, 2011, p. 334).

Data retrieved from the survey instrument remains anonymous with only number identifiers thatl correlate to participants' survey response as created in SPSS (IBM SPSS, 2016). Accessing the SurveyMonkey web link provided the subjects the "Informed Consent" information on page one of the survey; continuation and completion of the survey following the "Informed Consent" served as recognition that the solicited research subjects had accepted the terms defined in the informed consent and were voluntarily participating in the study. All data relevant to this study, collected using SurveyMonkey, is considered sensitive and was protected by Secure Sockets Layer (SSL) encryption during the transmission process via the Internet (SurveyMonkey, 2015). The research design employed several safeguards to insure participants were treated with the respect and all personal information remained confidential. No personal identifiers were used during the data collection or reporting steps of this study. Documentation utilized for sampling and contacting research subjects were destroyed immediately after the data collection period had concluded. Storage of the relevant documentation and data from

this study is maintained for a period of 3 years after the conclusion of the study, at this point, documentation is destroyed.

Informed Consent

Assurance of human research subjects' privacy and safety are integral to the informed consent process. All potential research subjects had viewed the "Informed Consent" statement on the first page of the electronic survey instrument uploaded to SurveyMonkey. The consent documentation clearly described the purpose of the study, research subjects' status as a volunteer participant, expectations and length of commitment in participating, right to privacy of data, and right to opt out of the study at any time. Additional information outlined in the consent included potential benefits for educational leaders by participating and contact information for the researcher in the event any participants had questions or concerns regarding the study.

Research Variables

Predictor Variables

The predictors in the study were:

Instructional Factors. Perceived sense of CTE program effectiveness as measured in the influence of technologies used during normal course/lesson instruction, the pace in which content was presented, topics presented, stimulation of instruction, and the academic engagement of the content or skills taught. Likert scale: interval level of measurement.

Non-Instructional Factors. Perceived sense of CTE program effectiveness as measured by factors not directly associated with the instruction; such as perceived stress levels,

preparation for instruction, advanced courses, time for extracurricular activities, and individual career goals. Likert scale: interval level of measurement.

Criterion Variable

Cumulative High School GPA. Cumulative High School GPA consists of all courses enrolled in while completing the required course work to meet graduation requirements. Grade Point Average was reported using seven interval level of measurement [Below 1.50; 1.50-1.99; 2.00-2.49; 2.50-2.99; 3.00-3.49; 3.50-4.00; Above 4.00]. *Figure 1* below presents the research diagram.

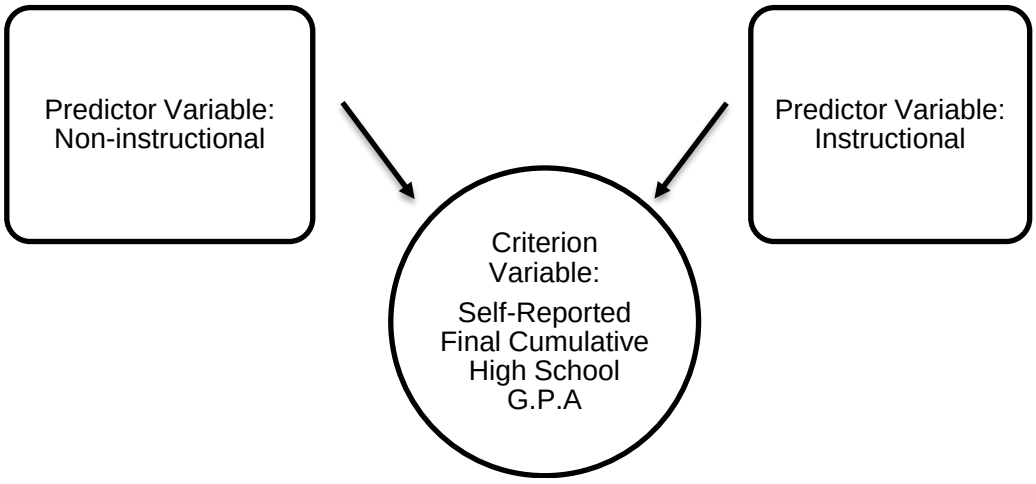

Figure 1. Alignment of research variables to the survey instrument

Research Questions and Hypotheses

The design of the current study employed numeric data to identify and predict relationships between two predictors related to the perceived sense of effectiveness of high school science-based CTE programs and self-reported final cumulative high school GPA. The following research questions and hypotheses serve to guide the current study.

The primary research question in the study is:

Does the perception of CTE program effectiveness predict academic success, as measured by final cumulative high school GPA?

RQ1. Is there a predictive relationship between instructional factors of Science-based CTE courses and final cumulative GPA in high school students?

$H1_0$. There is no statistically significant predictive relationship between perceived sense of effectiveness towards instructional factors employed within the science-based CTE courses and final cumulative high school GPA.

$H1_A$. There is a statistically significant predictive relationship between perceived sense of effectiveness towards instructional factors employed within the science-based CTE courses and final cumulative high school GPA.

RQ2. Is there a predictive relationship between non-instructional factors of Science-based CTE courses and final cumulative GPA in high school students?

$H2_0$. There is no statistically significant predictive relationship between perceived sense of effectiveness towards non-instructional factors related to the science-based CTE courses and final cumulative high school GPA.

$H2_A$. There is a statistically significant predictive relationship between perceived sense of effectiveness towards non-instructional factors related to the science-based CTE courses and final cumulative high school GPA.

Instrumentation

Measure of Outcome Variable: Self-reported Cumulative High School GPA

Graduates self-reported GPA was obtained using a single question on the survey instrument. The second prompt of the instrument measured self-reported cumulative high school GPA, added with an interval scale suggested by Reisig and DeJong (2005).

Measure of Program Instructional and Non-Instructional Effectiveness: The Reflections on High School Science Instruction instrument consists of 15 items, adopted and modified from a Likert-type survey used in a prior study conducted by Taylor and Porath (2006). Taylor and Porath (2006) used the original Likert-type survey instrument, with 20 items, to measure the self-efficacy towards college preparedness reported from high school graduates who were enrolled in International Baccalaureate (IB) programs. Permission to use and modify the original survey instrument was obtained from the original researchers. The instrument used a five point Likert scale ranging from "Strongly Agree" to "Strongly Disagree". Resulting from Exploratory Factor Analysis, two factors were obtained: Factor 1 - Perceived Sense of CTE Program Instructional Effectiveness (i.e. "Critical Thinking", "Instructional Topics", "Instructional Workload", and "Instructional Stimulation") with a Cronbach's alpha scale reliability coefficient of .857 and Factor 2 - Perceived Sense of CTE Program Non-Instructional Effectiveness (i.e. "Rigor Perception", "Course Perception", and "Transition Perception") with a Cronbach's alpha scale reliability of .807.

Field Test

The ultimate goal is to get relevant data that can accurately answer the research questions; therefore, the researcher makes every attempt to minimize the possibility of both random and measurement error (Litwin, 2013). Field testing the survey instrument serves to provide validity to the research study by allowing several professionals in the education community to assess the user-friendly nature of the survey structure, the amount of time needed to complete the survey, and general wording of each statement.

Four professional educators familiar with Colorado's high school CTE credentialing and pathway course work participated in the field testing of the survey instrument. The survey instrument was sent as an attachment via district email the participants of the field test were asked to complete the survey to provide feedback regarding the amount of time it takes to complete the survey instrument, an assessment of whether the survey instrument is user-friendly, and an assessment of the wording for each measured statement for clarity purposes. Participants of the field test reported that the survey took between four and eight minutes to complete and the structure is user-friendly; however, one of the educators who participated in the field test offered a few suggestions to clarify the wording of statements 2, 4, 7, 9, 12, and 15. The suggestions to clarify the wording were applied to the current survey instrument.

Appropriateness of Survey Instrument

Employment of a Likert-type survey provides a range of responses to a statement, or series of statements, that gauge the participants' attitude towards specific topics. Likert scales are more commonly used for research incorporating a survey design than

any other data collection instrument (Patterson, 2016). Standard intervals most commonly used for response to a Likert item includes "strongly disagree, "disagree," "neutral," "agree," and "strongly agree" (Patterson, 2016). Neutral response options incorporated into the Likert scale provide research subject the option not to respond one way or another, reducing the probability of response bias (Croasmun & Ostrom, 2011).

Data Collection

Data were collected electronically using SurveyMonkey, a secure, online survey platform. The first page of the survey presented the informed consent which the participants were prompted to read and agree to before moving on to the initial question(s) and measured statements. Approximately one week after initial email contact is made, a follow-up email was sent to solicit participation. The survey instrument was made available to participants for one month or until the minimum number of 68 participants was reached for the expected g-power and effect size of the given population.

Data Cleaning and Preparation

The possibility of missing, or incomplete data, in empirical research is more of the rule, rather than the exception (Jamshidian & Jalal, 2010). Data screening is best tackled through a step-by-step procedure of addressing missing values, dealing with univariate outliers, assessing assumptions, and checking for outliers (Meyers, Gamst, & Guarino, 2013). Dong and Peng (2013) argued, missing data introduces bias in parameter estimation, weakens the ability of the researcher to generalize the results to larger populations, and decreases statistical power, thus increasing standard errors. The online survey platform was designed to promote complete data sets by not allowing participants

to move on from each item until a response is recorded for the previous item. Thus, only completed surveys were included in the data for the current study.

Validity and Reliability

The research design calls for the use of a pre-existing survey instrument that had not previously been measured for reliability. The pre-existing instrument contains 20 statements utilized to assess self-efficacy related to workload, pace, rigor, and technology employed in IB courses; therefore, modifications required restructuring and rewording the statements to align with the identified population and variables of the current study. The modified survey instrument established whether or not the solicited subjects meet criteria within the controlled population by answering yes or no to an initial question related to the type of science instruction they receive while enrolled in high school. Only participants who meet the population criteria, of completing two or more science-based CTE courses while enrolled in high school, were included in the study. The survey was further condensed to 16 items, with the first prompt included to measure participants self-reported final cumulative high school GPA (Criterion Variable). The following 15 items included in the survey instrument followed a 5-point Likert scale to measure level of perceived instructional and non-instructional CTE program effectiveness among research participants.

The first step of the research design is to determine a sample size adequate to calculate a Cronbach's alpha coefficient, to determine instrument reliability (Wang, Chen, Gong, & Jacques-Tiura, 2014). Determination of reliability before using the research instrument ensures consistency and stability of the measurement over time and

across various items (Hazzi & Maldaon, 2015). Measuring a single construct using a scale composed of multiple items, with the goal of obtaining high reliability in a relatively few items, most closely aligns with the use of an internal consistency reliability test (Christensen, Johnson & Turner, 2014).

The use of Likert-type scales, that have not been previously employed and measured for reliability, necessitates the calculation and reporting of Cronbach's alpha coefficient for internal consistency reliability (Croasmun & Ostrom, 2011). Cronbach's alpha reliability coefficient of .75 or higher provides evidence that the instrument is acceptable at consistently measuring what it is designed to measure, while coefficients of .80 or higher indicates a very good reliability, and coefficients of .90 or higher indicates an excellent level of reliability (Wang, et al., 2013). For the current study, a Cronbach's alpha coefficient of 0.75 or higher was deemed acceptable to support the reliability of the current instrument.

Data Analysis

Data collected from the completed survey instrument was tabulated and analyzed using the Exploratory Factor Analysis (EFA) method, Principal Axis Factoring, a common statistical method used to identify underlying similarities between the measured variables within the construct (Kranzler & Pajares, 1997). The data were then treated using both descriptive and inferential statistics to examine potential relationships that may exist and predict future relationships between the identified variables.

Descriptive Statistics

Descriptive summary statistics were prepared to provide information on the central tendencies resulting from the data collected. The mean and range of resulting data scores for subject responses were the measures of central tendency provided. Measures of variability included the dispersion of scores of a distribution and these were reported as variance and standard deviation. The SPSS software program promptly provides descriptive statistics that are easily populated giving near instantaneous information regarding data frequencies. If selected, the analysis of descriptive statistic function provides a reference to data distribution that checks for normality, one of the major assumptions to be met regarding multivariate statistical techniques. If there is any doubt towards the parametric assumptions for testing, such as normal distribution, bootstrapping is available through the analyze-descriptive statistics-frequency tool.

Whether or not the data from the research instrument show heterogeneity of variance and forms a normal or non-normal distribution plays a role in predicting the probability of Type I and Type II errors (Zimmerman, 2014). The distribution of data also played a role in determining whether parametric or non-parametric analysis was most appropriate. Reduction of a Type I error (failure to reject the null when no significant difference actually exists between the variables studied for the population) was addressed by including a priori power analysis to insure a power of .80 or higher was achieved (Osborn, 2013).

Inferential Statistics

Exploratory Factor Analysis

Exploratory Factor Analysis (EFA) served as a critical component for identifying and re-confirming the construct structure to ensure the measurement accuracy in the analysis. Research notes a close association between factor analysis techniques and construct validity (Hayton, Allen, & Scarpello, 2011). Examination of potential cross-loads within the instrument construct helped to remove items and clean the resulting data for regression analysis. The decision to retain items and exclude others was important in factor analysis, as specifying too few factors results in the loss of relevant information; while, specifying too many factors often results in researchers focusing on minor factors at the expense of major ones (Hayton, et al., 2011). Thus, an exploratory factor analysis was performed on the predictors to re-confirm the structure of the constructs reported in previous research.

Multiple Regression Analysis

Researchers involved in quantitative studies use regression models more than any other statistical method to examine numeric data (Vogt, 2007). Regression analysis is employed for the sole purpose of providing a researcher a way to predict or explain a dependent variable (Y) if an independent variable (X) is known. Regression models are generally applied when researchers are attempting to predict an outcome of an investigation or to explain a phenomenon through the examination of multiple variables all at once (Osborne, 2010).

The goal is a stable regression equation that is representative of the population with an adequate representative sample of at least 15 subjects per predictor (Park & Dudycha, 1974; Pedhazur, 1997). When very little regression toward the mean is needed, the researchers can more accurately predict or explain the outcome measurement, or the dependent variable. If major regression toward the mean is necessary, the researcher is not very likely to predict the outcome with an acceptable degree of certainty (Vogt, 2007).

A few assumptions must be met to assure regression analyses are trustworthy, reducing the possibility of Type I or Type II error. Regression assumes that variables have a normal distribution, a linear relationship between the variables, assumptions about the homogeneity of variance (also called homoscedasticity), and reliability of measurements (Osborne & Waters, 2002). Various statistical techniques are available for researchers to test data skewness and kurtosis. Application of both histograms and a variety of tests of normality are acceptable to examine normal data distributions in research (Jamshidian & Jalal, 2010).

Assumptions Checked for Regression Analysis

- Normal Distribution of Data
- Homogeneity of Variance
- Reliability of Measure

In the current study, histograms and kurtosis or skewness testing served to examine relative normality in data distribution; while removal of outliers, as necessary, serves to reduce the probability of errors. The assumption of homoscedasticity was

examined using standardized residual plots available in the SPSS software program. In the event heteroscedasticity is indicated for a particular predictor variable, transformation of data were recommended to reduce the possibility of over estimating the significance of any relationships (Type I error). Subsequent calculation of Cronbach's alpha reliability coefficient of .75 or higher provided evidence that the instrument was acceptable at consistently measuring what it was designed to measure.

Summary

Chapter 3 includes a thorough description of the quantitative approach to designing the study and the general research methodology to address the research questions. Supporting arguments were provided for the appropriateness of the research design, the sampling and data collection techniques, and the chosen analytical approach to report statistical findings. At the beginning of the chapter, the purpose of the study was restated and the target audience most aligned with the research questions was identified.

The current study includes a predictive correlational design commonly used in social, psychological, and educational research studies. Only graduated high school students, who fit the specific criteria defined in the population, were included in this study and a survey instrument was used to collect data regarding the identification and predictability of relationships between two predictor variables and self-reported final cumulative high school GPA. All research subjects received the same survey instrument, administered online, to collect the necessary data for statistical analyses and to answer the research questions. The survey instrument used to collect data in this study was adapted

from a previous study conducted to examine the correlation between self-efficacy and International Baccalaureate (IB) programs in Vancouver, British Columbia. Permission to use and modify this survey instrument was obtained by the original researchers who designed it and modifications made were appropriate to align the survey with the research questions identified in this study.

The research questions provided the direction of the study and guided the research design. Analysis of the resulting data collected relates directly to the researchers' ability to describe the relationship between the identified variables.

The data and results of the study is presented in Chapter 4.

Chapter 4

Results

The purpose of the current quantitative predictive correlational study was to identify whether there is a predictive relationship between instructional and non-instruction factors of Science-based CTE courses and final cumulative GPA in high school students.

Chapter 3 discussed the research methodology and design, arguments supporting the appropriateness of the design, the research variables, questions, and hypotheses, and the population and sample, validity and reliability of the research instrument, and the chosen method of data analysis. Chapter 4 contains the presentation of collected data and the associated statistical analyses used to address each research question and hypothesis testing. Relevant steps used to satisfy assumptions necessary for regression analysis are presented. Data tables, graphs, and calculations are described. Chapter 4 is concluded with a summary of the study results.

Data Collection

Permission to provide contact information and to survey former students from the participating school district, located in the Northeastern region of Colorado Springs, Colorado, was granted by the districts' CTE director on November 13th, 2017. Additionally, the Data Access and Use Permission Form, required by the University of Phoenix Institutional Review Board, was reviewed and signed by a representative of the Colorado School District's IRB Committee on December 20th, 2017.

A master list of former CTE students (graduates between 2013-2017) from all district high schools was provided by the office of the CTE director, with only subjects' name, graduating high school, CTE pathway focus, and last known contact emails. A total of 2,679 former high school students who enrolled in at least one CTE were documented in the master list. Of the total number of potential subjects, only 1,491 were classified as "Occupational Concentrators" in a Science-based pathway, and therefore, could potentially meet the inclusion criteria.

The initial recruitment of subjects began on January 31st, 2018 with emails sent to over 400 of the potential research subjects. At first, subjects were selected at random using a sequential technique of every 3rd from the master contact list provided by the participating school district. The recruitment emails contained the recruitment statement detailed in chapter 3 and a web link to the SurveyMonkey instrument. The first page of the survey instrument contains the "informed consent" statement and the initial item of the survey instrument (item #1) served as the inclusion question regarding potential subjects' completion of a minimum of two science-based CTE courses, while enrolled in high school. Subjects who failed to meet the inclusion criteria, and answered no to item #1 of the survey instrument were thanked for their willingness to participate and were prompted to submit the survey without viewing or completing any further items.

During the initial round of recruitment, only 12 subjects volunteered to participate in the study, and two of those respondents did not answer yes to the inclusion question; therefore, did not meet the criteria to continue on to the data portion of the survey. Follow-up emails were sent one week after the initial recruitment emails went out, as

reminder to solicit participation. However, the follow-up solicitation did not significantly improve the response rate and only 19 additional subjects responded. Due to the low response rate, it was decided that resampling of the population was necessary and the master contact list was renumbered for a second round of sequential sampling. On Feb 12th, 2018, another 450 potential subjects were sent recruitment emails for voluntary participation in the current study.

During the second round of recruitment, 58 subjects volunteered to participate in the study; however, eight of those respondents either did not answer yes to the inclusion question or submitted the survey with no responses, what-so-ever. Although the response rate was significantly higher during the second round of recruitment from the master contact list, the desire to collect data from a strong representative sample and the relatively small population of Science-based CTE graduates from the participating school district prompted the researcher to reconsider sequential sampling and continue recruitment using blanket sampling technique for all remaining subjects not yet sampled from the master contact list.

On January 20th, 2018, the remaining potential subjects from the master contact list were sent recruitment emails and a final follow-up reminder email was sent to all previously solicited subjects. After choosing to blanket sample the entire list of potential subjects, approximately three weeks after initial solicitation was made, an additional 23 research participants volunteered to complete the online survey instrument; resulting in a total 112 participants.

Data Screening

Of the 112 recruited participants who agreed to the terms of the "Informed Consent" on page one of the survey instrument, eight responded no to the initial inclusion question and were prompted to exit the survey without continuing to the data collection section. Of the remaining 104 recruited participants who answered yes to the initial inclusion question, 97 continued on to respond to the data collection section of the survey. The survey instrument was designed to not allow participants to move from one item to the next without providing a response; thus, removing the potential for incomplete surveys to be submitted.

Actual Sample

Data were collected from 97 high school graduates from 2013-2017, using an online survey instrument administered through SurveyMonkey. Only participants who answered the inclusion question regarding taking a minimum of two Science-based CTE courses while enrolled in high school were prompted to complete the survey. Due to the design of the online survey instrument, all 97 participants submitted completed surveys for all items included.

Data Analysis

Confirming the Construct

An Exploratory Factor Analysis (EFA) was performed on the perceived sense of CTE program effectiveness measurement using Principal Axis Factoring and Promax rotation. The pattern matrix provided in Table 4.1 represents the results of the EFA performed on the 15-item survey instrument used to collect data.

Table 4.1

Exploratory Factor Analysis

	1	2	3	4
Instructional Pace	0.382		0.454	
Instructional Tech			0.998	
Instructional Rigor		0.596		
Critical Thinking	0.757			
Stress Perception				0.791
Pace Perception	0.500	0.473		
Instructional Topics	0.857			
Instructional Workload	0.781			
Course Perception		0.593		
Instructional Stimulation	0.779			
Transition Perception		0.937		
Instructional Engagement	0.417		0.365	
Tech Perception	0.313	0.485		
Extra-Curricular Perception				
Goal Perception				
Eigenvalues	8.336	0.983	0.830	0.695
Number of Test Measures	8	6	4	2

Note: KMO & Bartlett's Test = .928, chi-square = 925.735, df = 105, sig <.001

As Table 4.1 suggests, some of the scale items cross loaded on more than one factor. "Instructional Pace", "Pace Perception", "Instructional Engagement" and "Technology Perception" were found to be cross-loaded; thus, serving more than one factor. Cross-loading items were removed. "Extra-Curricular Perception" and "Goal Perception", did not show items loading most probably because values below, .30 were suppressed. These factors were removed. Removing cross-loading left Factor 3 with 1 item only (i.e. "Instructional Technologies"), and 1 item also loaded on Factor 4 (i.e. "Stress Perception"). A decision was made to remove these factors from the model because they represented minor factors with less than 3 items loaded on them (Hayton, et al., 2011).

The remaining factors were labelled: Factor 1 - Instructional Factor (i.e."Critical Thinking", "Instructional Topics", "Instructional Workload", and "Instructional Stimulation") and Factor 2 - Non-Instructional Factor (i.e. "Rigor Perception", "Course Perception", and "Transition Perception"). The factors were entered into the regression analysis as summed score variables.

Scale Reliability Analysis

The reliability of the scale used to collect the research data were determined using Cronbach's alpha coefficient, an acceptable means of estimating the reliability of research instruments to measure what they are intended to measure. SPSS software was employed to report the reliability coefficient of .922, for all original items included in the scale; however, after removing cross-loaded and minor factors, the scale reliability of the total scale was a Cronbach's alpha of .892. The scale reliability coefficient of Factor 1 - Instructional Factor was .857, and on Factor 2 - Non-Instructional Factor was .807. Previous research suggested a Cronbach's alpha reliability coefficient of .75 as acceptable for scale reliability and coefficients of .90 or higher to indicate an excellent level of reliability (Wang, et al, 2013). Thus, the alpha calculated for the instrument scaled used in the current study was significantly above the .75 criterion for acceptable reliability, and approached the suggested criteria of .90 or higher, indicating a very good level of reliability to accurately measure what it was designed to measure.

Description of Variables

Descriptive statistics was used to measure central tendency, variability, and the shape of the distribution of the collected data. The mean demonstrates variability within

the related data sets; while the dispersion of scores was reported through standard deviation and variance. Regression analysis assumes all variables have a normal distribution. Normality refers to the degree to which sample data distribution corresponds to a symmetrical bell shaped curve (Hair, Anderson, Tatham, & Black, 1998). Normality is the most fundamental assumption of multivariate analysis. Variables that are non-normally distributed are highly skewed, or kurtotic, and can impact the significance or regression results by distorting the examined relationships (Osborne & Waters, 2002). Kurtosis is a shape characteristic of the data distribution, referring to peaked or flattened sections of the distribution curve. Skewness is a measure of symmetry within a distribution curve. Positively skewed curves will show a shift to the right tail, while negative values of skewness represent a shift to the left tail. Kurtosis and skewness reported for asymmetry between -2.0 and +2.0 are deemed acceptable to prove normal univariate distribution of data (George & Mallery, 2010).

Table 4.2 depicts the descriptive statistics resulting from the collected data on GPA (Criterion Variable); the predictor variable, identified as the "Instructional Factor"; and the predictor variable, identified as the "Non-Instructional Factor".

Table 4.2.

Descriptive Stats for All Identified Variables

Variable	M	SD	Var.	Skewness	Kurtosis
Final Cumulative GPS (Criterion)	5.340	1.079	1.164	-.312	-.754
Instructional Factor (Predictor)	4.015	.9662	.963	-.895	.758
Non-Instructional Factor (Predictor)	3.784	1.116	1.254	-.761	.572

Cumulative High School GPA (Criterion Variable)

A single construct on the survey instrument served to collect data for the criterion variable, final cumulative high school GPA, measured using seven interval ranges. Descriptive analyses, as detailed above in Table 4.2, represents an examination of normality related to the distribution of data retrieved for all variables, including final cumulative high school GPA (Criterion Variable). Although slight kurtosis exists, the statistics for both kurtosis and skewness are not significantly different than zero and no removal of outliers or transformation of data were necessary. Regarding the criterion variable, the mean response for the collected data are 5.340, with a standard deviation of 1.079, showing the bulk of participating subjects reported a final cumulative high school GPA between 3.00 and 4.00. None of the participating subjects reported a final cumulative high school GPA below 2.00.

Table 4.3 depicts the frequency of responses resulting from the collected data aligned with GPA (Criterion Variable).

Table 4.3.

Frequency of Responses for GPA (Criterion Variable)

GPA Ranges	Responses	Percent %
2.00-2.49	4	4.1%
2.50-2.99	21	21.6%
3.00-3.49	22	22.7%
3.50-4.00	38	39.2%
Above 4.00	12	12.4%
Totals	97	100%

Examination of Table 4.3 shows that more than one third of the research participants responded with a final cumulative high school GPA of 3.50-4.00. Additionally, 74.3% of the total responses came from research subjects who finished high school with a 3.00 GPA or higher; further narrowing the demographic of the research sample participating in the current study.

Instructional and Non-Instructional Factors (Predictor Variables)

The following figure 2 reflect the probability distribution of summed data for survey items, aligned with factor 1, identified as the “Instructional Factor”.

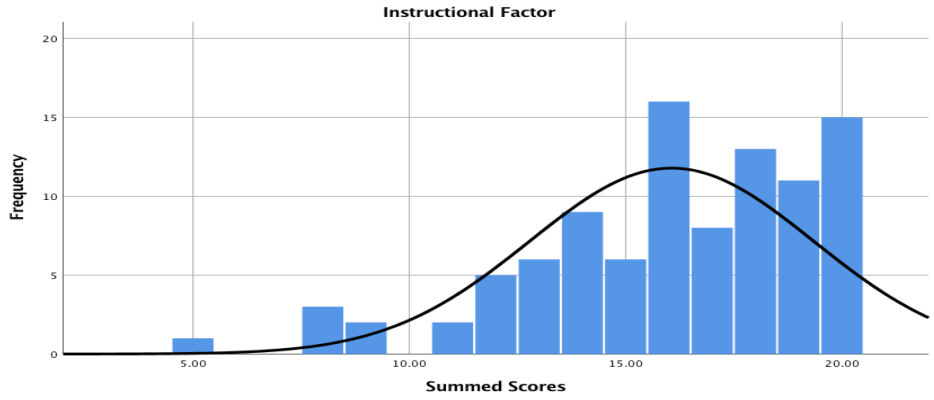

Figure 2. Distribution of Summed Data for "Instructional Factor"

The following figure 3 reflect the probability distribution of summed data for survey items, aligned with factor 2, identified as the “Non-Instructional Factor”.

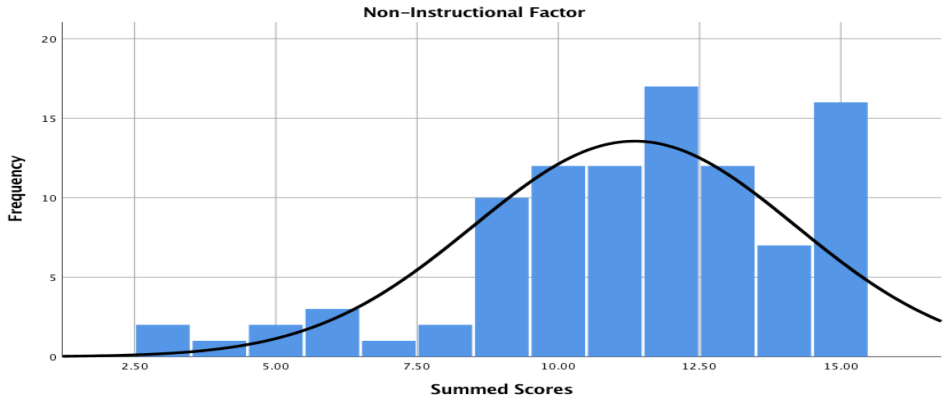

Figure 3. Distribution of Summed Data for "Non-Instructional Factor"

Although kurtosis exists in the collected data sets for both predictor variables, the reported statistics for kurtosis and skewness are not significantly different than zero and no removal of outliers or transformation of data were deemed necessary.

Table 4.4 depicts the frequency of positive, negative, and neutral responses resulting from the collected data aligned to the “Instructional Factor” and the “Non-Instructional Factor”.

Table 4.4.

Frequency of Responses for Predictors

	Instructional Factor	% Frequency of Responses	Non-Instructional Factor	% Frequency of Responses
Negative Responses	37	9.5%	41	14.1%
Neutral Responses	55	14.2%	60	20.6%
Positive Responses	296	76.3%	190	65.3%
Total	388	100%	291	100%

The mean response for the collected data from the four survey items aligned with the predictor variable identified as the “Instructional Factor” was 4.015 and the frequency

of responses show the bulk of participating subjects responded positively to their perception of Science-based CTE instruction. With the majority of participants, 76.3% responding “Agree” or “Strongly Agree” to the survey items aligned with this predictor. The mean response for the collected data from the three survey items aligned with the predictor variable identified as the “Non-Instructional Factor” was 3.784 and the frequency of responses show the bulk of participating subjects responded positively to their perception of factors not directly related to the Science-based CTE instruction. With the majority of participants, 65.3% responding “Agree” or “Strongly Agree” to the survey items aligned with this predictor.

Identifying Predictive Relationships

A multiple regression analysis was performed on the total sample (N=97), regressing the GPA on both predictors, the "Instructional Factor" and "Non-Instructional Factor". Cohen (1988) suggested, effect size plays a significant role in how coefficient should be interpreted in studies involving human behavior or perception. For the current study, regression coefficients were interpreted against the values suggested in Keith (2014), which is:

- Below .05: too small an effect to be considered meaningful;
- .05 to .10: a small but meaningful effect;
- above .10: a moderate effect;
- above .25: a large effect

The results of the analysis are presented in Table 4.5 below.

Table 4.5.

Standardized and Unstandardized Residuals

	B	SE	Beta	Sig.
(Constant)	6.442	.543		.000
Instructional	-.073	.033	-.224	.028
Non-Instructional	.166	.094	.440	.080
Summed Total	-.109	.047	-.575	.023

Note: R2 = .061, Adj. R2 = .041; p <0.05

The model summary accounted for approximately 6% of variance in GPA. In this model, the “Summed Total” of the two predictors had a statistically significant negative predictive relationship with final cumulative high school GPA. A negative predictive relationship reported with the summed total implies that if the values for B increases by a single unit, GPA will decrease by .109 units. However, it seems that only instructional factors showed statistically significant predictive relationships with the outcome variable, which means that the "Summed Total" is presented with only one factor that constituents a major role. The B coefficient for the "Instructional Factor" is -.073, with a significance reported less than .05; this means that if instructional factors decrease by one unit, the GPA will increase by .073 units.

Hypothesis Testing

Two sets of hypotheses were drafted to answer the research questions that are aligned with the purpose of the current study. Hypothesis testing is used in research studies to test the degree of empirical evidence that one or more of the identified variable does not affect the specified population (Moore & Notz, 2009).

Hypothesis 1

$H1_0$. There is no statistically significant predictive relationship between final cumulative high school GPA and research subjects perceived sense of effectiveness towards instructional factors related to the science-based CTE courses they completed.

$H1_A$. There is a statistically significant predictive relationship between final cumulative high school GPA and research subjects perceived sense of effectiveness towards instructional factors employed within the science-based CTE courses they completed.

Hypothesis 2

$H2_0$. There is no statistically significant predictive relationship between final cumulative high school GPA and research subjects perceived sense of effectiveness towards non-instructional factors related to the science-based CTE courses they completed.

$H2_A$. There is a statistically significant predictive relationship between final cumulative high school GPA and research subjects perceived sense of effectiveness towards non-instructional factors related to the science-based CTE courses they completed.

Table 4.6 below depicts the results of the Hypothesis testing.

Table 4.6.

Hypothesis and Results Summary

Hypothesis Statement	Results
Null Hypothesis 1 ($H1_0$)	Rejected
Null Hypothesis 2 ($H2_0$)	Accepted

The results of the regression analysis suggested that the regression model accounted for only the "Instructional Factor" as constituting a statistically significant relationship with GPA. Thus, rejecting the null and supporting the alternative hypothesis that a statistically significant predictive relationship exists between the Instructional Factor and the criterion variable. The primary research question can be answered, yes, a predictive relationship does exist between self-reported final cumulative high school GPA and research subjects perceived sense of effectiveness towards the science-based CTE courses, although this relationship is negative.

Summary

The research data used in the analysis resulted from all 97 research participants who met the inclusion criteria and completed all items on the online survey instrument. It is ideal to have a larger representative sample for quantitative research involving statistical analysis; however, considering a total population of 1,491 graduates, between 2013-2017 from the participating school district, the current sample represents 6.5% of this population, which seems to be a non-uncommon response rate in many studies.

A regression model was chosen to show the degree of relationships between the identified variables in the current study. Quantitative research designed for educational studies often involves the examination of correlations or associations between variables (Chen & Popovich, 2002). Variables measured using surveys focus on using numerous items within the instrument to collect data related to the potential relationships and are therefore more aligned with correlational designs (Black, 2005). The survey instrument utilized in the current study was determined to be reliable for the intended purpose.

There are two main models of regression analysis; simple linear regression, also known as Ordinary Least Squares, is most appropriate when reported values of measurements are fixed; while more complex variations of regression should be used when variable values are not numerically fixed (Ludbrook, 2010). When very little regression towards the mean is needed, researchers can more accurately predict or explain the measured outcome.

Distribution analyses provided in the current study showed the distribution of the data to follow a normal distribution for all items examined, with only a slight degree of skewness and kurtosis. Therefore, it was deemed appropriate to use parametric analysis techniques, such as regression and correlation.

The research questions and hypotheses developed to address the stated problem guided the design and data collection process in the current study. The resulting data showed a predictive relationship does exist between graduates' self-reported final high school cumulative GPA and a sum of the total factors related to their science-based CTE courses. However, data analysis for the predictive relationship between graduates' self-

reported final high school cumulative GPA and instructional factors alone, showed only a weak relationship existed.

Regression analysis reported an R squared value a of 4.1% for the criterion variable when the predictors are known. Although 4.1% can be argued to be a relatively low predictability, it was determined that there is a statistically significant relationship between the sum of these variables that can serve educational leaders and be generalized to similar populations, for the purpose of predicting future relationships.

The results suggested that educational leaders should pay more attention to promoting a positive perception among students towards CTE course instruction, rather than non-instructional factors related to students' educational experience.

Chapter 4 provided a detailed examination of resulting data for the current study, including an examination of instrument reliability, description of data distribution, and inferential statistics to show the strength of relationships between the identified variables. study was to examine the potential relationships between high school graduates perceived sense of effectiveness towards either instructional or non-instructional factors related to Science-based CTE courses and their final cumulative high school GPA.

Chapter 5 includes a discussion regarding the implications of the results from the current study towards educational leadership within the CTE community. Limitations within the current study and recommendations for future studies are also provided in chapter 5.

Chapter 5

Conclusions and Recommendations

Expansion of CTE pathways has become a staple of the Colorado high school experience. The general problem, outlined in Chapter 1 is that despite heavy financial investment and the growing popularity of both CTE and STEM programs, throughout American high schools, little empirical research has been published related to the effectiveness of these programs (Tofel-Grehl & Callahan, 2014). The Colorado Community College System provides financial support for CTE pathways in Colorado schools through the Carl D. Perkins Career and Technical Education Act of 2006 (Colorado Community College Systems, 2014).

With more and more high schools promoting a variety of CTE programs to help students explore career specific content, educational leaders are now pressed to insure the courses are effectively preparing students for post-high school transitions and providing a means of academic success. The ultimate goal of high school CTE programs is to provide adolescent students with both employability and technical skills to help smooth their post-high school transitions (Loera, et al., 2013). The specific problem defined in Chapter 1 is that insufficient empirical evidence exists regarding whether there is a predictive relationship between final cumulative high school GPA and graduates' perception of the effectiveness of the CTE programs they completed.

The purpose of the current quantitative predictive correlational study was to identify relationships between high school graduates perceived sense of effectiveness towards either instructional or non-instructional factors related to Science-based CTE

courses and their final cumulative high school GPA. The study included two research questions and two hypotheses pairs that were tested using a regression statistical model.

Chapter 4 provided the presentation of collected data and the associated statistical analyses used to test the hypotheses. Relevant steps used to satisfy assumptions necessary for regression analysis were presented with data tables, graphs, and relevant calculations. Chapter 4 concluded with a summary of the study results. Chapter 5 begins with a review of major findings from results and data analysis detailed in Chapter 4. Following the review of research findings, Chapter 5 includes a discussion of the potential implication of the results from the current study to educational leadership, limitations of the study, recommendations for future studies, and ends with a summary.

Review of Findings

This section includes a brief summary of the major research findings related to the research questions and hypotheses testing. Data collection, data screening, and data analysis conducted in Chapter 4 served as the foundation of the summary provided here.

The research instrument used was adopted and modified from a previous study conducted by Taylor and Porath (2006). Because multiple variables are involved in the design of the current study and loaded into the 16-item survey instrument used to collect research data, Exploratory Factor Analysis was employed to evaluate which factors to retain based on the relationships between the variables. Similar to the internal consistency reliability assessed using Cronbach's alpha, factor analysis techniques are commonly associated with researchers attempt to support construct validity (Hayton, et al., 2011). The results of the pattern matrix identified four potential factors; however,

several items on the instrument were removed from the analysis due to cross-loading between factors. Furthermore, two of the four factors were removed due to single item loading, classifying those as "minor factors". Subsequently, the pattern matrix was used to identify two major factors, loaded on multiple survey items; one identified as the "Instructional Factor" and one identified as the "Non-Instructional Factor".

Several assumptions regarding research data must be met before statistical test can be successfully applied (Osborne & Waters, 2002). The current study included a verification of the normal distribution of the collected data and used a design that insured an independent nature to the sampling of potential subjects. Both, normal data distribution and removal of researcher sampling bias were necessary assumptions that were met to reduce type I and type II research errors.

Descriptive statistics and frequency of responses were examined to identify trends within the data sets. Inferential statistics provided a means to answer the research questions and test the associated hypotheses. For research question #1 (RQ1), results of the inferential statistical analyses showed a weak negative predictive relationship existed between the criterion variable and items loaded to the "Instructional Factor". While results of the inferential statistical analyses for research question #2 (RQ2) showed a significance above a .05; therefore, no statistically significant predictive relationship existed between the criterion variable and items loaded to the "Non-Instructional Factor". The regression model summary showed that when combined, the two-dimensional factors "Instructional" and "Non-Instructional", has a negative predictive relationship with final cumulative high school GPA, -.109.

A negative predictive relationship reported with the summed total implies that if the values for B increases by a single unit, GPA will decrease by .109 units. However, since the results of the regression analysis indicate the "Non-Instructional Factor" does not share a statistically significant relationship with GPA; only the "Instructional Factor" constitutes a role in predicting final cumulative GPA. Using the current instrument and research design, a negative regression value for the only predictor found to show a statistically significant relationship with the outcome variable would suggest that as student perception of effectiveness increases, regarding "Critical Thinking", "Instructional Topic", "Instructional Workload", and "Instructional Stimulation", then their final cumulative GPA would decrease. Furthermore, these findings suggest that student perception of non-instructional aspects of the CTE programs, such as "Rigor", "Course", and "Transition", do not have a statistically significant relationship with their final cumulative GPA.

Results of the EFA showed a failure of the research instrument to adequately capture research participants' response to various factors aligned with their perception of CTE program effectiveness, suggesting further modification of the survey is needed. The instrument should include items that are properly loaded to factors relevant to the student perception of specific aspects related to CTE programs offered.

Implication of the Study to Research

Further empirical research is needed in the area of perceived effectiveness related to CTE programs offered at various academic levels (Loera, et al., 2013). Findings of the current study provide support for educational researchers wanting to examine the

relationship between high school graduates perceived sense of effectiveness towards Science-based CTE programs and final cumulative high school GPA. However, a negative relationship would indicate that GPA would decrease if the students' perception of program effectiveness were more positive. Employment of a field test serves to identify issues within the chosen research instrument; however, a pilot study might also serve to identify shortcomings with alignment of the research instrument to the identified variables.

Implication of the Study to Theory

John Dewey, considered by many to be the preeminent American philosopher in education, described learning as the gaining of knowledge through social, environmental, or professional influences (Martinez, 2010). CTE courses are, by nature, designed to present knowledge and skills in diverse environments to marry learning with specific workforce expectations. The framework of the Social-Cognitive Learning Theory postulates that learning occurs in variety of ways, including observations of social and professional interactions (Money, 1995). Findings from the current study suggests that positive social interactions and exchange of information between all parties has a role on the learning experience and the perception that students have for the learning environment can be used to predict academic success.

Constructivism is driving current reforms in science education by promoting learning environments that allow the learners to use their past and current experiences to build knowledge, rather than prescribing to any specific instructional practices (Lew, 2010). Findings of the current study support the constructivist principle that a positive

learning experience is related to the ability of the learner to construct more knowledge or skills, while achieving higher academic success.

Implications of the Study to Educational Practice

Student satisfaction plays a role in their perception of the educational process and the development of self-efficacy towards specific content or skills (Taylor & Porath, 2006). Developing career or content specific programs that promote a positive perception of various instructional and non-instructional factors is believed by many educators to promote academic success. Critical thinking skills, instructional workload, rigor, pace, and the use of relevant technology can influence student perception of program effectiveness. More studies are needed for educators to continue the development of practice that can balance the various factors that will most positively impact student success, as measured by GPA or other measures of academic success.

Implications of the Study to Educational Leadership

Funding through the Carl D. Perkins CTE ACT requires educators and educational leaders develop more engaging curriculum to better prepare students for more rigorous and focused course work that is specific to career paths (Wallace, 2012). The goal of the current study is to support educational leaders, CTE educators, and industry experts by examining relationships between academic success and the perceived effectiveness of science-based CTE programs; in the hopes of providing a framework to predict future relationships.

Promoting academic success is a fundamental component of building self-efficacy and smoothing the transition for students graduating high school. The results of the

current study show that while no statistically significant relationship exist between GPA and CTE students' perception of non-instructional factors, a weak negative predictive relationship does exist between GPA and students' perception of instructional factors related to CTE courses. The pattern matrix resulting for the Exploratory Factor Analysis identified four loaded survey items to the "Instructional Factor". Therefore, educational leaders who wish to see an influence in CTE graduates' GPA should utilize the results of the current study to consider the critical thinking activities in instructional designs, the level of engagement and stimulation in the instructional topics, and management of course workload.

Strengths and Limitations of the Study

A strength of the current study is that participants represented a population that included 1,491 high school graduates from between 2013-2017, that were classified as "Occupational Concentrators", and from various high schools within the participating school district. The school district involved in the current study has a well-established CTE program and promotes a variety of career pathways to their student population. CTE programs continue to represent a popular movement in secondary and post-secondary educational institutions throughout Colorado, and the United States, and the current study served to add to available research regarding the effectiveness of CTE pathways.

Another strength of the current study was the user-friendly design of the online survey instrument to collect complete data in a time efficient manner. Response rates for survey research are typically very low; however, options offered through SurveyMonkey

served to ensure participants completed all of the included items prior to submitting their response. Furthermore, the field test performed by four professional educators familiar with CTE programs in the state of Colorado served to ensure the Likert-type statements were worded in an efficient and clear manner.

Despite standardization movements in public education, academic programs vary by school district and instructional techniques vary among educators, within individual courses. A critical limitation of the current study relates to the potential for variety in the manner by which Science-based content was presented to the research participants. Participants were likely exposed to various CTE instructors throughout the specified time frame and the various high schools. Variety in CTE course rigor, workload, pace, and the technologies used by the instructors are not controlled in the current study and cannot be measured; therefore, the instructional and non-instructional factors that students experience are not universal.

Obtaining truthful and accurate responses from research subjects when self-reporting presented another limitation that could have only been addressed through objective verification of underlying relationships that may have biased the responses of each participant. Another limitation was the failure of most of the survey items to adequately load to relevant factors that might have shown more significance in the relationships between the variables identified in the current study. Using a more effective and research proven instrument to collect data of this nature would have improved the quality of the collected data sets and added to the construct validity of the scale used to measure responses.

A final limitation was that the majority of the research participants reported a final cumulative high school GPA of 3.00 or higher, narrowing the sample demographic.

Recommendations for Future Research

The relationships between "Instructional" or "Non-Instructional" factors related to CTE programs and GPA have implications beyond those identified in the current study. Another study might look into similar relationships at the elementary, middle school, or post-secondary levels. Further research into predictive correlational relationships that might exist in similar educational settings can serve to improve our collective understanding of the student experience and help to push reform using empirical evidence.

The current study revealed a predictive relationship does exist between GPA and student perception of instructional factors related to CTE programs, although it is negative. However, many other aspects of course instruction and non-instructional factors can be explored in future studies. For example, future studies might examine the potential for relationships between online instruction for CTE courses and student GPA. Another potential study might examine relationships between CTE class size and student GPA or student perception of the instruction delivered. Future research is necessary to help build predictive models that will assist educational leaders and CTE instructors to understand relationships between student success and perceptions.

Finally, future studies might benefit educational leaders by examining the influence of underlying relationships between students and instructors of CTE courses.

Specifically, relationships that might bias self-reported responses to survey items should be identified and examined to address this limitation.

Conclusion

A negative predictive relationship was reported between the "Instructional Factor" regarding perception of CTE program effectiveness and final cumulative high school GPA. A negative relationship suggests that as perception of program effectiveness increases, student GPA would decrease. Limitation reported in the current study and failure of all items included in the instrument to adequately load to factors suggested the need for further research on the stated problem and aligned with the current research questions.

Summary

The purpose of the current quantitative predictive correlational study was to identify relationships between high school graduates perceived sense of effectiveness towards either instructional or non-instructional factors related to Science-based CTE courses and their final cumulative high school GPA. Educational leaders having a growing need to use more empirical evidence in making their decisions and drafting new policies. Understanding the significance of relationships that exist between instructional or non-instructional factors and student success is paramount to making sound educational decisions and continuing to push the reform movement.

The current study supports the premise that CTE courses are structured to align with the Social Cognitive Theory of Learning as it has its roots and connection to human perception of the world around them. The current study builds on previous research

conducted by Aliaga, Kotamraju, and Stone (2014) by addressing a need to evaluate how CTE contributes to the preparation of high school students for the transitions they face after graduation. The current study addresses concerns posed by Tofel-Grehl and Callahan (2014) that educational funding was provided by the Obama administration to CTE and STEM programs although insufficient evidence existed on the effectiveness of the curricula taught and instructional methods used. Finally, the current study refutes arguments published by Silverberg, Warner, Fong and Goodwin (2004) suggesting that vocational programs, such as CTE, do not themselves add value to student achievement.

Although some limitations in the current study exist, several implications towards educational leadership are evident, including the continued need to use empirical evidence to make decisions. Future studies can address the limitations identified here and build on the findings to provide even more empirical evidence that will guide educational leaders and instructors to promoting continued academic success and positive student perceptions.

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