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Examining the Perceived Implications of Eliminating the STEM Career Cluster in Kansas

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Examining the Perceived Implications of Eliminating the STEM Career Cluster in Kansas

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by

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Abstract

Career and technical education (CTE) has been an effort in the United States to help bring quality career preparation programs to secondary schools nationwide, with many career clusters allowing schools to teach various courses. For example, the science, technology, engineering, and mathematics (STEM) career cluster provides interdisciplinary approaches and hands-on activities to help students succeed in postsecondary ventures. One of the integral subjects in STEM education is technology and engineering education (T&EE), which has been synonymous with STEM education for decades. T&EE is a discipline which has been around for over a century, nevertheless it may be confused with CTE. Understanding how these programs have cohesively existed, may allow for better collaboration in the profession. In 2017, the Kansas Department of Education removed the STEM career cluster, although the STEM career cluster is utilized in 37 other state frameworks. In this case study, the implications of removing the STEM career cluster will be examined from the perspective of Kansas teachers, CTE directors, and institutional leaders, specifically investigating the administrative, financial, professional, enrollment, and satisfaction implications. Considering recent trends in T&EE, this study will present contemporary considerations for states, programs, and teachers facing similar concerns.

Keywords: technology and engineering education, career and technical education, STEM education, career clusters, career pathways, case study, career and technical education frameworks

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Chapter One: Introduction

Introduction

Technology and engineering education (T&EE) is an educational discipline in the United States which focuses on advancing technological and engineering literacy for all students. T&EE is deeply rooted in a rich tradition dating back over a century. Once known as the industrial arts, it focused on the everchanging industrial era of America. As technological advances have occurred, so has the discipline. Accordingly, T&EE is positioned as one of the prime disciplines within the science, technology, engineering, and mathematics (STEM) education movement, primarily interested in the T and E of STEM education utilizing an integrative STEM education approach (International Technology and Engineering Educator's Association [ITEEA], 2021). Starr (2017), published the Phi Delta Kappa International's 49th poll of public attitudes toward public schools and found that "Americans feel that taking technology and engineering classes is one of the most important aspects of school quality (p. 24)." Accordingly, the value of T&EE is providing technological and engineering literacy to students while properly preparing them to become well-rounded citizens of society capable of critical thinking and problem-solving (Bowen, 2019; Brown et al., 2011; ITEEA, 2021).

Still, there have been issues within the T&EE discipline over the previous several decades, regarding not just enrollment, but as a presence in schools (Volk, 1993; Volk, 2000; Volk, 2019). One of the profession's most important areas of focus is teacher recruitment and retention (Caccavale, 2016; Daugherty, 1998; Love, 2014; Love et al., 2016). Extensive research has been conducted on recruitment and retention efforts within the discipline. Much of this research focuses on the secondary and postsecondary classrooms (Love et al., 2016). With the focus primarily on classrooms, little focus has been placed on the impact of state-level divisions of education. State-level education divisions and agencies impact attrition rates for teachers as well as assisting in recruiting them (Carver-Thomas & Darling-Hammond, 2019). Namely, looking at the broader picture, state-level agencies may also help halt the decline within the profession.

This chapter presents a basic understanding of T&EE and how it relates to STEM education. Also discussed is how the decline in programs over the last several decades is directly related to the lack of support and the professional involvement of teachers, which may help justify the need for support from state agencies to reinvigorate the profession. Next, concepts related to T&EE are defined and describe the questions guiding this study. Finally, the conclusion culminates in discussing the proposed study's scope and limitations.

Background of Study

T&EE is a general education subject offering technological and engineering literacy for all students in the K–12 realm (ITEEA, 2020). The curriculum for T&EE encompasses various subjects, including manufacturing, communication technologies, robotics/automation, power and energy, computer-aided drafting (CAD), construction, and additional technical areas. It has a complicated, shared history with career and technical education (CTE) (Volk, 2019), which will be highlighted in Chapter Two. Furthermore, CTE is the national model from which all states outline their technological course offerings at the secondary levels in public schools. T&EE has long been held under the umbrella of CTE models because of federal money tied to CTE programs. A majority of T&EE programs align under the STEM career cluster found in most CTE models at the state level (Stimel & Grubbs, 2016; Love & Maiseroulle, 2021), as seen in state models such as Missouri (Missouri State Career and Technical Education, n.d.) and Oklahoma (Oklahoma Career Tech, n.d.). These states were chosen as examples because they border Kansas and list T&EE under their respective STEM career clusters in the CTE frameworks. Like many other educational disciplines, T&EE is at a historical apex to help our younger generations be technologically and engineering literate, especially with the rapid increase in emerging technologies (ITEEA, 2021).

Both those inside and outside the education community are becoming increasingly familiar with the STEM acronym and the extensive efforts underway nationally to develop STEM programs that promote critical thinking, problem-solving, 21st-century skill development, and authentic learning experiences (Ingram, 2019). STEM education is an integrated, interdisciplinary, and student-centered approach to learning that encourages curiosity, creativity, artistic expression, collaboration, computational thinking, communication, problem-solving, critical thinking, and design thinking (Pennsylvania Department of Education [PADE], 2022). T&EE is uniquely positioned to complement the STEM education model, presenting an opportunity for a contemporary, updated outlook for the profession (Love and Maiseroulle, 2022; PADE, 2022).

In addition, declines in the number of T&EE teachers and teacher preparation programs since the 1970s have shown no signs of abating (Volk, 2019). Dugger (2007) estimated that there are approximately 35,000 T&EE teachers throughout the United States, with approximately 1,700 new openings. Nevertheless, with no new study since Dugger's (2007) work, there is no complete understanding of the number of graduates or openings today. Utilizing the Council of Technology and Engineering Teacher Education (CTETE) Directory, approximately 776 T&EE degrees were awarded, with only 453 of them being undergraduates entering the profession in 2020 (Rogers, 2020).

Similarly, the 2020 Kansas Technology and Engineering Education Association (KTEEA) job opportunities document, which reviews the teaching openings in the United States for T&EE professionals, revealed approximately 900 openings nationwide in 2020. The KTEEA is a state teacher organization that publishes nationwide openings for T&EE professionals. However, this publication only reviews openings published on state websites, not other job opportunity websites (e.g., Monster, Indeed, K12JobSpot and SchoolSpring). State websites may have a wide array of issues that include, but are not limited to, poor quality, delays in updating, and keeping old openings published. Another factor to consider is that not every state may require districts to post openings on their respective state websites, and some may not post charter or private school openings. Thus, 58 of the 900 openings in 2020 were in Kansas alone, which like many other states, faces an existential teacher shortage crisis (Garcia, 2022). Enough so, Kansas attributed roughly 6% of the openings nationwide. The remaining 323 degrees awarded were graduate degrees per the 2020 CTETE directory. These might have been individuals seeking to enter the profession; conversely, it is difficult to decide the reason for these graduate degree attainments. Based on discussions with experts in the profession, they accepted these degree attainments were established for T&EE educators earning a professional degree to further their careers, whether for postsecondary opportunities, column advancement in their salary schedules, or switching career paths into education.

The Kansas State Department of Education (KSDE) has a CTE division, which historically has followed the outline of career clusters and pathways proposed by the National Association for Career and Technical Education (ACTE), one being the STEM career cluster. Contrarily, beginning in 2017, the KSDE CTE division reframed the career clusters and pathways to no longer include the STEM career cluster. This STEM career cluster was how most

T&EE teachers aligned their programs. T&EE is such a broad spectrum of subjects, and if teachers wish to teach all the subjects in this spectrum, they no longer have the guidance to align their programs. In 2023, the researcher conducted a brief review of all 50 state CTE frameworks revealed only 13 states did not have a STEM Career Cluster in their outline. Though, of those 13 states, five of them did have a Career Cluster referencing or directly mentioning T&EE. See Appendix A for further details.

Need and Purpose

Another challenge educational disciplines have faced in recent years is declining enrollment in high school classrooms (Volk 2019). It seems clear that the decrease in the frequency of T&EE at the secondary school level is, in large part, due to high-stakes testing and the fact that this discipline is not directly assessed on any of the high-stakes tests required of secondary public schools in the United States (Musoleno & White, 2010). Another factor in the equation is the directors for CTE in each state. These leadership members influence how frameworks are outlined and guide the teachers in their respective states. If a CTE director has little to no background in the T&EE or STEM education profession or no knowledge of its existence, it may lead to confusion or the exclusion of the subject in frameworks. This “snowballing” effect may cause the demise of disciplines and other factors, including the lack of advocacy, resources, and current research (Volk, 2019). Therefore, this study will utilize a case study methodology to examine the perceptions of stakeholders with the implications of eliminating the STEM career cluster and the consequences which it may have on T&EE and STEM education.

Within the last two decades, research has declined regarding professional involvement in T&EE and how it relates to postsecondary preparation programs, as outlined by Volk (2019).

First, the transformation of T& EE programs to industrial technology and engineering has eliminated the need to accommodate the preparation of teachers or continue their past mission. Second, the few existing T&EE programs may not reflect the reality of many school programs, creating a mismatch between content and expectations when recruiting new student teachers. Lastly, with justifications for T&EE and its inclusion in the broader STEM umbrella based on economic justifications and national standards, there has been an increase in corporate-driven and foundation-sanctioned T&EE programs (Volk, 2019).

Identifying positive strategies to improve involvement based upon state support of these programs may be an excellent beginning point for turning the direction of T&EE. Love et al. (2016) identified that the most effective factor in recruiting T&EE teachers is direct conversations with high school T&EE teachers. Few studies have shown other efforts outside of the classroom as a direct correlation to helping reverse the decline in the profession. Furthermore, no known study has shown the effects of having a career cluster dedicated to STEM education may have on the T&EE profession.

The information in this study may be useful to coordinators of postsecondary preparation programs, state Department of Education leaders, leaders within the T&EE profession, and classroom teachers. The apparent decline seen in the profession may be attributed to several reasons. Relatively, the strategies to mitigate this decline are necessary for the profession's survival. The purpose of this study is to examine the implications of eliminating the STEM career cluster over the years in Kansas. Utilizing a case study approach will enable an in-depth investigation of the perceptions of key stakeholders regarding the potential consequences of eliminating the STEM career cluster in Kansas.

Statement of the Research Problem

Volk (2019) estimated that over 3,000 new T&EE teachers would be required to meet the demand filling all openings within the next few years, assuming the openings stay consistent. However, as stated above, 453 graduates entering the profession are insufficient to help fill these openings. Consequences of the COVID-19 pandemic include drastically more teacher openings, which set the discipline in a state of emergency to fill the massive gap of not just the normal openings, but also the teachers who chose to leave the profession entirely, those who chose early retirement, or those who left due to health concerns (Chalkbeat, 2022). Even further, due to the lack of teachers entering the profession, membership numbers within their respective state organizations declined (Volk, 2019).

As noted, studies have outlined strategies to recruit new students to T&EE preparation programs directed at secondary classrooms and student interests (Love, 2014; Love et al., 2016; Love & Love, 2022). Nevertheless, there is nothing outside this domain to help, such as guidance from state divisions and cohesiveness in career cluster models to national initiatives. Therefore, the following question and sub questions will be investigated to examine the implications of eliminating the STEM career cluster in Kansas:

Q1: What are stakeholders' perceptions of the policy change of removing the STEM career cluster in Kansas?

S1: What are the administrative implications of the policy change?

S2: What are the financial implications of the policy change?

S3: What are the professional implications of the policy change?

S4: What are the enrollment implications of the policy change?

S5: What are the satisfaction implications of the policy change?

Overview of Research Design

There are notable discrepancies when reviewing the CTE state division website layout for Kansas. It states that the division utilizes the National Career Frameworks developed by ACTE. Nevertheless, observing the latest framework, it does not include certain career clusters, most notably STEM. The National Career Frameworks currently has a STEM career cluster and an Engineering and Technology pathway within that career cluster, which suits T&EE. Furthermore, the state website shows no indication of any knowledge of Technology and Engineering Education. If you were to use the search engine for this terminology it returns zero results. Therefore, questions remain of why the state removed this broad-based pathway encompassing such a vast spectrum of educational disciplines and the rationale Kansas policymakers used for changing the framework for Kansas in 2017. Consequently, it is vital to consider how current stakeholders feel about reframing this layout since the policy change.

Typically, a case study uses an in-depth qualitative approach. A case study explores real-life data collection involving multiple sources of information and reports themes (Creswell, 2013). Therefore, this study will utilize a case study approach to examine stakeholder perceptions of STEM education in Kansas to produce more generalizable knowledge about how and why particular programs or policies have worked or failed. Accordingly, this study will examine the policy that eliminated the Kansas STEM career cluster and its positive or negative impact.

Moreover, case studies allow for a qualitative and holistic view, emphasizing the importance of collecting data from multiple sources that may include interviews, observations, and document reviews (Stake, 2005). They capture a range of perspectives, as opposed to the single view of an individual with a survey response or interview (Creswell, 2013). This viewpoint allows for gaining a greater understanding of the subject while reducing the potential for bias by diluting the agenda of a particular individual (Salmon, 2017).

The stakeholders directly involved in this policy change are the sample for data collection. The study will use purposive sampling to understand the rationale for Kansas eliminating the STEM career cluster in 2017 and the perceptions of those affected by this change. Purposive sampling is a form of non-probability sampling in which participants are selected based on one or more predetermined characteristics to examine information-rich cases from a given population to make analytical inferences (Palinkas et al., 2018). Therefore, interviews will be conducted with the stakeholders of Kansas STEM education, including Kansas CTE directors, past and present, who were involved in the change to discover the rationale behind this event and perceptions. Also involved are the respective undergraduate T&EE preparation program instructors in Kansas (i.e., Pittsburg State University and Fort Hays State University) and their institutional administrators to examine their influence and advocacy in connection with the Department of Education. In conclusion, the practitioners directly affected by this policy will be interviewed since the classroom teachers must follow this policy change, so it is imperative to represent their perspectives.

Interpretive Framework

T&EE has been a part of our educational systems for over 100 years. Moreover, what was once a vital aspect of education for students is now considered a dying art. There are several linkages to the importance of T&EE in modern society. For example, Wu-Rorrer (2017) identified how STEM (T&EE's homage to the CTE models in most states) is the central strength of current CTE and academic integration efforts, linking learned academic knowledge and skills directly with authentic applications. Hammond et al. (2007) also identified that 67% of high school dropouts left school because their courses were not interesting, engaging, and hands-on, which T&EE programs provide. Hence, the researcher will focus on a transformative framework. A transformative framework is that knowledge is not neutral and reflects the power and social relationships within society. The purpose of knowledge construction is to aid people in improving society (Mertens, 2003) with an action agenda for reform that may change participants' lives, the institutions where they live and work, or even the researchers' lives (Crowe et al., 2011).

Rationale and Significance

This study aims to understand why Kansas eliminated its STEM career cluster as well as the effects of removing this career cluster, providing insight from the teachers and teacher educators directly affected by the policy change. Hundreds of educators in Kansas have earned their degrees in T&EE and teach T&EE or T&EE-related subjects (KTEEA, 2018) yet are unaware of what career cluster and pathways to align with. This uncertainty directly affects undergraduate T&EE preparation programs within the state, which have existed for over a century and have trained thousands of teachers in Kansas. Therefore, a career cluster which directly reflects the teachings of their degree programs may dramatically affect their programs.

The rationale for this study is that the findings may impact policy at the state level by developing an understanding of policy changes regarding the CTE framework based on empirical evidence. This study may also be useful for other states facing similar issues. To conclude, it may also give other proactive professional members a map for changing aspects at the state level in their respective regions.

Role of the Researcher

At the time of the study, the researcher has been directly involved in many facets of the structure of the study. The researcher is a liaison between all parties involved in the study. The researcher is not only a teacher in Kansas who received a T&EE degree from a T&EE preparation program in Kansas but is also an adjunct lecturer at the same institution and holds a leadership role within the Kansas T&EE professional organization. These affiliations may be seen as a concern, as the researcher justifies T&EE in Kansas, with T&EE being of different philosophical beliefs of CTE. Furthermore, the researcher serves as a lecturer at a post-secondary institution for T&EE, and this has the potential to be perceived as a conflict of interest. Nevertheless, the researcher is also an educator of CTE at the high school level, as well as an advocate of both CTE and T&EE.

Researcher Assumptions

In this study, the researcher maintains assumptions about the respondents, the instrument, and the process. First, the researcher assumes the instrument, the interview questions in a focus group, will elicit reliable responses for precise analysis (Creswell, 2013). The researcher assumes the respondents of the interview process understand what T&EE is and the educational goals of T&EE. It is also assumed that respondents will fully understand the questions, providing honest answers to the best of their knowledge. Lastly, it is assumed that if the interview is conducted over the phone, the researcher will maintain consistency with the same outline as an email interview to avoid eliciting additional or less information (Creswell, 2013).

Definitions

The T&EE profession has been confused with several other similar disciplines in recent decades (Lewis, 2002; Brown et al., 2011, Moye et al., 2020), which may be why many individuals do not understand the discipline clearly. Therefore, this section aims to provide clear, concise definitions commonly used throughout the profession and within this study.

Technology and Engineering Education (T&EE) – T&EE is a broad field encompassing dozens of subdisciplines, from various technological focus areas (e.g., energy technology, transportation technology, and biotechnology) to information technology/computer science to many engineering subspecialties. T&EE in the PreK–12 environment also provides essential foundational understandings and abilities for all individuals, regardless of their career pathway (ITEEA, 2021). The goal of Technology and Engineering Education is to provide technological and engineering literacy for all students (ITEEA, 2021).

Career and Technical Education (CTE) – This approach to technical education is for responsible job-specific training and pathways for career preparation in a selected career field (ITEEA, 2020).

STEM – This umbrella term encompasses four fields of study: science, technology, engineering, and mathematics (Daugherty et al., 2014; Kelley, T.R & Knowles, J.G.).

Technology and Engineering Education State Organization – This state organization of teachers focuses on what students value to support teachers in the field and is dedicated to local and national technology organizations (KTEEA, 2021). An example (outlined in this chapter) is the KTEEA. KTEEA’s membership comprises teachers who are graduates of T&EE university programs, teach subjects related to T&EE, and are actively engaged in the discourse of T&EE current events. This organization is solely for Kansas teachers of T&EE. KTEEA is an affiliate of a parent organization known as the International Technology and Engineering Educator’s Association (ITEEA).

State Division of Education – The state division strives to serve all secondary engineering and technology education professions, whether the subject content is construction, communications, manufacturing, power and energy, transportation, or pre-engineering. The state division is closely aligned with the structure of the T&EE division of the ACTE (n.d.). State education agencies have an outsized role in promoting research use in education and wield substantial influence over the policy design and implementation of how research informs state and local decision-making. State divisions of education operate large-scale data collection systems that may fuel research into urgent questions about educational trends and challenges while using their statewide reach to advance research at the state, district, and school levels (Conaway, 2021). Several state agencies within the State Department of Education include a state agency solely for special education. This study directly focuses on state agencies associated with T&EE or CTE if T&EE falls within the CTE framework.

Undergraduate Enrollment – Students registered at an institution of postsecondary education working in a baccalaureate degree program have undergraduate enrollment (National Center for Education Statistics, 2022).

State Funding – Each year under the Perkins statute, Congress appropriates approximately $1.2 billion in state formula grant funds under Title I (Basic State Grants) to more fully develop the academic knowledge and technical and employability skills of secondary and postsecondary education students who elect to enroll in CTE programs of study (Perkins Collaborative Resource Network, n.d.).

Technological and Engineering Literacy – This literacy is the ability to use, manage, and assess the human-designed environment, which is the product of technology and engineering activity (ITEEA, 2021).

***Career Cluster* –** This structure comprises a broad group of occupations or industries (Jones, 2018). An example utilizing the Kansas CTE Career Cluster Guidebook (2021) is the Design, Production, and Repair Career Cluster, including career pathways in Construction, Transportation, Manufacturing, and Engineering.

***Career Pathway* –** Career pathways are small groups of occupations within a career cluster that share common skills, knowledge, and interests. A career pathway includes three levels of courses: introductory, technical, and application. An example of a pathway course list for the Construction pathway includes Introduction to Industrial Technology (introductory), Cabinetmaking (technical), Carpentry (technical), Cabinetmaking II (application), and Carpentry II (application) (KSDE, n.d.-a).

Summary

T&EE strongly influences today's educational system and is deeply rooted in tradition and innovation within the classroom. Moreover, due to several factors, there has been a decline in involvement within the profession which may lead to a turning point. Therefore, it is imperative to discover the deciding factors of involvement within the profession.

Hence, this study investigates Kansas' decision for policy change involving the STEM career cluster in the CTE framework to explore Kansas stakeholders' perceptions of this change, including its positive or negative implications. T&EE is at a crossroads, which must be defined and understood, while the need for teachers is growing exponentially. However, based on a limited supply of teachers, this study seeks to determine the perceptions of having a representative career cluster which may help lead the profession in a positive direction.

Chapter Two: Review of the Literature

Overview

Chapter One identified the lack of explanation for Kansas eliminating its STEM career cluster. This chapter will provide a brief overview describing the differences between and a brief history of CTE and T&EE and how they work cohesively in the current model due to funding. Next is the background of STEM education, including a review of the state CTE division outline for Kansas' framework. This explanation provides a narrative for how the framework of Kansas has changed from 2016 to today. Also discussed is the street-level bureaucracy theory and how it may guide this study. Finally, a comprehensive guide to the research questions will be thoroughly analyzed to determine why these questions may help lead to policy modification.

Literature Review

Technology and Engineering Education

T&EE is problem-based learning utilizing STEM principles (ITEEA, 2021). Unfortunately, T&EE is often misunderstood and overlooked in bridging the gap between science and mathematics in STEM. Too often, T&EE is misconstrued as the use of computers (Daugherty, 2009). While computers are certainly a part of T&EE, this definition is far too narrow and represents only one technological tool among many (Daugherty, 2009). In contrast, T&EE aims to develop students with a breadth of knowledge and capabilities who see the interactions between technology, engineering, and society and can use, create, and assess current and emerging technologies (ITEEA, 2019). The field of study has evolved from many transitions, such as manual arts, industrial arts, and technology education (ITEEA, 2021). It is also a general education subject that has provided career exploration and technical skill development for its students (Rogers, 1995; Daugherty, 2009; ITEEA, 2021).

The earliest form of education addressing industrial and technological topics in the United States was referred to as manual training. The objectives of manual training included keeping students in school, developing leisure-time interests, and providing instruction in the industry's basic principles, processes, and materials (Steinke & Putnam, 2006). The educational curriculum of industrial arts can be traced back to the late eighteenth century and early nineteenth century to Johann Heinrich Pestalozzi. Pestalozzi is credited with the development of the ideals for early industrial arts curriculum. His vision for industrial arts, including the issue of narrow vocationalism versus a broader educational background in preparing people for the world of work, are still debated today (Nelson, 1981). Due to the Jackson's Mill project and several other curricula efforts, the typical content includes construction, communications, manufacturing, power and energy, transportation, and pre-engineering (Association for Career & Technical Education, n.d.).

Hales and Snyder organized the Jackson's Mill project (1980) to determine a new direction for the profession, utilizing a modified Delphi technique to organize participants. This study identified the most integral topics for the study of technology: 1) construction, 2) manufacturing, 3) communication technologies, and 4) transportation. This effort is also what some account for the name change in 1985 from the industrial arts to technology education.

In 1985, the American Industrial Arts Association led a change to become the International Technology Education Association. Conversely, the organization again changed its name to the International Technology and Engineering Educator's Association in 2011. During this time, the Association of Career and Technical Education (ACTE) changed their divisions of industrial arts/technology education to reflect the name changes. Wicklein (2004) identified one of the championing reasons for adding engineering to technology education: the general populace better understood the need for engineering beyond technology education.

Some have struggled to distinguish between T&EE and CTE, so it is critical to establish a baseline difference between the two to avoid confusion. According to Iley (2021),

> T&EE is an encompassing program for all students. It is for those students not interested in specific technical careers. They learn avocational skills and knowledge to be more informed consumers and citizens in our technological world. Students learn to use tools and equipment safely and properly so they can pursue avocational and recreational activities. CTE is a program in which students learn all aspects and skills for a singular career pathway. This is to help the renewed focus on the workforce in American society. (para. 2)

This quote details both the differences and similarities between T&EE and CTE. While both educational realms teach skills relating to tool use and safety, they both have differing goals. T&EE is directed on providing the more basic skills to become well informed citizens whereas CTE is focused on being more circumstantial and exhaustive in vocational skills for the workforce. Moreover, an article published by Jones (1953) described the differences between the industrial arts (T&EE) and vocational education (CTE), which may seem dated. Nevertheless, his statements still hold to this day:

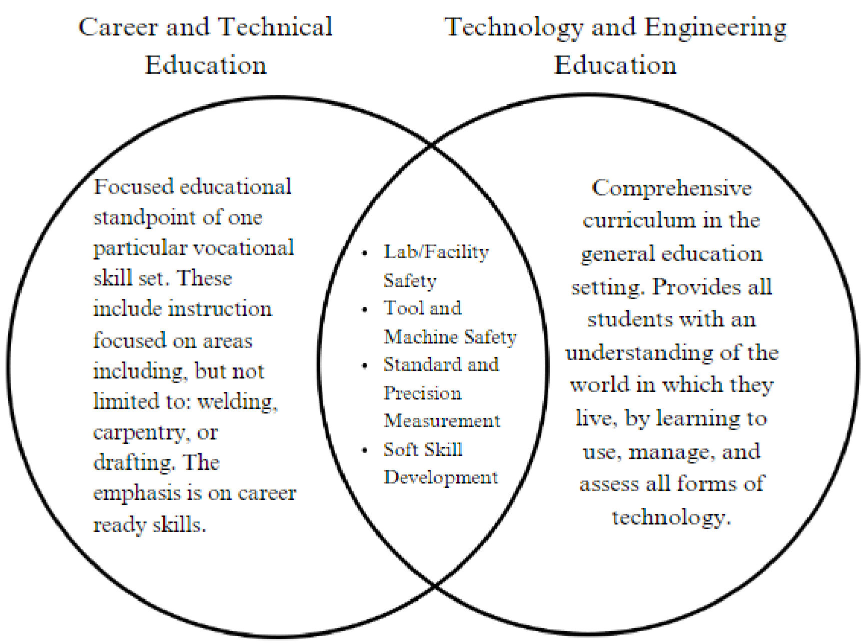
> There is a considerable difference in ideology between industrial arts and vocational education. The industrial arts shop makes objects and assists in projects. Because of limited time and equipment, these objects are frequently small but often very well done and worthy of commendation. The vocational shop provides real training on real jobs by taking contracts. The real difference between industrial arts and vocational education lies

in basic philosophy, as well as instructors, equipment, and time. Industrial arts is general education; its function is to give understanding and appreciation to enrich the program of general education. Vocational education is, according to the name, vocational, with a function of teaching youth to do, to make things, to produce according to trade standards. (p. 206)

While key differences separate T&EE and CTE, the two share notable similarities. They include approaches needed in any industry setting: safety, measurement, and soft skill development. These similarities and differences are identified in Figure 1 below.

Figure 1

Key Similarities and Differences Between T&EE and CTE



Note. This figure demonstrates the unique and shared elements between CTE and T&EE programs. Adapted from "Technology Education Curricular Content: A Trade and Industrial Education Perspective", by G.E. Rogers, 1995, *Journal of Technology Education, 32*(3), 59-74. Copyright 1995 by Journal of Technology Education.

Safety includes facility (i.e., identifying exits, tool locations, and proper clean-up strategies) and machine/tool safety (i.e., proper use of a bandsaw, identifying correct amperage in MIG welding, and understanding usage of portable power tools). Measurements are standard and precise. The basic reading of imperial and metric measurement systems includes understanding the measurement tools (i.e., measuring tape, calipers, and micrometers). The final shared trait between programs is the development of soft skills for students. Colman (2022) defined soft skills as dealing more with interpersonal relationships, such as conflict resolution, communication, listening, and problem-solving. Both program approaches have long understood these shared skills' importance, teaching them from their inception. Ideally, both T&EE and CTE programs should provide students with the opportunity to gain knowledge, skills, ability, and confidence to become productive members of society (Betts et al., 1992; Roberts & Clark, 1994). Rogers (1995) completed a nationwide study of CTE teachers to gauge what aspects students who transitioned from T&EE programs to CTE programs shared. The results directly reflect Figure 1 demonstrating the top characteristics being safety, measurement, and soft skill development.

Both T&EE and CTE have worked cohesively for several decades. Particularly due to funding purposes, T&EE has constantly been absorbed by the CTE pathways approach. For instance, Moye et al. (2020) identified funding as a top current and future issue facing the T&EE profession. However, having robust information on federal, state, local, and private funding may alleviate concerns and strengthen program funding (Moye et al., 2020). In 1917, President Wilson signed the Smith/Hughes Act. The legislation was a victory for industrial-type education and called for a separate education system, training workers to meet the nation's labor needs, limited to preparation for jobs that required skills and academic abilities below the college level (Steinke & Putnam, 2006).

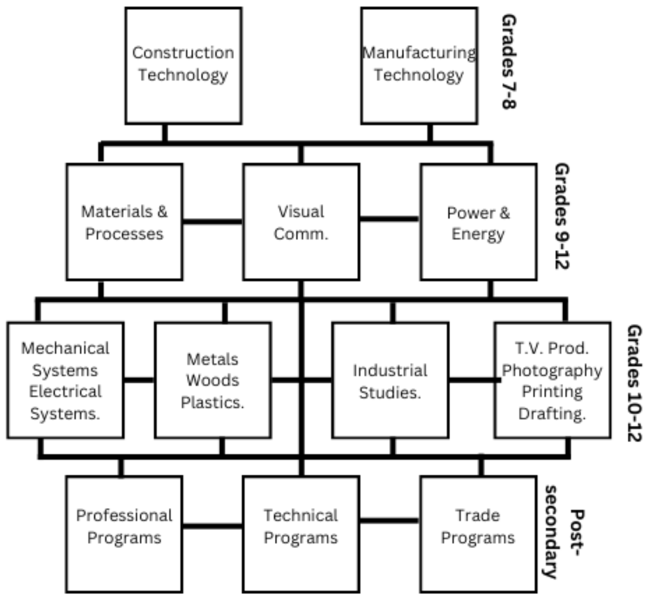
Moreover, the Perkins Act was the largest funding approach in history for technical programs. More recently, the act was revised as Perkins V in 2018, also known as the Strengthening Career and Technical Education for the 21st Century Act (Holecek, 2017). Funding for programs and teachers is complex in the US since education is largely a state and local endeavor. Furthermore, the recent passage of Perkins V continues federal funding for states that classify T&EE under CTE.

A factor for the industrial arts [T&EE] not coming to fruition has been federal funding for vocational programs. Zuga (1995) explained that although the industrial arts focus on general education, the promise of vocational money has kept the industrial arts professionals close to the vocational educators in case they could benefit from federal vocational monies. Zuga (1995) also explained that T&EE has always been seen as a general education subject, not a vocational subject, although vocational subjects have been taught.

Another example of how cohesive T&EE and CTE have been is the clear link to articulated programs of study throughout history. The Jackson's Mill project (1980) provided specific examples of how technology (and engineering) education should provide an articulated program of study from introductory technology education courses in middle school to high school specialization courses (i.e., T&EE communications to CTE electronics, T&EE manufacturing to CTE machining, and T&EE transportation to CTE automotive mechanics; Rogers, 1995). Another example directly linked to this study is the outline that the state of Kansas utilized for industrial education in secondary schools for decades, developed by Dr. Victor Sullivan, professor emeritus of Pittsburg State University (1972).

Figure 2

1972 Kansas Outline for Industrial Education (V. Sullivan, 1972)



Note. Grades 7–8 utilized the Industrial Arts Curriculum Project (IACP) developed by Drs. Willis Ray and Donald Lux as first initiated in 1965. Adapted from "1972 Kansas Outline for Industrial Education", by V. Sullivan, 1972, *Pittsburg State University*.

Reviewing the 1972 outline, Kansas recognized the cohesiveness of T&EE and CTE at one point. For example, students in grades 7–8 (middle school) took courses in T&EE construction and manufacturing technology. Once in high school, in grade 9, they could enroll in materials and processes, visual communications, and power and energy. These courses were T&EE comprehensive courses for students to explore these technology fields open to sophomores, juniors, and seniors (grades 10–12). Then, once students completed a T&EE course, they could move on to a vocational course of their choice. One of the most interesting factors of this approach was that students could make an informed decision on their postsecondary endeavors once they had taken any of the high-school-level courses.

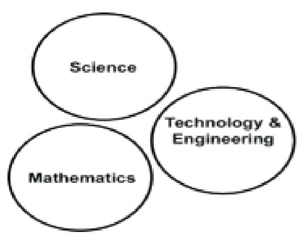
STEM Education

STEM was developed to answer challenges in the 21st century, where students are not only intelligent but also technically skilled (Widya & Yosi, 2019). STEM education aims to prepare students to be competitive and ready to work according to their preferred fields (Widya & Yosi, 2019). Although the roots of the STEM movement date back to President Dwight D. Eisenhower, and the formation of the National Aeronautics and Space Administration (NASA) and the National Science Foundation (NSF) in 1958, the acronym STEM was coined by Dr. Judith Ramaley, Assistant Director of the Education and Human Resources Directorate at NSF, in 2001 (Daugherty, 2013). Daugherty (2013) explained that the rationale for increased emphasis on STEM education had been largely driven by lackluster national assessments of PK–12 students over the last decade or two. He explained that these assessments have continued to indicate that the United States is failing to compete with other countries regarding student performance and interest in STEM subject areas. The argument for STEM education is that if the US is to compete with other nations, our children must be well-versed in 21st-century workforce skills related to STEM education (Daugherty, 2013). We are also often reminded that a lack of investiture in STEM can have dire consequences for the economic and political power of the United States (Puffenberger, 2010).

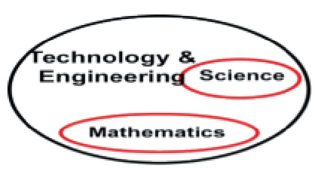
Contrarily, it is unclear if individuals teaching STEM touch upon all four subjects or simply teach a respective discipline while relying on other subjects to supplement the learning (Daugherty, 2013; Roberts & Cantu, 2012). Most programs generally use three approaches to approach STEM education: the SILO, embedded, and integrative approaches (Roberts & Cantu, 2012). The SILO approach isolates each of the four subjects taught by different instructors. This approach focuses primarily on the cognitive learning of the subjects rather than the application base and helps students maintain separate perceptions of each subject. In comparison, the embedded approach promotes knowledge through problem-solving and real-world situations, with one subject as the core while touching on the others through the learning process to show how they are related. Finally, the integrative approach eliminates boundaries between all subjects and does not show focus on one subject, equally sharing the importance of each in all situations. Roberts and Cantu (2012) developed several visual models to help illustrate the differences between each approach, as shown below (see Figure 3).

Figure 3

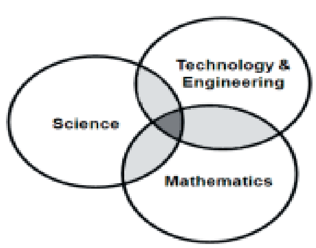
SILO Approach to STEM Education (Roberts & Cantu, 2012)



Embedded Approach to STEM Education (Roberts & Cantu, 2012)



Integrative Approach to STEM Education (Roberts & Cantu, 2012)



Note. The SILO, embedded, and integrative approaches to STEM education. Reprinted from “Applying STEM Instructional Strategies to Design and Technology Curriculum” by A. Roberts and D. Cantu (2012), Old Dominion University, pp. 112–114. Copyright 2019 by Old Dominion University.

Today, learning T&EE as a subject is an important part of school culture, laying the foundation for building a vibrant STEM workforce through collaborative problem-solving experiences that create solutions to tomorrow’s challenges (Asunda & Quintana, 2018). While STEM education is still prevalent throughout the US, misconceptions remain on how to approach it (Asunda & Quintana, 2018; Daugherty, 2013). Casual conversations with many STEM professionals have revealed much confusion and a sense that most individuals referring to STEM speak of science, technology, engineering, or mathematics individually (Daugherty, 2013). T&EE positions itself with a great deal to offer to the science and mathematics disciplines with the ability to offer authentic learning experiences and contexts involving their content (Daugherty et al., 2014; Kelley & Knowles, 2016). Nevertheless, the majority of T&EE educators align their programs with STEM career clusters found in most state CTE frameworks.

State Division of Education

Historically, the mission of a state division of education is to observe the school systems in operation and advise the legislatures of desirable changes and regulations. These divisions must provide voluntary and mandated services to educational agents and state agencies (Roe & Herrington, n.d.). State education divisions primarily focus on aiding the field in instructional best practices, standards implementation, assessments, and school accountability (Kansas Department of Education [KSDE], n.d.-b). From a legal perspective in the US, education is a state function. Education is not mentioned in the U.S. Constitution, so according to the reserved powers clause in the 10th Amendment, state's reserve the right to direct their respective education systems. This reality was underscored in San Antonio v. Rodriguez 411 U.S. 1 (1973) when the U.S. Supreme Court held that the federal constitution did not protect students in poor school districts from the state's uneven distribution of resources since education was not a federal constitutional right (Underwood, 2015).

Therefore, since education is a state function, most states review and outline what should be taught within the respective disciplines (Scotney, 2022). Many states typically follow the same outline for most disciplines to ensure students are taught the same mathematics, English, and reading materials (Scotney, 2022). Due to technical education including a broad spectrum of subjects, states vary dramatically in their outlines (Bowen, 2019; Love & Maiseroulle, 2022). One of the key reasons for the discrepancy between courses is that there is no nationally set list of courses. To properly examine Kansas, it is important to address the following: course outlines in the closest-relating pathway to T&EE/STEM Education, what entity houses the state CTE director, the certification and licensure requirements for teachers, the respective state professional organizations for T&EE/STEM, and lastly the universities that offer teacher preparation programs.

Kansas Framework Outline

Since 2017, Kansas no longer includes the STEM career cluster in their CTE frameworks. Instead, Kansas replaced the STEM career cluster with the Engineering career cluster. This career cluster has three pathways: engineering and applied mathematics, energy, and aviation production. Kansas also follows the traditional three (introductory, technical, and application) levels of courses, as proposed by the ACTE. Introductory courses include production blueprint reading and introduction to engineering. Technical-level courses include Engineering

Design, Drafting/CAD, Robotics, Foundations of Electronics, and Principles of Applied Engineering. Application-level courses include Engineering Design and Development, Digital Electronics, Computer-Integrated Manufacturing, Civil Engineering and Architecture, and Aerospace Engineering, with topics in engineering, emerging technologies, project management, and materials science and engineering. Some of these courses follow Project Lead The Way's (PLTW) outline of courses. Nevertheless, other courses follow the traditional industrial arts route (i.e., materials science and engineering, drafting/CAD), while some courses are open-ended and open to interpretation, such as emerging technologies.

Instead of the KSDE housing the state CTE director, the director is housed within the Kansas Board of Regents. The state CTE director oversees all decisions relating to CTE. Besides the traditional teacher training route for certification and licensure, Kansas allows for the certification, work experience, and education routes (KSDE, n.d.-b). The certification route is defined as holding an industry-recognized license for the specific pathway, which includes a Professional Engineer license. The work experience route completes a specified number of hours or years of work experience in the occupational area. For Kansas, this requirement is two years or 4,000 hours of experience.

An individual may become licensed in Kansas by holding the appropriate degree for the CTE program (i.e., an engineering degree). The only T&EE/STEM-affiliated professional organization in Kansas is the KTEEA. This organization is an affiliate of the parent organization ITEEA. Fort Hays State University offers a Bachelor of Science degree in Technology and Engineering Education with an additional certification in one of the following specific CTE pathways: construction, CAD design, manufacturing, STEM, or education. Pittsburg State University offers a Bachelor of Science in CTE and Master of Science in CTE degrees with a major concentration in Technology and Engineering Education. An important note about Pittsburg State University is its rich history with T&EE/STEM education. Pittsburg State began on September 8, 1903, with 52 enrolled students as the Kansas State Manual Training Normal School Auxiliary to explicitly train local teachers to teach manual training.

To this end, regarding Kansas' rich history of T&EE involves a document obtained by the researcher. This document was named the Kansas Technology Education Initiative and was published by the KSDE in 1998 as an eight-chapter layout (similar to the Missouri Technology and Engineering Education Planning Guide) on how to implement, teach, and assess quality technology education (T&EE) programs in Kansas public schools. It discussed the proper layout of courses a district should offer for students to become technologically literate, from K–5 Awareness of Technology in Our World (elementary level) to 6–8 Explorations of Technology (middle school level) to 9–12 Investigations of Technology and Applications of Technology (high school level). After reviewing this document, it was well-considered and ahead of its time, discussing opportunities for students taking T&EE courses while promoting postsecondary opportunities, including degree programs to become a T&EE educator. Conversely, the search results are null when searching KSDE's website for any mention of T&EE today.

2016–2017 Career and Technical Education Frameworks

The KSDE releases the newest and updated guides for its Career Cluster and Pathway Designs (CCPD) each year to provide visual diagrams of Career Fields, Career Clusters, and Pathways. Career Fields are broad fields that students might enter after completing school coursework (e.g., Industrial, Manufacturing, and Engineering Systems). Career Clusters are a more defined workforce field located within a Career Field (e.g., Architecture and Construction).

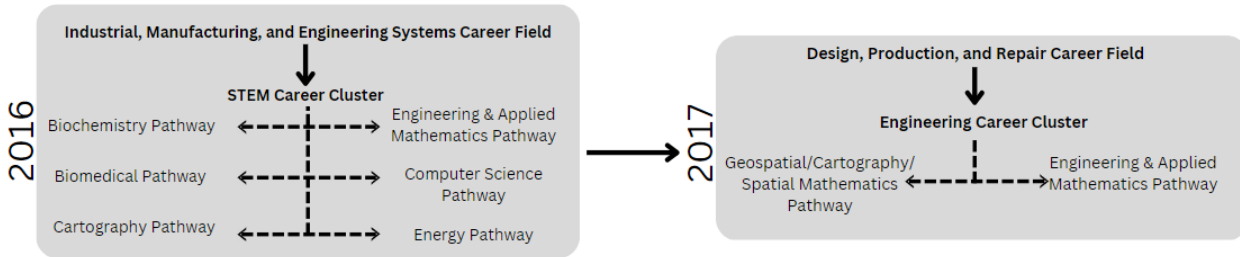
Finally, a Pathway is an in-depth study of a particular career within that Career Cluster (e.g., Construction and Design).

Following a review of the 2016 CCPD for Kansas, the Industrial, Manufacturing, and Engineering Systems Career Field had four Career Clusters: Manufacturing, Architecture & Construction, Transportation/Distribution/Logistics, and STEM. Moreover, the STEM Career Cluster had six Pathways: Biochemistry, Biomedical, Cartography, Computer Science, Energy, and Engineering & Applied Mathematics. This would be the last year STEM would be a representative career cluster in the framework.

Having examined the 2017 Career Cluster and Pathway Designs for Kansas, the Career Field previously known as Industrial, Manufacturing, and Engineering Systems would be replaced with a Career Field known as Design, Production, and Repair. The Career Cluster known as STEM was replaced with a cluster known as Engineering. The six pathways were taken to two pathways: Geospatial/Cartography/Spatial Mathematics and Engineering & Applied Mathematics. It is not known why Kansas Department of Education made the decision to make these changes. It should be noted that the researcher began teaching in 2017, when these changes took place and as a CTE teacher in Kansas. This resulted in the researcher never being contacted for input on these changes. It could be Kansas saw an opportunity to be proactive and make changes they saw necessary based upon enrollment numbers in certain pathways or changed it based upon a needs assessment. These changes from 2016–2017 are illustrated in Figure 4 below.

Figure 4

Comparison of 2016 and 2017 KSDE CCPD Frameworks



It should also be noted that the Kansas Department of Education states they utilize the National Career Frameworks developed by ACTE; however, when you observe their latest framework, it does not include certain career clusters, most notably the STEM career cluster. The National Career Frameworks currently has a STEM career cluster with only two pathways: Science and Mathematics as well as an Engineering and Technology, with Engineering and Technology being the most suitable for T&EE.

Concerns for the Profession

One of the largest issues facing T&EE/STEM education is the continuous decline in professional numbers (Volk, 1993; Volk, 2000; Volk, 2019). These numbers include professional organizations and undergraduate enrollment, which both provide professional development opportunities to learn new strategies and techniques to use in the classroom (Darling-Hammon et al., 2017). Planning educational programs for preservice and in-service technology teachers is based on their personal and professional needs. Indeed, teacher performance and educational effectiveness may suffer if teachers' needs are unmet. Some needs can be addressed with educational solutions, others with management changes, and still others by looking at teachers' lives beyond the professional arena (Scarborough, 1990). Many feel this goal can be achieved through professional development and involvement (PDI), especially PDI promoting a deep understanding of the subject matter and the best pedagogical practices (Shulman, 1986; Darling-Hammond et al., 2017). A deep understanding of the subject helps teachers facilitate student learning (Shulman, 1986). Indeed, PDI is important to STEM education, especially in technology and engineering education. PDI may only increase, though, if there is an increase in collaborative efforts amongst those in the profession.

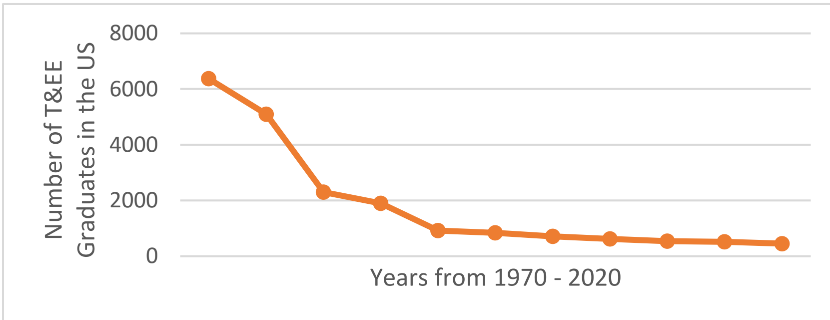
The profession must better define and promote collaboration within the field and, more broadly, through initiatives to gain higher participation (Bybee & Loucks-Horsley, 2000). An essential condition for the reform of T&EE is to change the attitudes of educators, and one good way to win hearts and minds is by their professional organizations—especially those positioned to reward individuals' achievements—conspicuously taking up the cause (Fisher & Wulf, 2002). Thus, young professionals must find opportunities to stand out, including the need to participate in a professional society (Sobin, 2015).

Many have asserted that T&EE is naturally collaborative, while others have felt threatened that groups like science teachers and library media specialists have become more active in delivering traditional T&EE learning activities and content branded by the STEM acronym (Moye et al., 2020). Collaboration should be embraced because it can result in more students and stakeholders becoming involved in T&EE programs and courses (Moye et al., 2020). There have been efforts to better promote collaboration within the profession such as the Learn Better by Doing (Moye et al., 2018) and $STEM^4$: The power of collaboration for change (Advance CTE et al., 2018) projects.

Nevertheless, based on historical analysis, the number of teacher education programs for T&EE has declined slightly over the last two decades. Volk (2019) noted that in the early 1970s, 6,368 degrees for industrial arts teachers were awarded. Compared to the 453 awarded in 2020, it constitutes nearly a 93% drop in 50 years (see Figure 5).

Figure 5

Number of T&EE Graduates in the United States (1970–2020)



Note. The number of bachelor's degree graduates in T&EE. Adapted from "The Demise of Traditional Technology and Engineering Education Teacher Preparation Programs and a New Direction for the Profession," by K. Volk (2019), *Journal of Technology Education, 31*(1), p. 4. Copyright 2019 by Journal of Technology Education.

The conclusion from this research is the concern and crisis over the insufficient quantities of qualified new technology educators entering the instructional ranks. Without individuals entering the profession, there will be less collaboration to help revitalize T&EE. As the most decisive indicator in this research, the dilemma over recruiting and preparing new technology teachers from university programs dwarfs all other concerns (Moye et al., 2020; Volk 2019). Therefore, the recruitment of student teachers into teacher education programs and insufficient quantities of qualified T&EE teachers are vital to the current and future health of the T&EE profession (Wicklein, 2004).

Recruitment and Retention Efforts

There are numerous teacher shortage initiatives announced each year throughout the United States. Increasing compensation, strengthening relationships with teacher preparation programs, and recruiting diverse candidates are a few listed by the Every Student Succeeds Act (Every Student Succeeds Act [ESSA], 2017). Indeed, some districts have provided retention bonuses to their teachers and incentives for veterans choosing not to immediately retire while expanding student loan forgiveness and assistance programs. Rather, Kansas has opted to alleviate the shortage issue by helping find substitutes to cover classes and/or placing substitutes into long-term positions. Kansas has recently passed two initiatives, one being that anyone with a high school diploma who completes an expedited online training program can become a substitute teacher. The other initiative is that anyone with a baccalaureate degree in any program area can be hired to teach (KSDE, n.d.-a).

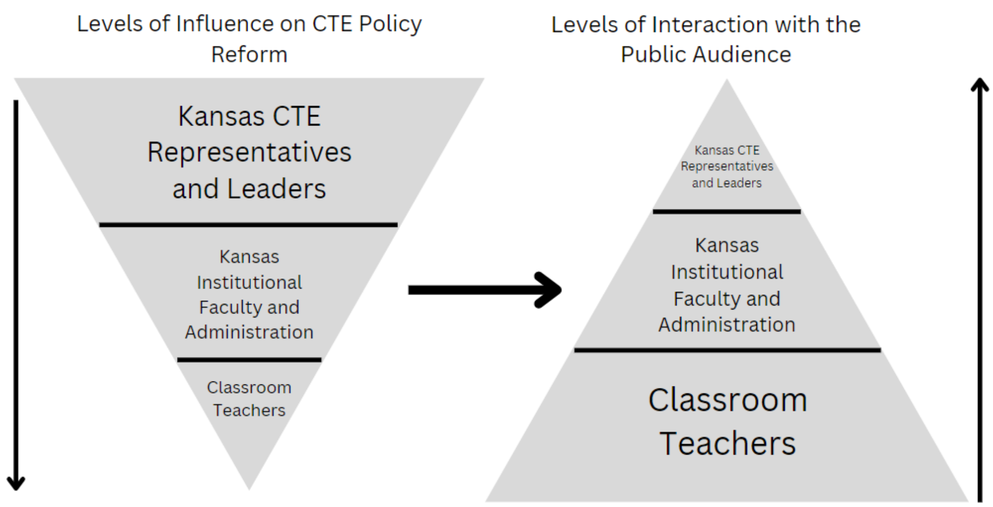
Theoretical Framework

This study examines the perceptions of those directly involved in the policy created at the state level utilizing the theory of street-level bureaucrats (SLB). Lipsky (2010) described SLBs as public service workers who interact directly with citizens during their jobs and have substantial discretion in executing their work. He explained that SLBs comprise many professional areas, including school teachers and postsecondary academics. The central thesis of the concept is that public servants have a cardinal role in the delivery of government "goods" and services to the citizens of any particular nation (Tummers & Bekkers, 2014). Lipsky (2010) described the process of SLBs as "employees at the lower end of the organization ladder who work with the public, providing services, but utilized discretion in meeting the needs of everyone

(p. 811).” In this instance, the institutional faculty and administration work with the future and current classroom teachers daily at a “street level” (see Figure 6).

Figure 6

Relationship of Stakeholders in Kansas CTE



The level of knowledge that the institutional faculty, administration, and classroom teachers have at this lower level can prove irreplaceable. If academic staff are allowed to play an active role in setting agendas or policy, planning and implementation as well as giving feedback in the policy process, perhaps the challenges brought on from policy change would be greatly minimized (Lipsky, 2010). Cerna (2013) asserted that “policy change goes hand in hand with policy implementation. Passing policies does not necessarily mean that the desired outcomes are achieved as policy implementation plays an important part of the process (p. 105)”. If the state of Kansas allowed those involved with implementing the policy changes (e.g., teachers), there would not be as much confusion or uncertainty at the street level. Academic staff as key players in the teaching and learning process can be considered critical to the implementation of any staff development intervention, such as policy change (Alsubaie, 2016).

Summary

This chapter presented the background of STEM education with a thorough understanding of the history of T&EE and how it cohesively works within CTE frameworks. Core philosophies of both T&EE and CTE were established, with similarities for both being highlighted. The frameworks for Kansas during the affected years were investigated with notable similarities and differences. The differences demonstrated how Kansas is missing a key component: a STEM career cluster. Concerns for the profession, mainly the number of individuals entering the profession, were examined. Without adequate numbers of individuals in the profession, it may bring troubles with collaboration and implementation of policies set at the state level. Change requires a perspective to analyze the implications of the missing STEM career cluster. The street level bureaucracy theory utilization allows the researcher to view the policy implementation of removing the STEM career cluster from different perspectives. The theoretical guide to the study explained how these components could work together to bring change within the T&EE/STEM educational realm.

STEM Education has provided an avenue for T&EE to bridge the gap between science and mathematics in recent years. This may allow T&EE to remain relevant within the general education setting. T&EE has a rich history but has been through a complicated journey in the last several decades, through what some would call an identity crisis, national reforms, and a decline in professional involvement, and the profession is at a turning point in history. Indeed, this turning point may lead to a resurgence in the profession’s popularity by determining a successful direction.

Chapter Three: Methodology

Introduction

This study aims to examine stakeholders' perceptions regarding the policy change of removing the STEM career cluster in Kansas. This investigation will allow the stakeholders to express their views on the policy change while appointed state representatives provide the rationale. This qualitative case study examines these perceptions from all parties. An examination of various implications of removing the STEM career cluster will be detailed. To enumerate the administrative, financial, professional, enrollment, and satisfaction implications will be examined. This chapter includes the context of the study, the research sample and design, and data collection and analysis. Moreover, ethical considerations, trustworthiness, limitations, and delimitations will be presented.

The following research question and sub questions will be investigated to examine the implications of eliminating the STEM career cluster in Kansas:

Q1: What are stakeholders' perceptions of the policy change of removing the STEM career cluster in Kansas?

S1: What are the administrative implications of the policy change?

S2: What are the financial implications of the policy change?

S3: What are the professional implications of the policy change?

S4: What are the enrollment implications of the policy change?

S5: What are the satisfaction implications of the policy change?

Methodology

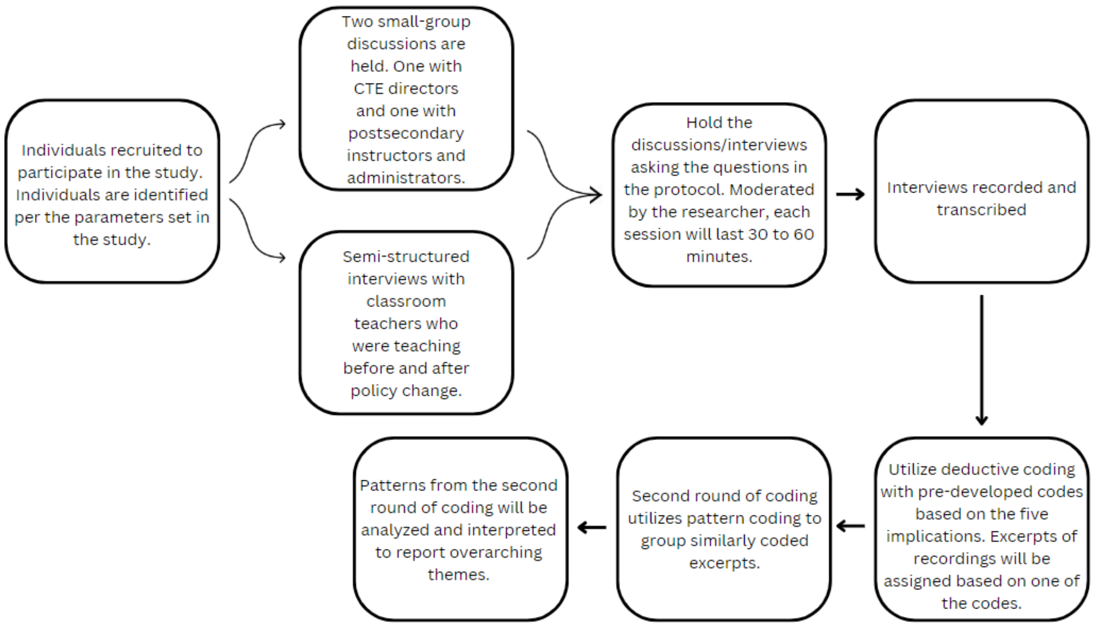
Qualitative Research Design

Qualitative research focuses on understanding a research query as a humanistic or idealistic approach. Thus, qualitative research methods are utilized to understand people's beliefs, experiences, attitudes, behaviors, and interactions (Pathak et al., 2013). In qualitative research, the data is non-numerical, most commonly in word form (Cresswell, 2013). Qualitative methods are used to answer questions about experiences, meanings, and perspectives, most often from the participants' standpoints (Crowe et al., 2011). Qualitative research techniques include *small-group discussions* for investigating beliefs, attitudes, and concepts of normative behaviors; *semi-structured interviews* to determine views on a focused topic, background information, or an institutional perspective; and *in-depth interviews* to understand a condition, experience, or event from a personal perspective (Hammarberg et al., 2016). These techniques are relative to this study because small-group discussions will be utilized to determine information from state CTE directors/representatives, postsecondary instructors, and administrators, while semi-structured interviews will be conducted with classroom teachers. In this study, there will be a higher likelihood of garnering participation by inviting the past and current directors to discuss the policy changes. A similar approach can be used with instructors and administrators of the Kansas institutions offering the appropriate degree programs.

Two group discussions will be conducted, one with the instructors and administration of Pittsburg State University and the other with the same members of Fort Hays State University. These institutions are utilized because these are the only two institutions that offer T&EE degrees in Kansas. To conclude, semi-structured interviews will be conducted with classroom teachers who were teaching before the policy change in 2016 and are presently still employed, meaning they experienced the policy change and its effects. A visual representation of the study can be found in Figure 7.

Figure 7

Flow Diagram of the Study Design



invincibility or inevitability: a qualitative research study", by A. Gowani et al., 2016, *BMC Research Notes, 9*(28), p. 3. Copyright 2016 by BMC Research Notes.

The Case Study Approach

A case study is an in-depth examination, often undertaken over time, of a single case – such as a policy, program, intervention site, implementation process or participant (Crowe et al., 2011). This study is considered an exploratory case study. Vincent (2022) explains that exploratory case studies form research questions to determine to what extent a phenomenon has on the population being studied and allows the researcher to track outcomes. Exploratory case studies examine cases to produce more generalizable knowledge about qualitative queries—how and why particular programs or policies work or fail (Goodrick, 2014). In this study, the phenomenon to be examined is the implications for stakeholders due to the policy change of removing the STEM career cluster in Kansas.

Several variables will be examined in this case study. The first variable being the CTE directors and representatives in Kansas, both past and present. These individuals have the knowledge of their state division frameworks and how and why these frameworks are outlined. Next, are the institutional members. The next variable examined will be the institution members. The institutional faculty and administration for both Pittsburg State and Fort Hays State have the expertise of the discipline and can provide insight to the advocacy they offer as well as some historical aspects behind the policy changes. The final variable will be classroom teachers who can help provide their perceptions of how the policy change directly affected their classrooms. Crowe et al. (2011) explained that:

> In contrast to experimental designs, which seek to test a specific hypothesis through deliberately manipulating the environment, the case study approach lends itself well to capturing information on more explanatory 'how,' 'what,' and 'why' questions, such as 'how is the intervention being implemented and received on the ground? (p. 3)

This case study will directly investigate policy change implications and seek to answer many "what" and "why" questions.

Research Setting

The state to be examined in this study is Kansas. When reviewing secondary 2020 CTE statistics from the Perkins Collaborative Resource Network, Kansas had 51,689 students statewide who took at least one CTE course. Kansas was relatively close in participation concerning gender, where male students (51%) outnumbered female students (49%). The U.S. Department of Education (n.d.) gathered data to release this information to the general public with the U.S. average being 35% of students being involved in STEM or a STEM related career cluster with Kansas at 41%, just above the average in the United States.

Sampling

Purposeful sampling will be utilized in this study, identifying and selecting individuals or groups especially knowledgeable about or experienced with the phenomenon of interest (Crowe et al., 2011). The individuals which will be selected for this study are considered the experts in Kansas for not just CTE but T&EE/STEM Education. The CTE directors for each state are directly responsible in the development of the framework for their states and assist in the critical decision-making process. In 2022, the CTE director for Kansas left the position to pursue new opportunities in another state. The new CTE director was an employee for the division when the policy change happened. Therefore, both the past and new CTE directors will be interviewed, to established perceptions from both individuals.

Institutional faculty and administration provide preservice teachers with up-to-date T&EE/STEM education training while advocating for the profession. These T&EE/STEM education content experts are actively engaged with their state divisions in preparing preservice teachers. Members from both Pittsburg State and Fort Hays State will be interviewed. Specifically, the chair of Applied Technology at Fort Hays and the director of Technology and Workforce Learning at Pittsburg State will serve as the administration members of these institutions. Both individuals were involved in the profession and held these positions during the policy change. Moreover, one instructor from each institution will be interviewed—the T&EE/STEM education program coordinators—who were in their current positions before and after the policy change took effect.

The final group to be interviewed are the classroom teachers whom of which are front-line workers delivering the content to secondary students. These individuals have experienced the daily implications of direct policy changes. A KTEEA (2018) study found that of the 315 CTE teachers in Kansas, approximately 68% received either a bachelor's or graduate degree from Pittsburg State University or Fort Hays State University. The teachers selected to interview in this study are established teachers who taught in the STEM career cluster before and after the policy change took effect during the 2016–2017 school year. Contact will be made with Pittsburg State University and Fort Hays State University to ask for recommendations on which graduates from their programs will be the best participants for this study. Each of these individuals and groups was associated with or directly impacted by the policy change of eliminating the STEM career cluster in Kansas. Thus, eight secondary T&EE teachers will be interviewed, with four graduates of Fort Hays State University and four graduates of Pittsburg State University.

Data Collection Methods

Data collection methods vary in case studies. This study will utilize semi-structured interviews in a round table discussion with each group of individuals identified. Cohen & Crabtree (2006) described the characteristics of semi-structured interviews as allowing for several respondents to engage in a formal interview, allowing the interviewer to create a guide of questions to follow but allowing for topical trajectories in the conversation when appropriate. Thus, the group discussions and semi-structured interviews will allow participants to answer to the best of their ability while other participants build on their answers, resulting in unintentional learning.

Moreover, Crowe et al. (2011) expressed "the concerns of avoiding leading questions during interviews to not deceive the participants (p. 7)." Therefore, the questions built into the interview protocol should avoid leading questions. One of the guiding reasons for this approach is that some CTE directors may not understand the T&EE/STEM education profession. Adams (2015) explained, "You must create the agenda for the interview guide, the outline of planned topics, and questions to be addressed, arrayed in their tentative order (p. 495)." With this study, different interviews will be conducted with various groups and individuals, so a different guide will need to be tailored to each group. These guides can be found in Appendix B. During semi-structured interviews, it is important to include probing questions following each main question (Delve, n.d.). These questions may help answer any sub questions arising after the main question is asked to help probe the interviewee to answer the question. The guides are modeled after Harrell and Bradley's (2009) focus group interview protocol since the interview protocol guide is tailored for group interviews but still maintains a voice for one-on-one interviews.

Methods for Data Analysis

NVivo 1.0 (2020 Version) will be utilized to analyze the data. NVivo is a software program used for qualitative and mixed-methods analysis of unstructured text, audio, video, and image data, including (but not limited to) interviews, focus groups, surveys, social media, and journal articles (NVivo, n.d.). Each interview, whether individual or group, will be transcribed using voice-to-text software. Each participant's answers will be divided into separate tables, grouped with the individuals of the same group (e.g., teachers, instructors, and administrators). Deductive coding will be utilized to begin the coding process. Deductive coding is a top-down approach that begins by developing a codebook with an initial set of codes based on the research questions or an existing research framework or theory (Delve, n.d). The five codes will be based on the implications: administrative, financial, professional, enrollment, and satisfaction. The codes follow the sub questions for the main research question of this study. The five implications are to assist in answering the main research question. Then, after reading through the transcripts, excerpts will be assigned based on one of the five codes.

Next, a second round of coding will be used to help reach a consensus on each concept while developing a better understanding. During the second coding round, codes will be abridged by pattern coding. With pattern coding, the researcher groups similarly coded excerpts under one overarching code to describe a pattern (Delve, n.d.). These patterns may then be cross analyzed to observe if they occur across different groups or are specific to one group. In conclusion, after reviewing the findings, the researcher will interpret the results and report the overarching theme(s) found from the results.

Ethical Considerations

Bloomberg and Volpe (2019) explained that with qualitative research, there is a sense of morality bound to the research to ensure it is conducted to minimize potential harm to those involved in the study. In this study, appropriate steps will be taken through the institutional review board (IRB) at the University of Arkansas. Bloomberg and Volpe (2019) also discussed that, for the most part, ethics issues focus on establishing safeguards to protect the rights of participants, including informed consent and privacy protection. Therefore, the researcher will establish anonymity and confidentiality.

For anonymity, the researcher will inform the participants that the results of this study will not include identifying information (e.g., names, email addresses, or phone numbers). It will also not include any way for their responses to be linked to their identities (e.g., ages). For confidentiality, any data collected in the focus group interviews will only be identifiable to the researcher. Hence, each participant will be assigned a number only known to the researcher. The researcher holds an obligation to protect any information obtained from unauthorized use, access, disclosure, modification, or loss.

Trustworthiness

It is imperative with qualitative research that the researcher establish credibility, dependability, confirmability, and transferability of the results (Statistic Solutions, n.d.). Credibility requires the researcher to link the results with reality to demonstrate the truth of the findings. One of the most important techniques is member checking, allowing the participants to review the data, interpretations, and conclusions (Statistic Solutions, n.d.). The researcher will share this information with the participants before it is finalized, allowing them to clarify misconceptions, correct errors, and provide additional information.

Dependability demonstrates how the study is consistent and repeatable concerning the results. Therefore, an inquiry audit will be conducted, having an institutional member of the University of Arkansas, the researcher's faculty advisor, review the data collection and analysis processes with the results to show that the conclusions are supported by the data collected. Moreover, confirmability is established to demonstrate that the findings are shaped by the participants rather than the researcher (Statistic Solutions, n.d.), thus this study will use reflexivity and audit trails. Reflexivity means the researcher will maintain an attitude to remove bias from the study so that the results reflect the participants' perspectives (Statistic Solutions, n.d.). Furthermore, an audit trail will consist of a document of the processes completed throughout the study with the researcher's thoughts and justifications about data collection and analysis (Statistic Solutions, n.d.).

Finally, transferability is similar to generalizability, meaning the findings may apply to other contexts. Bloomberg and Volpe (2019) described transferability as descriptive context-relevant findings applicable to broader contexts while maintaining content-specific richness. Therefore, purposeful sampling and thick description will be utilized in this study. As previously mentioned at the beginning of Chapter three, purposeful sampling will be used to identify the participants because these individuals are considered experts in T&EE/STEM education. In addition, a thick description provides depth to the collection process by detailing all the factors (Drew, 2009). For this study, the researcher will provide all details in the interview process to provide context, such as where and when the interviews took place (e.g., end of the day or beginning of the day). This notation will help provide a richer understanding of the setting for the readers.

Limitations and Delimitations

There are some limitations to this study's focus group interview approach. First, a perceived limitation is that the participants interviewed may be hesitant to answer questions honestly. They may feel the answer may damage the image of their respective organization. Moreover, the T&EE undergraduate and professional organization leaders may be biased in their answers because they have a preconceived value of T&EE, whereas the state leaders perceptions may be different. Interviews are a time-consuming process; therefore, focus group interviews require scheduling that may result in some participants feeling rushed to answer questions due to the busy schedules of academic leaders. All of these limitations could result in an unintentional misrepresentation of the phenomenon. Finally, a delimitation for this study is that participants must be leaders within each respective group associated with T&EE/CTE/STEM education.

Summary

This study aims to examine the stakeholders' perceptions of removing the STEM career cluster in Kansas. Focusing on CTE State Leaders, T&EE undergraduate program leaders and administrators, as well as T&EE classroom teachers, it is imperative to establish a rapport of trust and respect with these individuals from the beginning to the end of the study (Bloomberg and Volpe, 2019). Utilizing a small group discussion approach with semi-structured interviews will allow participants to answer to the best of their abilities while other participants build on their answers. Focus is placed on the five implications identified as the sub questions. These implications encompass the major perceptions of all stakeholders in Kansas in relation to the policy change of removing the STEM career cluster. In addition, data analysis will be conducted to create themes that might be transferred to other leaders, looking at what factors may impact their respective states to help establish a T&EE/STEM career cluster or maintain their T&EE/STEM career cluster. Therefore, this study is necessary to help improve technology and engineering education throughout the nation.

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APPENDIX A – United States STEM Career Cluster Review

State/Possession	Abbreviation	STEM Career Cluster (Yes or No)
Alabama	**AL**	**Yes**
Alaska	**AK**	**Yes**
Arizona	**AZ**	**No**
Arkansas	**AR**	**Yes**
California	**CA**	**No (T&EE)**
Colorado	**CO**	**Yes**
Connecticut	**CT**	**Yes**
Delaware	**DE**	**Yes**
Florida	**FL**	**No (T&EE)**
Georgia	**GA**	**Yes**
Hawaii	**HI**	**No**
Idaho	**ID**	**Yes**
Illinois	**IL**	**Yes**
Indiana	**IN**	**Yes**
Iowa	**IA**	**Yes**
Kansas	**KS**	**No**
Kentucky	**KY**	**Yes**
Louisiana	**LA**	**Yes**
Maine	**ME**	**Yes**
Maryland	**MD**	**No (T&EE)**
Massachusetts	**MA**	**Yes**
Michigan	**MI**	**Yes**
Minnesota	**MN**	**Yes**
Mississippi	**MS**	**Yes**
Missouri	**MO**	**Yes**
Montana	**MT**	**Yes**
Nebraska	**NE**	**No**
Nevada	**NV**	**Yes**
New Hampshire	**NH**	**Yes**
New Jersey	**NJ**	**Yes**
New Mexico	**NM**	**Yes**

New York	**NY**	**No (T&EE)**
North Carolina	**NC**	**Yes**
North Dakota	**ND**	**Yes**
Ohio	**OH**	**No**
Oklahoma	**OK**	**Yes**
Oregon	**OR**	**No**
Pennsylvania	**PA**	**Yes**
Rhode Island	**RI**	**No**
South Carolina	**SC**	**Yes**
South Dakota	**SD**	**Yes**
Tennessee	**TN**	**Yes**
Texas	**TX**	**Yes**
Utah	**UT**	**No (T&EE)**
Vermont	**VT**	**Yes**
Virginia	**VA**	**Yes**
Washington	**WA**	**Yes**
West Virginia	**WV**	**Yes**
Wisconsin	**WI**	**Yes**
Wyoming	**WY**	**No**

APPENDIX B – Interview Protocol

<table>
<tr><td>Welcome</td><td>Welcome, everyone. I want to thank you for attending today’s discussion. My name is ____________________ and I will be the facilitator for today’s group discussion. I am a researcher completing a study based upon factors relating to both Career and Technical Education as well as Technology and Engineering Education within Kansas.

We invited you to take part in this discussion today because you are (CTE State Leader, T&EE classroom teacher, T&EE Undergraduate Program instructor or administrator). We would like to talk to you today about factors involving CTE and T&EE in your respective state.

What we learn from today’s discussion will help us improve both CTE and T&EE in Kansas.

Provide a clarification of CTE and T&EE.</td></tr>
<tr><td>Ground Rules</td><td>Before we begin, I would like to review a few ground rules for the discussion.
a. I am going to ask you several questions; we do not have to go in any particular order, but we do want everyone to take part in the discussion. We ask that only one person speak at a time.
b. Feel free to treat this as a discussion and respond to what others are saying, whether you agree or disagree. We’re interested in your opinions and whatever you have to say is fine with us. There are no right or wrong answers. We are just asking for your opinions based on your own personal experience. We are here to learn from you.
c. Don’t worry about having a different opinion than someone else. But please do respect each other’s answers or opinions.
d. If there is a particular question you don’t want to answer, you don’t have to.
e. We will treat your answers as confidential. We are not going to ask for anything that could identify you and we are only going to use first names during the discussion. We also ask that each of you respect the privacy of everyone in the room and not share or repeat what is said here in any way that could identify anyone in this room.
f. We are tape recording the discussion today and taking notes because we don’t want to miss any of your comments. However, once we start the tape recorder we will not use anyone’s full name and we ask that you do the same. Is everyone OK with this session being tape recorded? [GET VERBAL CONSENT TO TAPE RECORD DISCUSSION.]

Does anyone have any questions before we start?</td></tr>
<tr><td>Introductions</td><td>[START TAPE RECORDER NOW.]
I’d like to go around starting with individual (give each individual a letter/number) and have each person introduce him or herself. Please tell us</td></tr>
</table>

	where you currently work, what your background education is, and how long you have been in your current position.
Group Discussion – CTE Directors	1. Does Kansas follow the National Framework developed by ACTE with 16 career clusters? a. PROBE: Why? Or why not? b. PROBE: What is the rationale for the names of career clusters? 2. Do you have any experience in T&EE/STEM Education? a. PROBE: What do you see as the goal of T&EE/STEM Education is? 3. What reasoning is there for the layout of courses in Kansas regarding each career cluster and pathways in those career clusters? a. PROBE: Which individuals assist in this layout? b. PROBE: Do teachers of the pathways provide input? c. PROBE: Why? Or why not? 4. What measures has your state taken with the issue of teacher shortage? a. PROBE: How does Kansas approach licensure of CTE teachers? b. PROBE: Why has Kansas chosen this approach? 5. Between 2016 and 2017, the Kansas framework changed to no longer include a STEM career cluster, why did this change? a. PROBE: What career cluster do you think T&EE/STEM teachers should align their programs with? 6. How often are you in contact with undergraduate programs which provide facets for CTE certification in your state? a. PROBE: Are you in contact with bordering states undergraduate programs?
Individual Interview – T&EE/STEM Teachers	1. To begin, what do you currently teach? a. PROBE: What current career cluster is your program aligned with? b. PROBE: What current pathway is your program aligned with? 2. How often do your representatives with the CTE state division of education contact you for your opinion on decisions being made? a. PROBE: What is the most effective method of communication, in your experience, with contacting your state leaders? b. PROBE: What changes have directly affected you and your program you currently teach? 3. How did losing the STEM career cluster affect your program? a. PROBE: Were there positive implications of this change? b. PROBE: Were there negative implications of this change? c. PROBE: Were there any professional implications? To be clear, professional in this study refers to any change in the profession you observed from the change.

	4. Has the state provided guidance to help align your program? a. PROBE: What resources has the state provided you with? 5. Have you seen a change in enrollment of your programs since the change of policy? a. PROBE: Positive or negative change in enrollment?
Individual Interview – T&EE Institutional Members (T&EE Instructors)	1. To begin, how many current students does your program have? a. PROBE: How many of these are undergraduate students? b. PROBE: How many of these are graduate students? 2. How often are you in contact with the state department of education in your respective state? a. PROBE: What is the most effective method of communication, in your experience, with contacting your state leaders? b. PROBE: How responsive are your state leaders to change regarding T&EE? 3. Do you have any influence on how state licensure for CTE/T&EE teachers is completed? a. PROBE: Do you have any influence on career cluster and pathway layout? 4. What do you see as the implications of no longer having a STEM career cluster in Kansas being? a. PROBE: What are the positive implications? b. PROBE: Similarly, what are the negative implications?
Individual Interview – T&EE Institutional Members (Administrators)	1. To begin, what involvement do you have with the state in T&EE/STEM Education? a. PROBE: Do you help set any standards at the state level? b. PROBE: Do you have any influence on career cluster and pathway layout? c. PROBE: How often are you in contact with the state department of education in your respective state? d. PROBE: What is the most effective method of communication, in your experience, with contacting your state leaders? e. PROBE: How responsive are your state leaders to change regarding T&EE? 2. How has the change in CTE framework in Kansas affected the way you approach your respective T&EE/STEM Education programs? a. PROBE: Are there any financial implications? b. PROBE: Does it have any effect on recruitment or retention of students for these programs? 3. What do you see as the implications of no longer having a STEM career cluster in Kansas being?

	a. PROBE: What are the positive implications? b. PROBE: Similarly, what are the negative implications?
Final Thoughts	Those were all of the questions I wanted to ask. 1. Does (do) anyone (you) have any final thoughts they (you) wish to share which they (you) haven't gotten to share yet?
Review and Wrap-up	Thank you for coming today and for sharing your opinions with me.