Author: **Ackland, Philip B.**

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STUDENT:

NAME: Philip Ackland **DATE: 05/10/2018**

ADVISOR: (Committee Chair if MS Plan A or EdS Thesis or Field Project/Problem):

NAME: Sylvia Tiala **DATE: 05/10/2018**

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Committee members (other than your advisor who is listed in the section above)

1. **CMTE MEMBER'S NAME:** **DATE:**
2. **CMTE MEMBER'S NAME:** **DATE:**
3. **CMTE MEMBER'S NAME:** **DATE:**

This section to be completed by the Graduate School

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Ackland, Philip B. ***High School Counselor & Administration Perceptions Toward CTE's Role in STEM Education***

Abstract

In response to a changing economic and technological landscape, there has been a recent call for action for secondary schools to place a greater focus on STEM education. In addition to science and mathematics courses, career and technical education (CTE) has shown to be a promising vehicle for teaching STEM concepts. Despite its benefits, it is common for CTE to be omitted in the STEM education discussion. To better understand why CTE is overlooked, this study sought to gain insight into the perceptions held by high school counselor and administrator as to the role that CTE has within STEM education. Results from a survey showed that administrators and counselors generally hold positive perceptions of CTE and its ability to prepare students for STEM-related postsecondary educational programs and careers. Results also showed administrators reporting a negative association between the overlap between CTE and STEM education at their schools. However, statistical comparisons using chi-square tests showed no meaningful variation between participate perceptions of CTE compared to other mathematics and science courses. Considering this, further research of factors that can impede CTE being used to teach STEM education is recommended.

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Chapter I: Introduction & Background to the Problem

The purpose of education is multifaceted. It serves to prepare our citizens for success in both personal and professional contexts as well as to address issues from local to global settings. Education is also dynamic. It must adapt to address the issues that arise in the ever-changing world. Recently, there has been a movement in education to focus on areas viewed as critical within our technologically-driven society. This includes science, technology, engineering, and mathematics, now commonly understood by the acronym STEM. Since the term STEM was created by the National Science Foundation in the early 2000's, its purpose and meaning has evolved beyond its constituent components (Dugger, 2010). STEM can be viewed as areas of study that are critical to having a strong understanding of in the 21st century. It can also reflect the interconnectedness these areas of study have to one another. Proponents of viewing STEM as an integration of multiple areas of study are Merill and Daugherty (2009), who view STEM education as an approach to teaching that demonstrates to students how concepts learned within multiple subjects can be integrated and applied in a meaningful way. Whether defined by STEM education focusing largely on the application of interdisciplinary concepts, or more simply, as a concentration in isolated science, technology, engineering, and mathematics courses, how this content should be taught and under what academic programs it is taught is still a matter of debate (Brown, Brown, Reardon, & Merrill, 2011; Daugherty, & Wicklein, 1993; Pathways to Prosperity Network, n.d.; Portz, 2015).

One promising vehicle for teaching STEM-related concepts is Career and Technical Education (CTE). CTE provides students with coursework that integrates core academic areas with applied knowledge and skills to help prepare students for post-secondary educational programs and careers. Concepts taught in "traditional" areas of study such as mathematics and

English are commonly generalized and abstract. CTE, however, provides occupationally-oriented coursework intended to provide students training that can be directly applied within career settings (Sarkees-Wircenski, & Scott, 2008).

Programs offered under the CTE purview are wide-ranging in order to meet the individual needs of a diverse student population. To provide better structure and focus for this array of coursework, the National Career Clusters Framework outlines the competencies and knowledge required to pursue employment in a total of 16 Career Clusters that comprise 79 Career Pathways (Advance CTE, 2017). Considering the broad scope of CTE, each of the 16 Career Clusters is taught through specialized CTE programs such as agricultural education, health occupations, business, family and consumer science, and technology and engineering education. The Career Cluster most relevant to this discussion is Science, Technology, Engineering, & Mathematics and is largely taught through CTE programs called Technology Education and Technology and Engineering Education (NASDCTEc, 2013; Shadoian-Gersing, 2015; SkillsUSA Inc., n.d.).

Considering that much of the data available regarding Technology Education and STEM is presented through a broader connection to CTE, for the purpose of this study the relationship between CTE and STEM education will be viewed as synonymous with the role of Technology Education and STEM. As stated by the National Association of State Directors of Career Technical Education Consortium (2013):

> STEM must not be viewed as a separate enterprise from CTE. While a state's CTE programs may not encompass everything within a state's STEM strategy, high–quality CTE programs can provide a strong foundation for and serve as a delivery system of STEM competencies and skills for a broader range of students. (p. 1)

Some of the primary functions of CTE are to prepare students for educational pathways that do not require a four-year degree. In addition, CTE provides students field-specific knowledge. Considering this, CTE's value in teaching STEM should not be overlooked. According to Rothwell (2013), 50% of all STEM-related jobs available in 2011 required an educational level of education beyond high school but less than a bachelor's degree. In addition, the *Pathways to Prosperity Network* (n.d.) found that 60% of employers look for potential employees with both broad-based competencies (e.g. basic math and science knowledge) and field-specific knowledge and skills. CTE offers coursework that helps in meeting these labor market demands by preparing students for success in a broad-array of post-secondary programs (Association for Career & Technical Education, 2017) and through teaching industry-contextualized skills (Symonds, Schwartz, & Ferguson, 2011).

Despite the benefits of CTE coursework being used to help prepare students for success in STEM-related post-secondary careers and academic programs, overall enrollment in CTE courses has shown a steep decline. As seen in Table 1, the U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics (2010) reported that, from 1990 to 2009, the average number of CTE credits obtained by students in public high school decreased from 4.2 to 3.6. In contrast, from 1990 to 2009 the average number of course credits earned by high school graduates increased from 23.5 to 26.2 credits. Despite an overall increase in credits earned by students, the number of credits earned by high school students in STEM-related CTE courses remained stagnant or showed a decline. Why there is limited enrollment in STEM-related CTE coursework despite a growing industry demand is not clear and warrants further attention.

Table 1

STEM Credits Earned by High School Graduates in 1990, 2000, 2005, & 2009

Total and Subject/Occupational Area	1990	2000	2005	2009
Total credits earned	23.5	25.9	26.7	26.9
Total CTE credits earned	4.2	4.2	4.0	3.6
CTE occupational area: Engineering technologies	0.2	0.2	0.2	0.1
Total mathematics credits earned	3.2	3.5	3.7	3.8
Total science credits earned	2.8	3.2	3.3	3.5

Note. STEM Credits Earned. Adapted from "Table H125. High School Transcript Study (HSTS), 1990, 2000, 2005, and 2009", by U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2010. Washington D.C. Adapted with permission.

One potential reason for low participation in STEM-related CTE could be credited to misunderstandings of these areas of study by various stakeholders. In framing the STEM initiative, there has shown to be two schools of thought. First, the perspective that CTE-related coursework plays an important role in the delivery system for secondary STEM education in addition to mathematics and science (ACTE, 2009; Asunda, 2011; NASDCTEc, 2013; Symonds, Schwartz, & Ferguson, 2011). Second, a perspective that shows little relationship or fails to even acknowledge CTE in the STEM education discussion (Brown, Brown, Reardon, & Merrill, 2011; Daugherty, & Wicklein, 1993; Portz, 2015; Rogers, 2005; Rose, 2007). An example of those who fail to acknowledge CTE's role in the STEM conversation include the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. In 2007 these organizations recommended an annual increase of 10,000 K-12 mathematics and science teachers to help combat our economic, scientific, and technological shortcomings. Other stakeholders have also discussed the importance of secondary STEM education yet fail to acknowledge CTE's role in secondary STEM education. One example can be seen with the authors of the Next Generation Science Standards (NGSS Lead States, 2013). Another example is seen with the former president Obama through his speeches and STEM-related initiatives (Executive Office of the President of the United States, 2014).

Associating STEM education strictly with mathematics and science course offerings implies a view that STEM education is an extension to mathematics and science courses. Such perspectives fail to acknowledge that technology and engineering courses also are components of the STEM initiative. This oversight can lead to students receiving a STEM education with a focus primarily on science and mathematics. Moreover, these attitudes marginalize the important role of technology and engineering education; areas that many CTE courses concentrate on. Without a focus on all of the individual components of STEM, it is unlikely that students will have a comprehensive STEM education.

A divide between the role of CTE in STEM education extends itself to stakeholders within secondary schools. When addressing the growing need for STEM education, school districts often choose to ignore the "T" and "E" components and instead focus their attention on increasing mathematics and science courses. As discussed by Portz (2015), confusion as to how to provide students an education in science and technology is common within secondary school districts. Science and mathematics are subjects that are easily understood. However, teaching students concepts related to engineering and technology is something that alludes many in education. Portz (2015) further discusses how these attitudes could be influenced by a disconnect existing between academia and industry. The discussion by Portz could apply to many individuals. Considering the various positions held within a school, some perspectives can have a greater influence than others. Stakeholders who have significant influence on school direction, allocation of resources, and teaching practices are secondary administrators. According to Valentine and Prater (2011), principals within a school have an important role in keeping up-to-date with current trends in education. In addition, they collaborate directly with staff to provide teaching strategies and maximizing student engagement.

Considering their role in helping students with course enrollment and academic planning, guidance counselors have a significant impact on student course enrollment. According to Adams (2014), high school counselors are influential in guiding students towards post-secondary educational programs. This is especially true with low-income students and students of color. With the influential roles that school administrators and counselors have within secondary schools, these stakeholders' perspectives have the potential to influence what coursework is used to teach STEM and CTE-related education.

Statement of the Problem

Despite CTE representing a promising vehicle for preparing students for STEM-related post-secondary educational programs and careers, enrollment in STEM-centered CTE courses in public high schools has shown stagnation or decline. Looking at the function that secondary STEM education has in educating students for post-secondary educational programs and careers, a failure to provide students STEM educational opportunities through CTE coursework has ramifications. Overlooking CTE can negatively impact many students' post-secondary preparation, and as a consequence, the national economy and demands of the labor market.

Purpose of the Study & Research Questions

Considering the influential roles that administrators and counselors have on student attitudes, student course enrollment, school policies, funding, and strategic direction, this study aims to determine the perceptions administrators and counselors hold regarding the relationship between CTE and STEM education. To set a framework, the study will focus on answering the following questions:

1. How do counselors' perceptions of CTE compare with their perceptions of STEM in preparing high school students for post-secondary college and career readiness?
2. How do administrators' perceptions of CTE compare with their perceptions of STEM in preparing high school students for post-secondary college and career readiness?

Importance of the Study

Career and technical education at the secondary level plays an important role in helping to prepare our citizens for high-demand, high-wage occupations. This function of CTE has broader implications as this discipline is tasked with helping school districts fulfill local, state, and national economic needs. With a recent call for action for students to pursue careers in STEM-related fields, secondary CTE has shown to have the potential to help in meeting this demand. Despite CTE representing a promising vehicle for teaching STEM-related concepts, national enrollment trends in CTE courses at the secondary level show stagnation or decline. To ensure that we are meeting economic demands and preparing students for success in STEM-related post-secondary careers and education programs, it is important to gain an understanding of the factors that impact the extent to which students pursue CTE courses. Factors that have the capacity to affect CTE enrollment include influential individuals working within the secondary school system such as administrators and counselors.

Definition of Terms

A glossary of select terms relevant to the study is provided to give context and clarity when reading.

Broad-based competencies. Skills and knowledge that can be applied to an array of jobs. Such competencies include, for example, possessing a foundational knowledge of mathematic principles and being fluent in communicating through verbal and written mediums.

Career and technical education (CTE). Career and Technical Education is a multifaceted area of study that seeks to prepare students to be college and career ready. More "traditional" academic fields, such as mathematic and English, primarily teach more generalized or abstract concepts. Alternatively, CTE separates itself by focusing on skills and knowledge specific to careers. Such concepts are taught largely through an applied approach where topics learned in core subjects are used and applied in a practical sense (Gordon, 2008; Sarkees-Wircenski, & Scott, 2008).

Science, technology, engineering, and mathematics (STEM). This acronym stands for science, technology, engineering, and mathematics. The term STEM has become commonplace to represent concepts and competencies that are viewed as vital in our increasingly technological world (National Association of State Directors of Career Technical Education Consortium, 2013; National Science Board, 2007; U.S. Department of Commerce Economics and Statistics Administration, 2011). Despite an acceptance of the individual components that comprise the acronym, its meaning and purpose within academia is not uniformly agreed upon. STEM can refer to teaching through an interdisciplinary approach where topics related to science, technology, engineering, and mathematics are applied in a meaningful way. STEM can also reflect a demand for students to place a greater focus on each of these areas in isolation (Brown, Brown, Reardon, & Merrill, 2011; Portz, 2015). Either definition of STEM will be viewed as valid for the purpose of this study and will not distract from the findings.

Technology and engineering education (TEE). Technology and engineering education represents a component of general education that seeks to prepare students with a background in human adaptive systems and a technological literacy (Dugger, 2013). Teaching approaches within TEE are largely based on applied approaches and have a focus on the practical application of many of the concepts learned in general education courses such as mathematics, science, and English (Kelley & Kellam, 2009).

Chapter II: Literature Review

The following literature review shows the connection between STEM and CTE. It also shows how administrators and counselors view the relationship between these areas of study. The review examines the history of STEM education and the history of CTE. This is followed by a discussion of the benefits of teaching STEM through CTE coursework. Lastly, the review looks at the influence that guidance counselors and administrators have in affecting the extent to which STEM is taught through CTE coursework.

History of STEM Education

The STEM movement has only recently been a primary focus within the education community. However, large-scale efforts to expand science, technology, engineering, and mathematics education can be found earlier in our Nation's history. The emergence of STEM education as a broad-based intervention in the United States finds its roots with the passing of the 1862 Morrill Act. Through this act, the federal government gave states land grants to be used as a resource to fund the expansion of state agriculture and technology training programs. The concessions provided through this act allowed younger, less-developed Western states to expand their educational offerings, and subsequently, lay the foundation for larger universities and technical schools (Butz et al., 2004).

Major historical events, including World War II and the Soviet Union launching Sputnik 1 and Sputnik 2, prompted efforts to expand and improve STEM education (White, 2014). As a result of the technological advances from WWII and public concerns regarding our Nation's ability to be a global economic and militaristic leader, federal funding was allocated toward STEM-related research and development. Such federal support is exemplified with the establishing of the National Science Foundation (NSF) in 1950. The NSF promoted STEM education through the funding of workshops for K-12 science teachers (Butz et al., 2004). Large-scale federal funding for K-12 STEM education was provided through the passing of the National Defense Education Act (NDEA) of 1958. This funding was provided due to the launching of Sputnik 1 and Sputnik 2. The display of technological power by the Soviets raised American's concerns about our ability to maintain our national security. Consequently, the NDEA increased federal support for STEM education through increased funding for math and science teacher training and the development of related curriculum. This support also encouraged a greater focus on inquiry and problem-solving over more traditional passive-learning strategies at the secondary level (Bybee, 2013).

Trends showed failings in our economic and technology preeminence despite major federal efforts to promote STEM education. In 1983, the National Commission on Excellence in Education published *A Nation At Risk*. The report discussed how America's current education system was failing to meet the demands of the modern world. Warnings were given that such deficiencies would result in other nations surpassing America in the areas of technology, commerce, science, and industry.

Over thirty years later publications echoing these findings have been released including a report by the World Economic Forum (2015). They found that the United States ranked 44 out of 140 nations in its quality of math and science education. The report also found that America ranked 18 out of 140 nations in its overall quality of the education system. The Organisation for Economic Co-operation and Development (2012) found that out of 34 countries analyzed, the United States scored poorly in math education. America had an average math rating of 27 out of 34 and an average rating of 20 out of 34 in science.

Findings such as these demonstrated an immediate need to increase Americans' competency in STEM areas of study. This prompted a declaration of action by a number of stakeholders whose publications stressed the importance of improving and expanding STEM education (Executive Office of the President: Office of Science and Technology Policy, 2014; National Science Board, 2007; U.S. Department of Commerce Economics and Statistics Administration, 2011; U.S. Department of Education, 2007). Recommendations from these stakeholders inspired a STEM movement motivating former President Obama to allocate $2.9 billion to various federal programs focused on improving STEM education with the 2015 fiscal budget (Executive Office of the President of the United States, 2014).

History of CTE

Career and technical education in America begins during the colonial period in the form of apprenticeships. An apprenticeship reflected an arrangement between an employer and indentured student where the employer would train the student in a vocation in return for the student's labor (Gordon, 2008). The apprenticeship remained the predominate model of vocational education until the early 1800's when America entered into the Industrial Revolution. This new era of production prompted a national shift from a farming, agrarian-based society to one that was heavily mechanized and factory-based. In response to the changing economic landscape, vocational education shifted predominately to more formalized trade instruction. The shift from the apprenticeship model was done with the intent to prepare the American workforce to better meet the labor-market demands of the period (Wang, 2009).

An emphasis on vocational education declined in the early 1900's until the production demands created by World War I and World War II. During these periods of war, deficiencies within our labor-market created a need for a greater focus on vocational education. These demands prompted action by the federal government to enact multiple pieces of legislation in support of specialized occupational training in areas such as manufacturing. Funding to expand vocational programs significantly improved the war efforts and resulted in a thriving post-war labor force (Gordon, 2008).

During the second-half of the 20th century, vocational education continued to help in meeting the labor market demands of America. The Korean War during the 1950's and the Vietnam War during the 1960's demanded an increase in production to meet wartime needs. These same periods are marked by the beginning of the cold war with Russia. During this period, Americans feared our Nation's ability to maintain its role as a global leader in technological advances and gross domestic production. These national issues were paired with an ever-changing workplace where the production of goods was increasingly becoming automated. With the dawn of the digital age, it became apparent that the United States needed to ensure the creation of a workforce ready to meet the needs of an evolving technological landscape (Gordon, 2008). In response to these demands, a series of federal legislation was passed to promote and expand CTE programs. These included the National Defense Education Act of 1958, the Manpower Development and Training Act of 1962, the Vocational Education Act of 1963, and the Carl D. Perkins Vocational Education and Applied Technology Act of 1984 (Gordon, 2008). These, and other pieces of federal legislation sought to help prepare a workforce that could meet the labor market needs of America. Through these measures vocational offerings at the secondary and post-secondary level were expanded and instruction was improved (Wang, 2009). From the early apprenticeship model to its modern-day incarnation, CTE within the United States has evolved considerably. Despite its changes, CTE's primary function has remained constant, to meet national production demands by providing students career-oriented instruction.

CTE's Role in STEM Education

An examination of the histories of STEM and CTE education in the United States demonstrates considerable parallels between these two areas of study. Events such as the passing of the 1862 Morrill Act, the launching of the Sputnik satellites, production and education demands stemming from WWI and WWII, and fears related to our Nation's ability maintain its position as a global leader, show that needs for STEM and CTE education occur simultaneously in the United States. Both are shown to be historically born from economic and labor market demands that coincide with each other.

Considering their shared economic goals, the function of CTE and STEM education can be looked at as symbiotic. It is apparent that STEM education requires attention to mathematics and science courses. It is unreasonable to suggest that these areas of study by themselves can provide appropriate attention to the need for competencies related to technology and engineering. There is the tendency for science and mathematics courses to be taught in a vacuum where students may not be shown the practical application of learned concepts. Nor is the interconnectedness of the different STEM areas of study fully demonstrated (ACTE, 2009; NASDCTEc, 2013; Symonds, Schwartz, & Ferguson, 2011). CTE demonstrates a way to supplement such shortcomings by offering courses related to technology and engineering and by teaching these areas through integrated problem-based STEM curricula such as Project Lead the Way (PLTW) and Engineering byDesign (ACTE, 2009; Asunda, 2012; Asunda & Mativo, 2016). According to the Brookings Institute (Rothwell, 2013), CTE shows great promise for being used as a delivery system for STEM education through: an alignment of secondary to post-secondary education; establishing industry and secondary education partnerships; an ability to promote problem-based and project-based learning; an incorporation of technology; a use of cross-discipline education; and for its ability to be accessible by traditionally underrepresented students.

Another possible benefit of teaching STEM through CTE coursework is its ability to ensure that students are leaving high school being college and career ready through the instruction of skills and knowledge relevant to industry demands. According to Symonds, Schwartz, and Ferguson (2011), the majority of employers believe that it is critical that their employees possess both broad-based competencies as well as specialized training/skills. Yet, only 11% of business leaders feel that students are leaving college with the skills and knowledge needed for success in their work. CTE presents a way to bridge this gap. It can teach students curriculum that aligns with industry demands (ACTE, 2009). Symonds, Schwartz, and Ferguson (2011) discuss the current skills gap and how America's current education system has fallen short in meeting economic needs. Schwartz and Ferguson assert that CTE programs that teach students 21st century skills through STEM curriculum has potential to prepare students for college and career readiness.

There are benefits of teaching STEM by connecting CTE with post-secondary educational opportunities. This is evident when looking at CTE's focus on helping students work toward degrees requiring less than four years of college. Often, STEM education has an association with preparing students for advanced degrees requiring a baccalaureate degree or higher. These attitudes do not reflect labor market demands. Half of all STEM jobs that are in demand do not require an education at the bachelor level (Rothwell, 2013). Considering this, these perspectives cause high school stakeholders to overlook the real demands for STEM occupations requiring less than a bachelor's degree such as technical degrees and certificates.

Despite the benefits found in teaching STEM education through CTE, trends show a rapid decline in CTE course enrollment. According to the National Center for Education Statistics (2010), the overall number of CTE courses taken by high school students has significantly decreased compared to other academic areas. From 1990 to 2009, the average number of high school CTE credits students earned decreased from 4.2 to 3.6. Alternatively, the average number of credits earned in all other subject areas increased. Despite an average decrease in CTE course enrollment, the extent and type of change varies from one occupational area to the next. Table 1 on page 10 shows student enrollment in CTE courses related to STEM has stagnated or declined in numbers (National Center for Education Statistics, 2013).

Counselor and Administration Influence within Schools

Course offerings and enrollment, staffing, government regulation, and funding are all examples of variables that affect school programs. These variables are influenced by stakeholders not limited to: parents, teachers, policy makers at the local, state, and federal level, school guidance counselors, and school administrators. Considering the financial and time limitations of the researcher, counselors and school administrators are the focus of this research. The question to be addressed is how do administrators' and counselors' perceptions of CTE coursework in preparing high school students for post-secondary college and career readiness compare to their perceptions of STEM in preparing high school students for college and career readiness.

High school counselors. Among the primary responsibilities of secondary school counselors are academic and career guidance and planning (American School Counselor

Association, n.d.; McKillip, Rawls, & Barry, 2012). This guidance can take the form of leading students toward a particular career based on the student's individual interests, skills, and academic aptitude. Such counseling guides students toward enrollment in particular courses that lead to preparation for a particular career field. As discussed by Carlson and Knittel (2013), academic planning is one of primary roles of the guidance counselor.

One of the main functions of this academic planning process is to prepare students for their post-secondary plans. Mau, Hitchcock, and Calvert (1998) surveyed 10th and 12th graders regarding this counselor-student relationship. Results from their study showed that 2% of 10th grade students and 2.5% of 12th grade students perceived their high school counselors expected them to enroll in a trade school. This compared to 55% of 10th graders and 71% of 12th graders perceiving that their counselors expected them to enroll in some other form of college. These perceived counselor expectations failed to align with students' actual post-secondary aspirations. Survey results from this study showed that 16% of 10th graders and 12% of 12th graders planned on attending a vocational or trade school and 14.5% of 10th graders and 35% of 12th graders planned on attending other types of colleges. The perceptions of counselor expectations for students' post-secondary plans show contrast to economic demands (Mau, Hitchcock, & Calvert, 1998). According to Carnevale, Smith, and Strohl (2010), in 2018 only 33% of jobs are projected to require a 4-year degree while 66% of jobs will require only a technical degree, associate's degree or less.

A conflict between student aspirations and counselor expectations has significant ramifications on students' post-secondary decisions. The Mau, Hitchcock, and Calver (1998) study showed that 55% of 10th grade students and 71% of 12th grade students perceived that their high school counselors were significantly influential on their post-high school decision.

Twelfth grade students perceived high school guidance counselors as almost equal in the role of establishing a set of college expectations as compared to their own parents. Results also showed that counselors were more influential than students' friends, teachers, relatives, and coaches. These results demonstrate the important relationship between the high school counselor and student in the development of post-secondary plans. Though a relation of a counselor and a student's career plans can be established, the data does not infer that high school counselors can, and do, influence students to enroll in specific coursework related to either the counselor's manifested plan for the student or the student's actual career goals. Yet, the level of influence arguably has the ability to influence the extent to which students enroll in CTE coursework.

The study by Mau, Hitchcock, and Calvert (1998) looked at perceived expectations students had of high school counselors, but the data collected does not discuss the extent to which counselors actually invested time in helping guide students toward achieving their post-high school plans. A study by Lee and Ekstrom (1987) sought to answer this question. In their study, results showed that 37% of senior high school students planning to attend a two-year college received counseling on their post-high school plans compared to 50% of senior students planning on attending a four-year university received counseling for their post-high school plans. The study also compared students who were on different academic tracks. One academic track was a "academic curriculum track" and referred to a pathway that prepared students for post-secondary education. Another track was a "vocational curriculum track" and referred to a pathway that prepared students to go directly into the workforce after high school. Lee and Ekstrom (1987) found that 43% of students on the "academic curriculum track" reported receiving guidance from counselors on their post-high school plans. This compared to only 29% of students receiving guidance on their post-high school plans when they were on the "vocational curriculum track". These findings show evidence that counselor perceptions of a student's plan may influence the extent to which post-secondary guidance is given. The results of this study do not show that these differences influence student enrollment in specific coursework. However, this variation in guidance given may affect what courses students enroll in during high school. Considering one of the major functions of guidance counselors is assisting students in academic planning, the counselors' understanding of STEM and the relationship between STEM and CTE may have significant implications for student educational opportunities.

High school administrators. Another highly influential stakeholder group being studied is high school administrators including assistant principals and principals. Administration within a high school take on a variety of functions from basic daily managerial duties such as staff hiring, course offerings/scheduling, allocation of budget/resources, and organizing professional development opportunities (Bureau of Labor Statistics, US Department of Labor, 2015). Their duties also extend themselves to broader roles such as guiding schoolwide reform and direction (National Association of Secondary School Principals, 2006). With an ability to guide school policy and direction through duties such as hiring, budgetary decisions, and decisions related to school direction, administration within high schools can have a major impact on schools, their programs, and ultimately on students' educational experience (Clifford, Behrstock-Sherrate, & Fetters, 2012). Considering their influential role, administrators have significant potential to affect the extent to which CTE is used in teaching STEM curriculum by promoting and expanding upon courses associated with CTE.

In establishing the influential role of the high school administrator, it would be insightful to understand how these individuals view STEM and its relationship to CTE. In one study conducted by Brown, Brown, Reardon, and Merrill (2011) qualitative responses were collected from administrators and teachers in relation to their understanding of STEM education and the role that technology and engineering has in its implementation. Brown et al. found of 22 respondents that only 10 could define STEM as education that involves science, technology, engineering, and mathematics. Brown et al. additionally noted that the percentage of administration without a basic understanding of STEM education could be even higher. Some administrators indicated they did not want to participate in the study because they were not familiar with STEM and their response would not be of value.

Literature Review Conclusions

From the review of the professional literature, it was found that counselors and administrators within secondary schools can have significant influence within a school. The review showed evidence that many stakeholders often associate STEM education solely with science and mathematics courses. There was some evidence to show that these attitudes extend to high school administration. The evidence for this, and for counselors, was not sufficient to answer the research questions posed within this study.

Chapter III: Methodology

In this chapter, information is presented concerning the methods used to collect and analyze data. This chapter will explain the subjects who participated in the study, the survey instrument used, data collection procedures, limitations posed by the study, and the process used for the analysis of collected data.

Subject Selection and Description

The school system used in this study spans multiple continents and includes American faculty and students from a wide-variety of locations throughout the United States. Considering confidentially concerns, the specific school system in question cannot be directly named. Therefore, the school system that participated in this study will be referred to as District X.

All high school principals, assistant principals, and high school guidance counselors within District X were contacted and asked to participate in this study. The total number of individuals contacted was 182. This includes 42 high school principals, 44 high school assistant principals, and 96 high school guidance counselors. Of those contacted, 35 responded and agreed to participate including 10 principals, 11 assistant principals, and 14 guidance counselors.

Instrumentation & Data Collection Procedures

In February, 2018 potential participants were sent a hyperlinked survey using Survey Monkey to their school e-mail account requesting their participation in the study. Appendix A shows the explanation of the study. Information relating to research protocols, and a statement ensuring that the study has institutional review board (IRB) approval was included. A statement addressing study participation being optional and a statement of consent to participate was included to insure IRB compliance. Potential participants were sent a follow-up e-mail requesting their participation one week after the initial request. Due to a limited response rate, a third e-mail was sent informing participants that the deadline was extended by one week. Potential participants were given a total of three weeks from the date the first e-mail was sent to respond to the survey. Participants who decided to participate in the survey were tracked and their responses recorded using Survey Monkey.

The survey was developed by the researcher and was comprised of 18 questions. The survey sent to participants used a combination of question types including short answer, Likert-type scale, and multiple choice. The full survey can be found in Appendix B. The first seven questions asked for descriptive data to gathering demographic information about the participants. The last 11 questions were asked to answer the following research questions:

1. How do counselors' perceptions of CTE compare with their perceptions of STEM in preparing high school students for post-secondary college and career readiness?
2. How do administrators' perceptions of CTE compare with their perceptions of STEM in preparing high school students for post-secondary college and career readiness?

The questions asked on the survey were:

1. What is your position within the school?
2. How many years of experience have you had taking courses in the following CTE areas while attending high school?
3. How many years of experience have you had taking courses in the following CTE areas at a two-year technical or community college?
4. How many years of experience have you had taking courses in the following CTE areas at a four-year university?
5. How many years of experience do you have with teaching in the following CTE areas?

6. How many years of experience do you have working in the following businesses/industries?
7. What type of college/university degrees have you earned? (List the degree type and the subject.)
8. Rate on a scale of 1-5 (with 1 being low and 5 being high) what post-secondary career training and educational levels you perceive CTE courses best prepare students for.
9. Rate on a scale of 1-5 (with 1 being low and 5 being high) how well you perceive secondary mathematics courses help to prepare students for STEM-related post-secondary programs
10. Rate on a scale of 1-5 (with 1 being low and 5 being high) how well you perceive secondary science courses help to prepare students for STEM-related post-secondary education programs
11. Rate on a scale of 1-5 (with 1 being low and 5 being high) how well you perceive secondary CTE courses help to prepare students for STEM-related post-secondary education programs
12. Rate on a scale of 1-5 (with 1 being low and 5 being high) how well you perceive secondary mathematics curriculum at your school aligns with the present and future demands of the labor market
13. Rate on a scale of 1-5 (with 1 being low and 5 being high) how well you perceive secondary science curriculum at your school aligns with the present and future demands of the labor market

14. Rate on a scale of 1-5 (with 1 being low and 5 being high) how well you perceive secondary CTE curriculum at your school aligns with the present and future demands of the labor market
15. Rate on a scale of 1-5 (with 1 being low and 5 being high) how much effort you use to promote and expand STEM educational programs through CTE coursework for students in your school
16. Rate on a scale of 1-5 (with 1 being low and 5 being high) how much effort you use to promote and expand STEM educational programs through mathematics coursework for students in your school
17. Rate on a scale of 1-5 (with 1 being low and 5 being high) how much effort you use to promote and expand STEM educational programs through science coursework for students in your school
18. Rate on a scale of 1-5 (with 1 being low and 5 being high) how much overlap you perceive there is between the STEM and CTE coursework at your school

Data Analysis

Participant responses collected from surveys were compiled and reviewed by the researcher using ordinal measurement scales. Results from survey questions eight through 18 were compared to the collected demographic information gained from questions one through five using descriptive statistics.

Survey questions #1-7. Survey questions one through seven collected descriptive data. This information includes participants' position at the school, post-secondary degrees earned, and experience they have had with education and employment related to CTE. This demographic information was collected to allow statistical comparisons between groups with little CTE experience and groups with significant CTE experience.

Survey questions one through five asked participants their position in the school in addition to their experience with CTE during high school, two-year colleges, four-year colleges, and teaching CTE-related courses. To provide greater clarity within statistical comparisons discussed later in this paper, responses from assistant principals and principals to these questions were aggregated. Similarly, questions related to experience with CTE were also aggregated to reflect those with CTE experience in high school and those with CTE experience in post-secondary education and in teaching.

Question six asked participants about the experience they had working within industries associated with CTE. This question was asked to determine if participants had experience with employment related to CTE areas of study to provide a more compressive understanding of their background within vocational-related fields. Collected data from this question showed that participants largely had little to no experience in employment in CTE areas. Considering this, it was decided to not include this information within the data analysis and discussion sections of this paper. Question seven asked participants the type of post-secondary degrees that they have earned. After a review of the responses to this question, it was determined that this data was too varied and therefore did not provide any clarity to the research. Considering this, it was decided to not include these findings within the data analysis and discussion sections within this paper.

Survey questions #8-18. Survey questions eight through 18 were asked to gain insight into participants' perceptions of the ability of secondary mathematics, science, and CTE coursework to prepare students for the demands of the labor market and STEM-related post-secondary educational programs. A chi-square test for independence was used to compare perceptions of CTE related to mathematics and science education. For these tests, a .05 alpha (α) level of significance was used to determine if p-values were significant. Statistical analyses between variables will help to compare participant perceptions of CTE to other STEM courses in preparing high school students for post-secondary college and careers. Though no statistical analysis was used to compare the results of the collected participant background information to the conducted chi-tests, results from aggregated demographic data allows for an analysis of any trends warranting further research.

Limitations of the Study

In order to gain insight into the perceptions held by secondary administrators and counselors in regard to the relationship between CTE and STEM, data was gathered using Likert-like scales. This method of collecting data, however, presented the following limitations:

1. The collection of ordinal data using surveys provides a limited view of the actual perceptions of the participants. This type of data can provide some insight but cannot fully communicate participant feelings.
2. Collection of ordinal data limited the number and type of statistical comparisons that could be made.
3. Limitations with the researcher's time and resources confined the study to individuals employed by District X.
4. District X is unique in its diverse student and faculty population. Generalizations to the population cannot be easily made.
5. The small number of respondents made data analysis difficult. Small changes in participants' answers resulted in a large shift in the reported percentages.

Chapter IV: Results

This chapter discusses the purpose of each survey item in answering the research questions and the results of the data analysis. Survey results were aggregated and compared using statistical analyses. Discussions are provided for any salient findings.

Demographic

A total of 182 administrators and counselors were asked to participate in the study. Thirty-five individuals consisting of 14 counselors, 10 principals, and 11 assistant principals responded to the invitation. Demographic information was collected through survey questions asking respondents' position in the school. In addition, participate experience with CTE courses during and after high school were included in the survey.

Item Analysis

Survey questions one through five were designed to determine the participant experience in CTE. Survey questions eight through 18 were designed to measure counselors', assistant principals', and principal's perceptions regarding the ability for high school mathematics, science, and CTE courses to prepare students for STEM-related post-secondary education programs and labor market demands. Tables are provided corresponding to each question showing the frequency and percentage of each response. It should be noted that data was aggregated to facilitate analysis. Responses showing a rank of one or two were combined to reflect those with a lower rating of the topic in question. Responses showing a rank of three are viewed as having a mid-rating of the topic in question. Responses showing a rank of four or five were combined to reflect those with a high rating of the topic in question.

Survey questions #1-5. Survey questions one through five asked participants to state the extent of CTE experience they have had both during and after high school. As shown in Table 2, the majority of counselors have taken at least one CTE course while attending high school (92.9%) and taken at least one CTE course during their post-secondary education and teaching career (92.9%). High school administrators reported having considerably lower experience with CTE in high school with 57.1% responding with taking at least one course. Administrators did report having more experience taking CTE courses during post-secondary education and through teaching CTE courses in high school (90.5%).

Table 2

Participant Experience with CTE as a Percentage

Variable	Counselors Number/Percent	Administrators Number/Percent
CTE in High School	14/92.9%	21/57.1%
CTE in Post-secondary/Teaching	14/92.9%	21/90.5%

Survey question #8. Survey question eight asked participants to rate on a scale of 1-5, with one being low and five being high, what post-secondary career training and educational levels they perceive CTE courses best prepare students for. Respondents were given the ability to rate the following categories: workforce, technical degree, associates degrees, and bachelor's degree. Responses for both counselors and administrators were aggregated. Ratings of one or two were categorized as "Low". Ratings of four or five were categorized as "High". Ratings of three were categorized as "Mid". As shown in Table 3, the majority of counselors ranked CTE as High in its ability to prepare students for the workforce (64.3%), technical degrees (78.6%), associates degrees (57.1%), and bachelor's degree (50%). Counselors see CTE courses as being able to prepare students across all categories.

Table 3

Counselor Perceptions of Extent CTE Prepares Students for Post-Secondary Options

	Workforce		Technical Degree		Associates		Bachelors	
Responses	*n* (14)	Percent	*n* (14)	Percent	*n* (14)	Percent	*n* (14)	Percent
1-2 (Low)	3	21.4%	2	14.3%	3	21.4%	3	21.4%
3 (Mid)	2	14.3%	1	7.1%	3	21.4%	4	28.6%
4-5 (High)	9	64.3%	11	78.6%	8	57.1%	7	50.0%

Note. Numbers in parenthesis indicate total number of responses.

Administrators were asked to what extent CTE prepares students for post-secondary options. Their responses show positive perceptions. As shown in Table 4, the majority of administrators responded positively to CTE's ability to prepare students for each of the listed post-secondary career training and educational level options.

Table 4

Administrator Perceptions of Extent CTE Prepares Students for Post-Secondary Options

	Workforce		Technical Degree		Associates		Bachelors	
Responses	*n* (35)	Percent	*n* (35)	Percent	*n* (35)	Percent	*n* (35)	Percent
1-2 (Low)	4	19.1%	5	23.8%	4	19.1%	5	23.8%
3 (Mid)	4	19.0%	4	19.0%	5	23.8%	5	23.8%
4-5 (High)	13	61.9%	12	57.1%	12	57.1%	11	52.4%

Note. Numbers in parenthesis indicate total number of responses.

High ratings (61.9%) for CTE preparing students for the workforce, 57.1% rating CTE high for preparing students for a technical degree, 57.1% rating CTE at a high level for an associate's degree, and 52.4% rating CTE at a high level for a bachelor's degree. Little variation was found between counselor and administrator responses with exception to CTE preparing students for technical degrees. Results show that 57.1% of administrators rated CTE as High in preparing students for technical degrees in contrast to 78.6% of counselors.

Survey question #9-11. Survey question nine asked participants to rate on a scale of 1-5, with one being low and five being high, how well they perceive mathematics courses help to prepare students for STEM-related post-secondary education programs. Table 5 shows that 10 (71.4%) counselors and seven (70%) principals reported a high rating. These counselors and principals perceive math courses as helping prepare students for post-secondary STEM careers. Four of eleven (36.4%) of assistant principals perceived math courses as helping prepare students for post-secondary STEM careers. While the researcher acknowledges that the small sample size has a large impact on percentages, it should be noted that this connection between math and CTE was perceived at half the rate by the assistant principal group. Only one (7.1%) counselor, one assistant principal (9.1%), and one principal (10%) did not perceive secondary mathematics courses as helping to prepare students for STEM careers. Assistant principals perceived secondary math's ability to prepare students for STEM careers at half the rate of the counselors and principals. Assistant principals indicated math's ability to prepare students for CTE careers at the mid-range twice as often as did the counselors and principals. The groups see a connection between math and STEM careers at a similar percentage (approximately 70%) if the mid and high perceptions are added. The total responses show a majority (60%) of respondents providing a high rating and only 8.6% of respondents reported a low rating of secondary math's importance for STEM careers. Collected responses show that assistant principals perceive mathematics' ability to prepare students for STEM careers as less than the perceptions of counselors and principals.

Table 5

Perceptions of Secondary Mathematics Ability to Prepare Students for STEM Careers

	Counselors		Assistant Principals		Principals		Totals	
Responses	*n* (14)	Percent	*n* (11)	Percent	*n* (10)	Percent	*n* (35)	Percent
1-2 (Low)	1	7.1%	1	9.1%	1	10.0%	3	8.6%
3 (Mid)	3	21.4%	6	54.6%	2	20.0%	11	31.4%
4-5 (High)	10	71.4%	4	36.4%	7	70.0%	21	60.0%

Note. Numbers in parenthesis indicate total number of responses.

Survey question 10 asked participants to rate on a scale of 1-5, with one being low and five being high, how well they perceive science courses help to prepare students for STEM-related post-secondary education programs. Table 6 shows that 11 (78.6%) counselors, seven (63.6%) assistant principals, and four (40%) principals gave secondary science a high rating on its ability to prepare students for CTE.

Table 6

Perceptions of Secondary Science Ability to Prepare Students for STEM Careers

	Counselors		Assistant Principals		Principals		Totals	
Responses	*n* (14)	Percent	*n* (11)	Percent	*n* (10)	Percent	*n* (35)	Percent
1-2 (Low)	1	7.1%	0	0.0%	1	10.0%	2	5.7%
3 (Mid)	2	14.3%	4	36.4%	5	50.0%	11	31.4%
4-5 (High)	11	78.6%	7	63.6%	4	40.0%	22	62.9%

Note. Numbers in parenthesis indicate total number of responses.

Conversely only one (7.1%) counselor, no assistant principals (0%), and one (10%) principal provided a low rating for science's ability to prepare students for STEM careers. Totals show that 62.9% of respondents reported a high rating while only 5.7% reported a low rating on secondary science's ability to prepare students for STEM careers.

Survey question 11 asked participants to rate on a scale of 1-5, with one being low and five being high, how well they perceive CTE courses help to prepare students for STEM-related post-secondary education programs. As shown in Table 7, nine (64.3%) counselors, seven (63.6%) assistant principals, and six (60%) principals reported a high rating. Conversely only four (28.6%) counselors (28.6%), two (18.2%) assistant principals, and one (10%) principal rated CTE low in its ability to prepare students for STEM careers.

Table 7

Perceptions of Secondary CTE Ability to Prepare Students for STEM Careers

	Counselors		Assistant Principals		Principals		Totals	
Responses	*n* (14)	Percent	*n* (11)	Percent	*n* (10)	Percent	*n* (35)	Percent
1-2 (Low)	4	28.6%	2	18.2%	1	10.0%	7	20.0%
3 (Mid)	1	7.1%	2	18.2%	3	30.0%	6	17.1%
4-5 (High)	9	64.3%	7	63.6%	6	60.0%	22	62.9%

Note. Numbers in parenthesis indicate total number of responses.

Responses to questions pertaining to perceptions of mathematics, science, and CTE courses' ability to prepare students for STEM-related post-secondary education programs were compared with a chi-square test using a .05 level of significance. Separate statistical analyses were performed with perceptions of counselors and with perceptions of administrators. Table 8 shows the data used in the chi-square test conducted with the perceptions of counselors. The chi-square test resulted in a *p*-value of 0.38, which is larger than the alpha level of .05. There is not a significant difference in counselors' perceptions of math, science, and CTE courses' ability to prepare students for STEM careers.

Table 8

Counselor Perceptions of Courses' Ability to Prepare Students for STEM Education

	Courses			
Reported Ratings	Math STEM	Science STEM	CTE STEM	*p*-value
1-2 (Low)	1 (7.1%)	1 (7.1%)	4 (28.6%)	0.38
3 (Mid)	3 (21.4%)	2 (14.3%)	1 (7.1%)	
4-5 (High)	10 (71.4%)	11 (78.6%)	9 (64.4%)	

Note. $\chi^2 = 4.2$, df = 4, $\alpha = .05$. Numbers in parenthesis indicate column percentages.

The chi-square test, performed using data provided from administrators', is shown in Table 9. The chi-square test resulted in a *p*-value of 0.66, which is larger than the .05 alpha level. There is not a significant difference in administrators' perceptions of math, science, and CTE courses' ability to prepare students for STEM careers.

Table 9

Administrator Perceptions of Courses' Ability to Prepare Students for STEM Education

	Courses			
Reported Ratings	Math STEM	Science STEM	CTE STEM	*p*-value
1-2 (Low)	2 (9.5%)	1 (4.8%)	3 (14.3%)	0.66
3 (Mid)	8 (38.1%)	9 (42.9%)	5 (23.8%)	
4-5 (High)	11 (52.4%)	11 (52.4%)	13 (61.9%)	

Note. $\chi^2 = 2.4$, df = 4, $\alpha = .05$. Numbers in parenthesis indicate column percentages.

Survey question #12-14. Survey question 12 asked participants to rate on a scale of 1-5, with one being low and five being high, how well they perceive mathematics curriculum at their school aligning with present and future demands of the labor market. As shown in Table 10, responses from counselors, assistant principals, and principals show little consensus. Respondents who ranked math curriculum aligning to future demands of the labor market low include four (28.6%) counselors, four (36.4%) assistant principals, and one (10%) principal. Respondents who reported a high rating include four (28.6%) counselors, two (18.2%) assistant principals, and two (20%) principals. The category with the most agreement was the mid-level response with six (42.9%) counselors, five (45.5%) assistant principals, and seven (70%) principals indicating some alignment. Respondents who chose a rating of three reflect 51.4% of the total response.

Table 10

Perceptions of Secondary Mathematics Alignment to Labor Market Demands

	Counselors		Assistant Principals		Principals		Totals	
Responses	*n* (14)	Percent	*n* (11)	Percent	*n* (10)	Percent	*n* (35)	Percent
1-2 (Low)	4	28.6%	4	36.4%	1	10.0%	9	25.7%
3 (Mid)	6	42.9%	5	45.5%	7	70.0%	18	51.4%
4-5 (High)	4	28.6%	2	18.2%	2	20.0%	8	22.9%

Note. Numbers in parenthesis indicate total number of responses.

Survey question 13 asked participants to rate on a scale of 1-5, with one being low and five being high, how well they perceive science curriculum at their school aligning with present and future demands of the labor market. Similar to survey question 12, Table 11 shows that responses from counselors, assistant principals, and principals show little consensus.

Table 11

Perceptions of Secondary Science Alignment to Labor Market Demands

	Counselors		Assistant Principals		Principals		Totals	
Responses	*n* (14)	Percent	*n* (11)	Percent	*n* (10)	Percent	*n* (35)	Percent
1-2 (Low)	4	28.6%	3	27.3%	0	0.0%	7	20.0 %
3 (Mid)	7	50.0%	5	45.5%	7	70.0%	19	54.3%
4-5 (High)	3	21.4%	3	27.3%	3	30.0%	9	25.7%

Note. Numbers in parenthesis indicate total number of responses.

Respondents who rated the alignment between science and labor market demands low included four (28.6%) counselors, three (27.3%) assistant principals, and no (0%) principals. Respondents who rated the alignment between science and labor market demands high included three (21.43%) counselors, three (27.3%) assistant principals, and three (30%) principals. Participants indicated some alignment between science and labor market demands most frequently with seven (50%) counselors, five (45.5%) assistant principal, and seven (70%) principals choosing a mid-level rating. Respondents who chose a rating of three reflect 54.3% of the total response.

Survey question 14 asked participants to rate on a scale of 1-5, with one being low and five being high, how well they perceive CTE curriculum at their school aligning with present and future demands of the labor market. Table 12 shows that five (50%) principals indicated that the alignment between CTE and the demands of the labor market was high. Seven (50%) counselors and four (36.4%) assistant principals rated the alignment between CTE and the demands of the labor market at the mid-level. Total response data shows a rating of three as having the highest frequency with 40%.

Table 12

Perceptions of Secondary CTE Alignment to Labor Market Demands

	Counselors		Assistant Principals		Principals		Totals	
Responses	*n* (14)	Percent	*n* (11)	Percent	*n* (10)	Percent	*n* (35)	Percent
1-2 (Low)	4	28.6%	3	27.3%	2	20.0%	9	25.7%
3 (Mid)	7	50.0%	4	36.4%	3	30.0%	14	40.0%
4-5 (High)	3	21.4%	4	36.4%	5	50.0%	12	34.3%

Note. Numbers in parenthesis indicate total number of responses.

Responses to questions pertaining to perceptions of mathematics, science, and CTE courses' alignment with the demands of the labor market were compared with a chi-square test using a .05 level of significance. Separate statistical analyses were performed with perceptions of counselors and with perceptions of administrators. Table 13 shows the data used in the chi-square test conducted with the perceptions of counselors. The chi-square test resulted in a *p*-value of 0.99, which is larger than the alpha level of .05. There is not a significant difference in counselors' perceptions of math, science, and CTE courses' ability to prepare students for labor market demands.

Table 13

Counselor Perceptions of Courses' Ability to Prepare Students for Labor Market Demands

	Courses			
Reported Ratings	Math STEM	Science STEM	CTE STEM	*p*-value
1-2 (Low)	4 (28.6%)	4 (28.6%)	4 (28.6%)	0.99
3 (Mid)	6 (42.9%)	7 (50.0%)	7 (50.0%)	
4-5 (High)	4 (28.6%)	3 (21.4%)	3 (21.4%)	

Note. $\chi^2 = 0.30$, df = 4, $\alpha = .05$. Numbers in parenthesis indicate column percentages.

The chi-square test, performed using data provided from administrators', is shown in Table 14. The chi-square test resulted in a *p*-value of 0.38, which is larger than the .05 alpha level. There is not a significant difference administrators' perception of math, science and CTE courses' ability to prepare students for labor market demands.

Table 14

Administrator Perceptions of Courses' Ability to Prepare Students of Labor Market Demands

	Courses			
Reported Ratings	Math STEM	Science STEM	CTE STEM	*p*-value
1-2 (Low)	5 (23.8%)	3 (14.3%)	5 (14.3%)	0.38
3 (Mid)	12 (57.1%)	12 (57.1%)	7 (33.3%)	
4-5 (High)	4 (19.0%)	6 (28.6%)	9 (42.9%)	

Note. $\chi^2 = 4.23$, df = 4, $\alpha = .05$. Numbers in parenthesis indicate column percentages.

Survey question #15-17. Survey question 15 asked participants to rate on a scale of 1-5, with one being low and five being high, how much effort they use to promote and expand STEM educational programs through CTE coursework for students in their school. As seen in Table 15, the total response shows that only 14.3% of respondents reporting a low rating for the effort they use to promote and expand STEM programming while 45.7% reported that they promote and expand STEM at a high level.

Table 15

Effort Used to Promote and Expand STEM Through CTE

	Counselors		Assistant Principals		Principals		Totals	
Responses	*n* (14)	Percent	*n* (11)	Percent	*n* (10)	Percent	*n* (35)	Percent
1-2 (Low)	3	21.4%	2	18.2%	0	0.0%	5	14.3%
3 (Mid)	4	28.6%	4	36.4%	6	60.0%	14	40.0%
4-5 (High)	7	50.0%	5	45.5%	4	40.0%	16	45.7%

Note. Numbers in parenthesis indicate total number of responses.

Seven (50%) counselors and five (45.5%) assistant principals rated their efforts to promote and expand STEM at highest levels. This is in contrast to the six (60%) principals whose most frequent response was a mid-level rating (60%). Survey question 15 shows a divide between those who rated their efforts to promote STEM at a mid-level and those who rated their efforts to promote STEM at a high level.

Survey question 16 asked participants to rate on a scale of 1-5, with one being low and five being high, how much effort they use to promote and expand STEM educational programs through mathematics coursework for students in their school. As seen in Table 16, counselor responses show a relatively high frequency (64.3%) rated their efforts to promote STEM through mathematics courses as “High”. This is in contrast to the three (27.3%) assistant principals and two (20%) principals who rated their efforts to promote STEM through math at a high level.

Table 16

Effort Used to Promote and Expand STEM Through Mathematics

	Counselors		Assistant Principals		Principals		Totals	
Responses	*n* (14)	Percent	*n* (11)	Percent	*n* (10)	Percent	*n* (35)	Percent
1-2 (Low)	3	21.4%	4	36.4%	0	0.0%	7	20.0%
3 (Mid)	2	14.3%	4	36.4%	8	80.0%	14	40.0%
4-5 (High)	9	64.3%	3	27.3%	2	20.0%	14	40.0%

Note. Numbers in parenthesis indicate total number of responses.

Survey question 17 asked participants to rate on a scale of 1-5, with one being low and five being high, how much effort they use to promote and expand STEM educational programs through science coursework for students in their school. As seen in Table 17, nine (64.3%) of counselors and four (40%) principals rated their efforts to promote STEM through science at the highest level. Four (36.4%) assistant principals rated their efforts to promote STEM through science at the middle level. The same number of assistant principals gave a low rating to their efforts to promote STEM through science. Total responses show little consensus.

Table 17

Effort Used to Promote and Expand STEM Through Science

	Counselors		Assistant Principals		Principals		Totals	
Responses	*n* (14)	Percent	*n* (11)	Percent	*n* (10)	Percent	*n* (35)	Percent
1-2 (Low)	4	28.6%	4	36.4%	1	10.0%	9	25.7%
3 (Mid)	1	7.1%	4	36.4%	5	50.0%	10	28.6%
4-5 (High)	9	64.3%	3	27.3%	4	40.0%	16	45.7%

Note. Numbers in parenthesis indicate total number of responses.

Responses to questions pertaining to perceptions of effort used to promote and expand mathematics, science, and CTE courses were compared with a chi-square test using a .05 level of significance. Separate statistical analyses were performed with perceptions of counselors and with perceptions of administrators. Table 18 shows the data used in the chi-square test regarding the perceptions of counselors. The chi-square test resulted in a *p*-value of 0.64, which is larger than the alpha level of .05. There is not a significant difference in counselors' effort to promote STEM through math, science, and CTE courses.

Table 18

Counselor Effort to Promote STEM Through Courses

	Courses			
Reported Ratings	Math STEM	Science STEM	CTE STEM	*p*-value
1-2 (Low)	3 (21.4%)	3 (21.4%)	4 (28.6%)	0.64
3 (Mid)	4 (33.3%)	2 (14.3%)	1 (7.1%)	
4-5 (High)	7 (50.0%)	9 (64.3%)	9 (64.3%)	

Note. $\chi^2 = 2.52$, df = 4, $\alpha = .05$. Numbers in parenthesis indicate column percentages.

The chi-square test, performed using data provided from administrators', is shown in Table 19. The chi-square test resulted in a *p*-value of 0.92, which is larger than the .05 alpha level. There is not a significant difference in administrators' effort to promote STEM through math, science, and CTE courses

Table 19

Administrator Effort to Promote STEM Through Courses

	Courses			
Reported Ratings	Math STEM	Science STEM	CTE STEM	*p*-value
1-2 (Low)	4 (19.0%)	4 (19.0%)	5 (23.8%)	0.92
3 (Mid)	11 (52.4%)	12 (57.1%)	9 (42.9%)	
4-5 (High)	6 (28.6%)	5 (23.8%)	7 (33.3%)	

Note. $\chi^2 = 0.92$, df = 4, $\alpha = .05$. Numbers in parenthesis indicate column percentages.

Survey question #18. Survey question 18 asked participants to rate on a scale of 1-5, with one being low and five being high, how much overlap they perceive that there is between the STEM and CTE coursework at their school. As seen in Table 20, there is little consensus between the perceptions of participants. Seven (50%) of counselors indicated there was a high amount of overlap between STEM and CTE curriculum. Five (35.7%) counselors indicated there was little overlap between STEM and CTE curriculum. Assistant principals' ratings were the opposite of counselors. Six (54.5%) assistant principals indicated little overlap between STEM and CTE curriculum. Three (27.3%) assistant principals perceived there was a high degree of overlap between STEM and CTE curriculum. Principal ratings were distributed evenly across the low, mid, and high ratings (30% low, 40% mid, and 30% high) for curriculum overlap between STEM and CTE curriculum.

Table 20

Perceived Overlap Between STEM and CTE

	Counselors		Assistant Principals		Principals		Totals	
Responses	*n* (14)	Percent	*n* (11)	Percent	*n* (10)	Percent	*n* (35)	Percent
1-2 (Low)	5	35.7%	6	54.5%	3	30.0%	14	40.0%
3 (Mid)	2	14.3%	2	18.25	4	40.0%	8	22.9%
4-5 (High)	7	50.0%	3	27.3%	3	30.0%	13	37.1%

Note. Numbers in parenthesis indicate total number of responses.

Chapter V: Discussion, Conclusions, and Recommendations

This chapter provides a discussion of the results of the study and their ability to answer the stated research questions. Based on the findings of the study, recommendations are given for further research on administrator and counselors perceptions of CTE. In addition, other variables which can impact the extent to which CTE is used to teach STEM concepts are identified and suggested to be a focus for further research.

Discussion & Conclusions

Results from the survey indicate that both counselors and administrators generally perceive CTE courses as being beneficial in preparing students for STEM-related post-secondary programs. The chi-square tests performed do not indicate statistical significance in the way counselors and administrators perceive science, math, and CTE courses. The distribution of responses throughout the study, and the results of responses to CTE-related questions compared to mathematics and science courses, show relatively similar perceptions among participant groups with few exceptions.

The data shows that counselors and administrators have a more neutral perception of CTE's alignment with labor market demands; but responses also show that this is not an attitude specific to this content area. These findings could indicate that these stakeholders perceive that an inability to provide students relevant post-secondary STEM skills and knowledge is an issue associated more with secondary education as a whole rather than the problem being related to specific academic areas of study.

Participants indicated a relatively low level of overlap between STEM and CTE courses. This low perception was found to be higher in the administrator responses. The relatively little experience administrators reported with taking CTE courses in high school could influence these perceptions. A lack of exposure to CTE could result in lower perception of its value in preparing students for STEM-related post-secondary education and careers. Alternatively, the wide-array of courses that is a part of the CTE purview could help to explain administrators' responses. The way in which survey questions were asked could be providing an incomplete picture. As discussed earlier in this paper, CTE courses encompass many unique areas of study. Many of which, such as family and consumer science and business, are not primarily associated with STEM-related fields. Considering that respondents likely perceived the question pertaining to CTE as a whole, it is understandable that responses were not significantly favorable towards CTE.

Another confounding variable that could explain participant responses is the quality of instruction provided at their specific school. Though the minority, there was a number of responses showing a rating less than high in participant perceptions of CTE, mathematics, and science courses ability to prepare students for STEM-related post-secondary programs and their alignment with labor market demands. It is possible that respondents could hold a higher esteem to the value of these subjects' but responded with ratings of less than four or five due to a negative perception of instruction specific to their school. Such factors that could have prompted such ratings include, for example, the curriculum used, the quality of teacher instruction, coursework offered, and funding provided to these subject areas.

Recommendations

Results indicate that counselors and administrators generally view CTE as an effective vehicle for teaching STEM concepts. Findings from the research did, however, show that a large number of administrators held a negative perception regarding the level of overlap between STEM and CTE coursework at their school. Considering the limitations posed by the low number of participants and the subjective nature of ordinal data, no causal or correlation statistics were used in this study. In lieu of these limitations, it is suggested that further research is needed to look at the factors that can negatively affect CTE being used as a vehicle to teach STEM concepts. Further research looking at the perceptions of counselors and administrators using assessment tools that may more accurately capture respondents' perceptions would provide a clearer understanding of these stakeholders perceptions. It would also be beneficial to look at the same variables with a larger sample size in order to better extrapolate findings to the population.

Though further research could be conducted pertaining to the perceptions that counselors and administrators have, it may be more insightful to gain a better understanding of the perceptions of other stakeholders. These other stakeholders would have an influence on the extent that CTE is used to teach STEM concepts. For example, parents/guardians and students may be surveyed about their perceptions of CTE, science, and math curriculum. In addition to the perceptions of stakeholders, there could be benefits in looking at the factors that influence these individuals. Popular media, politics, and social influences have may impact stakeholders' perceptions and could be topics for further research.

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Appendix A: Consent Form

UW-Stout Implied Consent Statement
for Research Involving Human Subjects

Consent to Participate In UW-Stout Approved Research

Title: High School Counselor & Administration Perceptions Toward CTE's Role in STEM Education

Investigator:
Philip Ackland
+81 080-8813-2290
philip.ackland@districtx.edu

Research Sponsor:
Sylvia Tiala
715-232-5619
tialas@uwstout.edu

Description:
With a recent call for action for students to pursue careers in STEM-related fields, secondary Career and Technical Education (CTE) has shown potential in helping to meet this demand. Despite CTE representing a promising vehicle for teaching STEM-related content, national enrollment trends in CTE coursework at the secondary level show stagnation or a decline in numbers. To gain a better understanding of this issue, this study aims to determine the perceptions held by influential stakeholders as to the role that CTE coursework has in preparing students to be college and career ready in STEM fields of study. Administrators and counselors working within District X were chosen to be the center of focus of this study. To gain insight to their perceptions regarding the comparison between CTE and STEM, all administrators and counselors working within District X are being requested to participate in the study through the completion of a survey.

Benefits and Risks:
This study has the potential to benefit students at the secondary level by gaining insight into factors that can impact the quality of their education. The risks and discomfort associated with answering the questions found in the provided survey are no greater than those ordinarily encountered in daily life.

Time Commitment:
The survey is comprised of 18 questions and is expected to take 10-15 minutes to complete.

Confidentiality:
The information that you provide is anonymous. We do not believe that you can be identified from any information that you provide.

Right to Withdraw:
Your participation in this study is entirely voluntary. You may choose not to participate without any adverse consequences to you. You have the right to stop taking the survey at any time. Please be advised that as soon as you submit the survey it will not be possible to remove your results as data collected is anonymous.

IRB Approval:
This study has been reviewed and approved by The University of Wisconsin-Stout's Institutional Review Board (IRB). The IRB has determined that this study meets the ethical obligations required by federal law and University policies. If you have questions or concerns regarding this study, please contact the Investigator or Advisor. If you have any questions, concerns, or reports regarding your rights as a research subject, please contact the IRB Administrator.

Investigator:
Philip Ackland
+81 080-8813-2290
philip.ackland@districtx.edu

Advisor:
Sylvia Tiala
715-232-5619
tialas@uwstout.edu

IRB Administrator
Elizabeth Buchanan
Office of Research and Sponsored Programs
152 Vocational Rehabilitation Bldg.
UW-Stout
Menomonie, WI 54751
715.232.2477
buchanane@uwstout.edu

Statement of Consent:
Completing the survey found by accessing the hyperlink provided in this email implies your consent to participate in the project entitled, "High School Counselor & Administration Perceptions Toward CTE's Role in STEM Education". Please be advised that if you change your mind at a later time and wish for your results to be removed, it will not be possible as data collected is anonymous.

Appendix B: Survey Instrument

Title: Perceptions Toward CTE's Role in STEM Education

Thank you for agreeing to take the time to take part in this study. The aim of this study is to determine perceptions held by high school administrators and counselors regarding the relationship between CTE and STEM in preparing high school students for post-secondary college and career readiness. This survey should take 10-15 minutes to complete. Be assured that all answers you provide will be kept in the strictest confidentially. When you are finished answering the questions below, click "submit".

19. What is your position within the school?

    ○ Counselor ○ Principal ○ Assistant Principal

20. How many years of experience have you had taking courses in the following CTE areas while attending high school?

Technology Education	○ 0 ○ 1 ○ 2 ○ 3 ○ 4+
Business and Marketing Education	○ 0 ○ 1 ○ 2 ○ 3 ○ 4+
Agriculture Education	○ 0 ○ 1 ○ 2 ○ 3 ○ 4+
Family and Consumer Science	○ 0 ○ 1 ○ 2 ○ 3 ○ 4+
Health Occupations	○ 0 ○ 1 ○ 2 ○ 3 ○ 4+

21. How many years of experience have you had taking courses in the following CTE areas at a two-year technical or community college?

Technology Education	○ 0 ○ 1 ○ 2 ○ 3 ○ 4+
Business and Marketing Education	○ 0 ○ 1 ○ 2 ○ 3 ○ 4+
Agriculture Education	○ 0 ○ 1 ○ 2 ○ 3 ○ 4+
Family and Consumer Science	○ 0 ○ 1 ○ 2 ○ 3 ○ 4+
Health Occupations	○ 0 ○ 1 ○ 2 ○ 3 ○ 4+

22. How many years of experience have you had taking courses in the following CTE areas at a four-year university?

Technology Education	○ 0 ○ 1 ○ 2 ○ 3 ○ 4+

Business and Marketing Education	○ 0 ○ 1 ○ 2 ○ 3 ○ 4+
Agriculture Education	○ 0 ○ 1 ○ 2 ○ 3 ○ 4+
Family and Consumer Science	○ 0 ○ 1 ○ 2 ○ 3 ○ 4+
Health Occupations	○ 0 ○ 1 ○ 2 ○ 3 ○ 4+

23. How many years of experience do you have with teaching in the following CTE areas?

Technology Education	○ 0	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7	○ 8	○ 9	○ 10+
Business and Marketing Education	○ 0	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7	○ 8	○ 9	○ 10+
Agriculture Education	○ 0	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7	○ 8	○ 9	○ 10+
Family and Consumer Science	○ 0	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7	○ 8	○ 9	○ 10+
Health Occupations	○ 0	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7	○ 8	○ 9	○ 10+

24. How many years of experience do you have working in the following businesses/industries?

Technology/ Engineering	○ 0	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7	○ 8	○ 9	○ 10+
Business and Marketing	○ 0	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7	○ 8	○ 9	○ 10+
Agriculture	○ 0	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7	○ 8	○ 9	○ 10+
Family and Consu Science	○ 0	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7	○ 8	○ 9	○ 10+
Health Occupation	○ 0	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7	○ 8	○ 9	○ 10+

25. What type of college/university degrees have you earned? (List the degree type and the subject)

Short answer text

26. Rate on a scale of 1-5 (with 1 being low and 5 being high) what post-secondary career training and educational levels you perceive CTE courses best prepare students for

entering workforce out of high school	○ 1 ○ 2 ○ 3 ○ 4 ○ 5

technical degree	○ 1 ○ 2 ○ 3 ○ 4 ○ 5
agriculture Education	○ 1 ○ 2 ○ 3 ○ 4 ○ 5
associate's degree	○ 1 ○ 2 ○ 3 ○ 4 ○ 5
bachelor's degree or higher	○ 1 ○ 2 ○ 3 ○ 4 ○ 5

27. Rate on a scale of 1-5 (with 1 being low and 5 being high) how well you perceive secondary mathematics courses help to prepare students for STEM-related post-secondary programs

    ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

28. Rate on a scale of 1-5 (with 1 being low and 5 being high) how well you perceive secondary science courses help to prepare students for STEM-related post-secondary education programs

    ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

29. Rate on a scale of 1-5 (with 1 being low and 5 being high) how well you perceive secondary CTE courses help to prepare students for STEM-related post-secondary education programs

    ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

30. Rate on a scale of 1-5 (with 1 being low and 5 being high) how well you perceive secondary mathematics curriculum at your school aligns with the present and future demands of the labor market

    ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

31. Rate on a scale of 1-5 (with 1 being low and 5 being high) how well you perceive secondary science curriculum at your school aligns with the present and future demands of the labor market

    ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

32. Rate on a scale of 1-5 (with 1 being low and 5 being high) how well you perceive secondary CTE curriculum at your school aligns with the present and future demands of the labor market

    ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

33. Rate on a scale of 1-5 (with 1 being low and 5 being high) how much effort you use to promote and expand STEM educational programs through CTE coursework for students in your school

    ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

34. Rate on a scale of 1-5 (with 1 being low and 5 being high) how much effort you use to promote and expand STEM educational programs through mathematics coursework for students in your school

    ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

35. Rate on a scale of 1-5 (with 1 being low and 5 being high) how much effort you use to promote and expand STEM educational programs through science coursework for students in your school

    ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

36. Rate on a scale of 1-5 (with 1 being low and 5 being high) how much overlap you perceive there is between the STEM and CTE coursework at your school

    ○ 1 ○ 2 ○ 3 ○ 4 ○ 5