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Connecting Common Core State Standards to Career and Technical Education

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CONNECTING COMMON CORE STATE STANDARDS TO CAREER AND TECHNICAL

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Abstract

The purpose of this literature review was to identify the current educational pathways that are offered at the secondary level, explore the intersections that exist between career and technical education (CTE) and core academic courses, determine how states are currently using this information to prepare students for college and career readiness, and identify the obstacles that occur due to integration. The need for integration is visible in the research but the implementation of common core state standards (CCSS), especially used by English language arts, mathematics, and science, into CTE is not as simple as just inserting these standards into CTE courses. Reviewing the intersections that occur with both CTE and academic core courses, identifying limitations and funding concerns, and ensuring that there is time allocated to complete the implementation is imperative to successfully integrate core academic standards into CTE courses.

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Chapter I: Introduction

Career and Technical Education (CTE) has been a well-known entity in traditional educational settings for hundreds of years, however it is not often referred to as a path to prepare students for college or higher-level careers. Many may view these courses as a way to just simply prepare students for a technical job and do not look at the core content, including science, math, and English, that can be embedded into these courses. Great Schools Partnership (2014) defines CTE in the following manner: "Career and technical education is a term applied to schools, institutions, and educational programs that specialize in the skilled trades; applied sciences, modern technologies, and career preparation. It was formerly (and is still commonly) called vocational education; however, that term has fallen out of favor with most educators" (para. 1).

According to data collected from the Department of Education (2019), CTE courses currently develop problem-solving skills, deepen community ties, and attain strong student engagement. Research has provided additional information about CTE courses such as outcomes and content in work-related communication, time management, and critical thinking skills required for success in employment. Based on this information, the integration of common core standards into CTE courses and CTE concepts into core academic courses would benefit all stakeholders. As individual states are working on aligning CCSS into their core courses to ensure that all students graduate ready for college, careers and life; leaders can use this opportunity to finally break down the silos between core academic courses and CTE. This cohesion will help ensure that the new standards rigorously engage students in both academic and CTE courses (Meeder & Suddreth, 2012). Reflecting on the history of CTE, the current pathways offered today and the need for college and career readiness in secondary educational settings has led to a

deeper look into the ability to integrate core academic standards into career and technical education courses and the concerns and obstacles that would surface while attempting this integration.

History of Career and Technical Education

The concept of career and technical education has been integrated into the way we have educated students for decades, from parents informally teaching their children specific household chores or farm tasks to on-the-job training within educational institutions. According to Wang (2011), traditional vocational education began in the form of apprenticeships to ensure that there were enough workers trained within various fields in the community. As the industrial revolution began, apprenticeships could provide an adequate number of trained employees to operate the various equipment needed in a factory, leading to the evolution of technology and career education within a school setting.

Throughout history, education has opened many doors of opportunity and has implemented strong building blocks of knowledge for people to expand upon as they navigate their path in life. The education provided was not only in the form of college-ready courses, but there were also technical or career courses. These courses typically provide skills for students to become successful in the workforce upon completion.

In 1916, the United States passed the first law regulating child labor, producing an influx of students into public education and a decrease in the number of workers able to maintain high volumes in factories and farms (Brush, 2016). This change would ultimately be a launching point for technical education programs within schools. The first federal role in vocational education began with the Smith-Hughes National Vocational Act in 1917. This was the first known federal investment in secondary vocational education. This piece of legislation established vocational

education as an adequate form of training for trades such as plumbers, mechanics, and factory workers to occur in a high school setting. This training was intended for students who would not need a bachelor's degree to successfully complete their job. The Smith-Hughes National Vocational Act became a catalyst for the advancement of CTE education in schools (Brush, 2016).

Over the years, there have been additional investments and regulations from the federal government concerning CTE, but none truly addressed the problems of early CTE programs such as diversity, equity, and adequate core education. Carl Perkins, member of the House of Representatives and chairman of the Education and Labor Committee, had a vision to improve career and technical education and was a strong supporter of the Vocational Act of 1963 (Blunk, 2010). Throughout his tenure as the chairman of the Education and Labor Committee, Perkins revised funding for career and technical education and ensured that the quality of education in these programs would be strong. With the revised version of the Vocational Act of 1963 occurred, it was named after Carl Perkins due to his impact and support for vocational education. The Carl Perkins Act of 1984 allocated $950 million to vocational education, encouraged funding to be used in academic integration, and dedicated over 50% of that funding to students in disadvantaged and special populations. With strong support and funding from the federal government, vocational education began to flourish (Blunk, 2010).

There have been various versions and changes to the Carl Perkins Act leading up to the current version, now known as the Strengthening Career and Technical Education for the 21st Century Act (Perkins V). The purpose of this Act is to create a deeper level of academic, career, and technical skills for secondary and postsecondary students who choose to enroll in CTE programs. One of the main components of this act is to ensure high-quality standardized

programs and to promote the integration of academic, career, and technical instruction. This act coincides with the Every Student Succeeds Act (ESSA) of 2015, that requires that all students in America be taught to high academic standards that will prepare them to succeed in college and careers. The ESSA Act shows unprecedented support for CTE programs and of integrating academic standards into CTE courses. ESSA gave control to the states in regards to their Common Core Standards (CCSS) integration, ensuring that the states' academic standards would align with the college entrance exams and relevant career and technical education standards (Landl, 2018).

Implications

The legislative definition of career and technical education courses encompasses the need for a high level of academic and technical material that will help prepare students for future educational and career paths. The current legislation definition states that these courses "provide individuals with rigorous academic content and relevant technical knowledge and skills needed to prepare for further education and careers" (House of Representatives Bill 2353, 2018). The legislation also implies that CTE programs integrate experiences with academic content into student learning content. The specific inclusion of academic content is relevant because it can change how CTE is conceptualized and pave the way for the integration of CCSS into CTE and CTE content into core academic courses.

Career and Technical Education Clusters

There are a variety of careers that fall under the career and technical education umbrella. According to Stauffer (2020), "Career and Technical Education (CTE) is the practice of teaching specific career skills to students in middle school, high school, and post-secondary institutions" (p. 1). CTE is divided into 16 career clusters that represent high-demand career fields. These

clusters are organized into the following categories: health science, business, sales, finance, information technology, STEM (science, technology, engineering, and mathematics), manufacturing, logistics, government, law, agriculture, human services, construction, training, and arts, which includes: audio/visual technology and communications.

Not every category or track is available at every school in every state, but there is a variety based on demand, economy, and culture in the various locations and school districts. CTE pathways, commonly known as CTE tracks, change based on new technology, innovative breakthroughs, and best practices in the career fields. This fluidity allows educational institutions and school boards to adapt programs based on career fields, current trends in the economy, ensuring that students can explore a wide range of careers that interest them in a safe learning environment. The Minnesota Department of Education created a graphical "wheel" model that encompasses all 16 clusters into 6 career fields. Using the wheel as a guide, students can see the foundational knowledge and skills that would fit into a chosen career path. The graphic for the Minnesota Career and Technical Education Clusters can be found in Figure 1.

College and Career Readiness

The phrase "college and career readiness" has been discussed in secondary education for decades but it has not always been the focus of curriculum within educational settings. According to the U.S. Department of Education, it is important to "Raise the bar so that every student in this country—regardless of socioeconomic status, race, or geographic location—is held to high learning standards that will ensure students have the skills to compete in today's global, knowledge-based economy" (U.S Department of Education, 2021, para. 1). Students in various courses or academic paths may be overlooked when it comes to college and career readiness skills due to the stigma that surrounds CTE courses.

In reviewing Minnesota's Department of Education Career Technical Education statistics, secondary students have a higher graduation rate than students who did not take a CTE course and a desire to attend post-secondary training for their career choice. This is often due to students feeling prepared and excited for their future career. When comparing the Minnesota CTE concentrators graduation rate data to the Minnesota non-CTE concentrators graduation rate data, the overall graduation rate from high school in 2019 was 83.7%, which is lower than the 2019 CTE concentrators' graduation rate of 92%. Additional statistics about CTE graduates, such as "nearly two-thirds (65%) of Minnesota high school CTE concentrators enroll in postsecondary" and "86% of postsecondary students completing a CTE program were placed in employment by the end of the second quarter" (2020, p. 2). These statistics show that CTE courses can truly help prepare students for their next path in life.

College and career readiness does not have to be compartmentalized into specific courses or content areas, this concept can be instituted across all areas of secondary education. Students can be prepared for a successful path outside of high school by ensuring high-quality content in all courses.

Purpose and Guiding Question

The purpose of this thesis is to explore the literature available on CTE programs, the relationship between CTE and common core academic standards, and the integration of these standards into CTE courses. Research from states currently practicing the integration of CCSS into CTE classes will be explored and identified. Research on strategies, obstacles, and limiting factors on integration will also be addressed. Questions that are guiding the literature review are:

GQ1: What are the intersections (commonalities, divisions) between academic standards used in Career & Technical Education fields and English language arts (ELA) and mathematics core academic standards?

- ○ Sub-GQ1: How can the intersections (commonalities, divisions) assist high school students with career and college readiness?

- ○ Sub-GQ2: How can the intersections (commonalities, divisions) help high school teachers collaborate to help all students with career and college readiness?

- ○ Sub-GQ3: How are states utilizing research from the intersections to re-envision CTE?

Definition of Terms

Below are research-based definitions of the most important terminology used throughout this thesis.

Common Core State Standards (CCSS)

The Common Core State Standards initiative defines the common core as "a set of high-quality academic standards in mathematics and English language arts/literacy (ELA). These learning goals outline what a student should know and be able to do at the end of each grade. The standards were created to ensure that all students graduate from high school with the skills and knowledge necessary to succeed in college, career, and life, regardless of where they live" (Common Core State Standards Initiative, 2021).

Career & Technical Education (CTE)

*"*Career and technical education is a term applied to schools, institutions, and educational programs that specialize in the skilled trades; applied sciences, modern technologies, and career

preparation. It was formerly (and is still commonly) called vocational education; however, that term has fallen out of favor with most educators" (Great Schools Partnership, 2014).

Project Based Learning (PBL)

The Buck Institute for Education (n.d.) defines Project Based Learning as, "a teaching method in which students learn by actively engaging in real-world and personally meaningful projects"(p. 1).

Department of Defense Education Activity (DoDEA)

The Department of Defense Education Activity is responsible for "planning, directing, coordinating, and managing pre-kindergarten through 12th grade educational programs on behalf of the United States Department of Defense" (2021).

Curriculum Crosswalk

A Curriculum Crosswalk allows for gaps to be found between current coursework and expected knowledge and skills on the job. These gaps and deficiencies can then be used to develop new coursework, new courses, and/or new opportunities for students to gain the necessary knowledge and skills (Bitters & Wegner, 2009).

Every Student Succeeds Act (ESSA)

Wikipedia states that Every Student Succeeds Act (ESSA) is "a U.S. law that was passed in December 2015 and governs the United States K–12 public education policy and replaces the No Child Left Behind Act. This bill is the first to narrow the federal government's role in elementary and secondary education since the 1980s. The ESSA retains the hallmark annual standardized testing requirements of the 2001 No Child Left Behind Act but shifts the law's federal accountability provisions to states. Under the law, students will continue to take annual tests between the third and eighth grades" (Wikipedia, 2021).

Common Career Technical Core

Advanced CTE identifies The Common Career Technical Core (CCTC) "as a state-led initiative to establish a set of rigorous, high-quality standards for Career Technical Education" (Advanced Career and Technical Education, 2021, para.1).

Linked Learning

Connect ED, The National Center for College and Career, identifies Linked Learning as "an approach to educational reform that combines rigorous academics, demanding career and technical education, real-world experience, and integrated student support" (Connect ED, 2019, para.1).

Soft Skills

"Soft skills are character traits and interpersonal skills that characterize a person's relationships with other people. In the workplace, soft skills are considered to be a complement to hard skills, which refer to a person's knowledge and occupational skills. Sociologists may use the term soft skills to describe a person's emotional intelligence quotient (EQ) as opposed to intelligence quotient (IQ)" (Kenton, 2021, para.1).

Chapter Summary

In summary, the history of CTE and the implementation of the career clusters or pathways has helped move vocational education into a more robust educational path for students to explore. With new focus placed on college and career readiness in educational settings and the concerns that are vocalized about students being left behind, it is imperative for the education sector to take a deeper look to ensure that students can be successful in any path they choose after high school whether this is college or career. This thesis is meant to help take these first steps by exploring the relationships among CTE, CCSS, and academic core courses. This

exploration can help to review the relationship and integration of content that can assist with a more integrated system that aligns with the current workforce needs to benefit all stakeholders.

Chapter II: Literature Review

To find the literature and information for this thesis; searches of Education Journals, EBSCO Host Mega File, ERIC, and Google Scholar were conducted for studies and publications from 2000-2020. The keywords used in these searches were "Career and Technical Education," "CTE," "similarities," "vocational education," "Common Core State Standards," "academic standards," "common standards," "common vision for CTE," and "alignment with common core".

Overview of Literature Reviewed

Chapter 2 will review the literature on CTE course standards and common core state standards and the integration of CCSS standards into CTE courses and CTE standards into academic courses.

The research will be divided into the following sections: commonalities of CCSS academic courses and CTE courses; differences and reputation of CTE courses from academic courses; and integration of CCSS into CTE courses and CTE standards into core academic courses with a focus on secondary schools that are currently following the integration model. This chapter will end with how the integration of CCSS into CTE courses and CTE standards into academic courses can assist in academic student success and concerns that may face states with the implementation of CCSS standards within CTE courses.

Chapter 2 is divided into two parts and organized as follows: review of intersections (commonalities, divisions) in CTE and CCSS courses and states that are currently integrating CTE and CCSS standards within their classrooms/curriculum; review of literature associated with answering the following thesis sub-questions: How can the intersections (commonalities, divisions) assist high school students with career and college readiness? How can the

intersections help high school teachers collaborate to help all students with career and college readiness? How are states utilizing research from the intersections to re-envisioning post-secondary CTE?

Intersections: Commonalities

This section will explore the various commonalities that can be found in CTE and Common Core courses. In the last decade, conversations about the need for unified educational standards in our schools have increased and the adoption of Common Core State Standards has occurred in 41 states, the District of Columbia, Department of Defense Education Activity (DoDEA), and four territories. These standards set precedent for a major shift of instruction in and out of the classroom and were meant to ensure that all students would graduate from high school with the skills and knowledge needed for life, no matter their chosen path of college or career. These common core standards were created to set high academic standards for mathematics and ELA and were broken down into different categories ("Standards in your state", 2021).

Industry standards, based on the technical skills needed for specific jobs, have been a key component of CTE courses since the implementation of these courses in schools. These standards are used to create the technical knowledge needed to be successful within specific occupations. These standards vary based on occupation, location and even vocational needs. According to the Center on Standards and Assessment Implementation, "CTE standards can be defined as clearly articulated expectations of what students should know and be able to do at the end of a CTE program or course. Similar to other academic standards, CTE standards may be course specific and created in conjunction with expert and community stakeholder input and review" ("Career and technical education standards", 2021, p.1). For example, if a CTE program

is teaching students to wire a residence in Indiana then the instruction, within the course, would be based upon Indiana's electrical code and building codes but the common standards such as Occupational Safety and Health Administration (OSHA) certification completion, understanding blueprints, shop drawings and basic plans do not change from one state to another (Indiana Department of Education, n.d.).

There is an array of intersections (commonalities & divisions) between CCSS and CTE standards that can impact student achievement. Taking a deeper look at these intersections can support educators in developing stronger academic programs that can assist students in career and college readiness. In both academic and CTE courses, students are required to meet standards that are outlined by a governing authority, whether this is the State Department of Education or industry-recognized certification boards. These content areas have skills that are associated with both areas such as critical thinking, technical literacy, written and verbal communication, applied scientific theories and principles, as well as mathematical literacy and comprehension. "CTE programs provide students opportunities to extend their literacy skills through exercises involving the in-depth integration of both reading and writing, along with critical thinking and employability skills like oral communication, leadership and teamwork" (Levels, 2009, p.5). High levels of literacy are essential for post-secondary education and the current workforce, however the challenge for CTE teachers is identifying the specific skills that correlate with CCSS. "Many CTE teachers are working to reinforce the academic content as they teach but have limited experience with the explicit integration of literacy and math into their CTE content areas" (Meeder & Suddreth, 2012, p. 23).

Assessment

Varied assessments are another commonality between CTE and academic courses. The use of multiple assessments including performance-based assessments used to measure skills attainment. CTE courses use skills-based performance testing in all content areas from Agriculture to Manufacturing. Assessments based on CTE content can be broken into four different categories: technical assessments, workplace readiness assessments, performance-based rubrics, and authentic assessment practices (Jones, n.d).

Technical assessments are used to identify competency in technical skills needed for a particular career/content area. This is often based upon industry-recognized certifications that are acquired in the specific career field. Although specific technical skills assessments would not necessarily be presented in a CCSS course, the structure and layout of the assessment and even some content could be similar.

Workplace readiness assessments are not focused on content as much as on skills needed for workplace success. These skills are the hard and soft skills necessary to be successful in a future career. Each CTE content area has specific workplace readiness skills that are measured but the overall soft skills are measured across the courses. CCSS courses measure soft skills in a variety of ways such as arriving to class on time and prepared, research and analytical assessments, and even relational assessments or oral presentations are all assessments that measure workplace readiness.

Performance-based rubrics are used in CTE courses as a standard way to assess understanding of academic and technical content, as well as to ensure the application of this knowledge. These assessments can be performed as a formal or informal assessment and can be used for a required grade or just skill enhancement. Academic core courses use these variety of

assessments/rubric when there are skills or content that a student would need to be proficient in prior to moving to the next level of learning. These performance-based rubrics can be used in live work, group projects, demonstrations, and even presentations.

Authentic assessment practices are a summative assessment for instructional units, midterms or full courses. These assessments align to the level of rigor and relevance of the course content, and assess skills, knowledge and behavior of the student. The assessment can use a rubric for the performance portion and will often provide the student with constructive feedback that can be used to help a student move toward skill proficiency. Academic courses that integrate CCSS have similar assessments, such as midterms and final exams, that will measure students' proficiency in content areas and skills.

Ethics

Commonalities for CTE and core academic courses continue with the presentation and endorsement of honor code and ethical implications, especially in the secondary educational settings. It is important for CTE courses to imbed essential soft skills, including moral and ethical concepts, into their content and often becomes a daily occurrence in these courses. Even though the use and enforcement of ethics is not always at the forefront of academic courses, these are still taught and used within them. Ethics starts with any teacher modeling strong character traits that include honesty, perseverance, respect, lawfulness, fairness, patience, and unity. Teachers who treat their students with kindness and respect without showing favoritism, prejudice or partiality will set the expectations for the classroom. Ethical decision-making skills such as integrity, critical thinking, and leadership are all top attributes in careers and can be reviewed and taught within any classroom. Bringing ethics into teaching in any classroom can come in the form of case studies, guest speakers, simulations, self-integration, self-assessments

and reflection. "The importance of teaching ethics to student success is directly tied to the following two aspects: employability and promotability. Simply put, students lacking ethical decision-making skills don't possess the fundamental skills required to build a successful career" (Capsim, 2021, para. 1).

Experiential Learning

Experiential learning theory is rooted in Dewey (1938), who believed learning through experiences was the starting point of the educational process. Kolb's (1984) experiential learning model is a conceptual model that describes the process of experiential learning as "the process whereby knowledge is created through the transformation of experience" (p. 26). Understanding that learning is not a one-way linear process but includes application and experiences helps to ensure that teachers can deliver content in a way that allows students to obtain, retain and apply knowledge.

The focus on familiarity, comprehension, and application of content is essential in both CTE and core academic courses and this is evident in both industry-recognized standards and CCSS. Both core academic and CTE courses use a variety of techniques to emphasize and teach comprehension and application of content. These techniques, such as project-based learning, technical reading, and application of content, as well as hands-on experiments and application can be seen in courses such as English language arts, science, and engineering.

"Only 35 percent of 12th graders are considered proficient in reading and can demonstrate overall understanding of texts, make inferences, draw conclusions and make connections to previous experiences" (Levels, 2009, p. 2). According to the Common Core State Standards Initiative (2021), the skills and knowledge found in the ELA/literacy standards are designed to prepare students for literacy outside of the classroom. These standards include

critical-thinking skills, the relation of texts outside of the class, cogent reasoning and evidence collection skills. The standards also lay out a vision of what it means to be a successful literate person in the 21st century. The application of literacy occurs in every subject and content area, not just ELA courses. "CTE courses are brimming with opportunities for teachers to integrate literacy and math skills as real-life applications. And ultimately, isn't that what learning is all about-real-life skills that benefit the individual and community" (Gammil, 2015, para. 7).

Content in any subject area can be strengthened with the use of guest speakers and field trips to view learning in the natural environment and experience first-hand from primary resources. According to the National Educator Association (2021), "Today's students are visual learners and a field trip lets them touch, feel, and listen to what they're learning about" ("How field trips boost", para. 4). These experiences help them gain a better understanding of classroom content, build cultural understanding and tolerance, and expose them to worlds outside their own. CTE teachers are often current in their content field and have a close relationship with other members in that career field, allowing for more field trips and guest speaker opportunities but these opportunities are not exclusive to CTE courses. Common core courses take field trips and have influential guest speakers that visit the classroom to solidify learning on a continuous basis.

Intersections: Differences

This section will explore the differences that can be found between CTE and academic core courses. Commonalities in both CTE and core academic courses are clear and can be a good starting point in encouraging more integration aligning the educational system with the current workforce needs, all while promoting equity for students but there are some stark differences in these two types of courses. CTE courses are focused on the employability of their students. The additional path of college education is always in the thoughts of the instructors but the original

focus, until the passing of the ESSA Act and the updated versions of the Strengthening Career and Technical Education for the 21st Century Act (Perkins V), was to ensure that students were appropriately prepared for workforce demands. These courses do not just focus on the technical skills needed for the workforce but the soft skills, employability skills, and the ability for students to be driven to attain additional knowledge in their fields, or become lifelong learners. "CTE teaches transferable workplace skills in applied learning contexts to provide opportunities to explore high-demand career options, and gives students the technology and skills needed for success in adult life" ("Career and Technical Education", n.d, para. 1).

Technical Soft Skill Integration

Standards created for CTE courses are based upon both the technical information needed to be successful in a career field and soft skills integration needed, such as communication, time management, and professional dress. Activities such as oral presentation, research, technical reading, mathematical calculations, and research and application techniques are used to accomplish this. In both technical and soft skills standards, input is obtained directly from employers in the local community. These experts are known as subject matter experts (SME). The national certification boards for the CTE course content also provide input on technical and soft skill standards. Not only do the standards taught have to meet the expectations of the certifying boards and employers but they must also meet the state's department of education and all stakeholders' expectations, as well.

Teacher Qualifications

Another difference is the qualifications needed to teach CTE courses. CTE courses are considerably more focused on career content skills and application of career content knowledge than the academic content area courses such as English language arts, science or math and this

focus drives the qualifications of the teacher. "High-quality CTE programs and pathways ensure that coursework is simultaneously aligned to rigorous academic standards and postsecondary expectations and informed by and built to address the skills needed in specific career pathways" (Brand et al., 2013, p.2). CTE course content teachers are not always traditionally trained educators but are considered experts in their subject matter. These teachers must have extensive knowledge and experience in the field in which their students will be trained. This experience may not be enough in many states that require a CTE credential prior to teaching a course, such as an industry-recognized certification and/or a teaching license (Keily & Perez, 2021).

CTE teachers in secondary education also fall into the highly qualified teacher requirements that were included in the Elementary and Secondary Education Act (ESEA) of 2002 (American Institute of Research, 2013). This means that CTE teachers must be certified with the appropriate education foundation and content courses required by ESEA, although the requirements do vary by state.

For example, Minnesota offers a teaching license that is specific to CTE or career pathways. In order to be eligible for this licensure, the applicant must meet at least one of the requirements: "Hold an Associate's degree or higher in the area directly related to the requested licensure field; hold a professional certification in an area directly related to the requested licensure field; or have five years of verified work experience in an area directly related to the requested licensure field" (Minnesota Department of Education, n.d, para. 6).

Another example is the state of Florida's requirements. These requirements depend on the specific CTE subject matter that is to be taught by the teacher. The flexibility allows for technical area specialties across CTE and provides an ease of hiring in high-need content areas. An example of this is that an individual can teach Engineering and Technology education by

either possessing a bachelor's degree or higher in engineering or technology education or a combination of a bachelor's degree with 30 semester hours in four of the 10 specific content areas taught in this course such as energy and power technology, construction technology or biomedical technology (Keily & Perez, 2021).

In contrast, Maryland has four paths to certification based on the applicant's level of education. The educational requirements for each path ranges from a bachelor's degree in a state-approved CTE program to a secondary school diploma with three years of occupational experience plus completion of professional education coursework. All paths, except for the bachelor's degree in a state-approved CTE program, must also complete 12 credits of professional education course work in the following areas: Planning, delivering, and assessing instruction; Managing an effective classroom and minimizing risk; Differentiating instruction to accommodate special needs; and Providing reading, writing, and mathematics literacy instruction relevant to the career area (Maryland State Board of Education, 2021). Many states have had to lower their requirements because of the inability to find licensed teachers who also have the subject matter expertise.

Once an industry expert is certified with an industry certification and has a desire to teach, there may be other requirements. They may not be qualified to meet ESEA requirements, bringing another struggle to obtain a license to teach CTE in secondary schools. Colleges that offer education degrees rarely have a CTE track for training or if the college does offer this track, it may not be financially or time feasible to the individual. Not only does this individual need to complete their CTE academic program but must simultaneously remain current in their industry to ensure that he/she is on top of changes and adaptations to the field.

According to Association for Career and Technical Education (ACTE), "86 percent of State Directors reported a moderate or severe CTE teacher shortage in at least one Career Cluster at the secondary level, and a further 60 percent indicated the same at the postsecondary level. The underlying causes for these shortages most often relate to the difficulties CTE programs have in competing with the private sector for the same pool of qualified instructors along with the fact that many universities have closed their CTE teacher preparation programs in recent years" (Imperatore, 2021, para. 2).

Qualifications for CTE teachers are extensive and require work on the part of the CTE teacher but academic core teachers also require additional education that specializes in content chosen to teach, supervised student teaching experience, assessments, and licensure through the Department of Education in the specific state he/she chooses to teach in. Each state has specific teaching licensure requirements and it is the responsibility of the individual to know what is needed prior to applying for licensure. For example, Minnesota has a tiered licensing system, which means that teacher licensure is granted based on qualifications such as education, experience, teacher preparation programs and subject area. Teachers who are looking to obtain licensure may also be subject to additional testing. The licensure process is overseen by the Professional Educator Licensing and Standards Board (PELSB). This system allows for many different ways of becoming a teacher, depending on your qualifications and experience (Minnesota Department of Education, n.d).

Work-Based Learning

Work-based learning represents the integration of workplace experiences and career and technical education (CTE) curriculum. It involves students in the construction of knowledge by engaging them in current tasks of the workplace that "create a context for creative decision

making in uncertain situations" (Harnish & Wilke-Schnaufer 1998, p. 22). Work-based learning engages students in reflective practices that allow them to grow personally and professionally.

Work-based learning (WBL) includes a range of activities that go beyond the traditional classroom setting of learning. Cooperative education in the form of job shadowing, service learning, internships, and apprenticeships all fall into the category of work-based learning. Since CTE courses are focused on specified career areas, these courses offer opportunities for students to participate in career exploration and career-building activities in the classroom, as well as hands-on learning experiences outside of the classroom. Students will not only learn about the skills needed but get the opportunity to listen to experts in their field during guest speakers and field trips. Luft (1999) identified that students who engaged in their own learning via personal experiences with an employer, working independently and working as a team to solve problems in a work setting, increased student self-confidence and encouraged them to continue to learn. Although core classes may offer students the opportunity to visit or explore career options, many do not offer the extensive opportunities that are provided to CTE students.

Employer Relationships

CTE courses combine classroom-based instruction with work-based learning opportunities such as internships, externships, and apprenticeships. This approach provides students with the opportunity to work with local employers. This student/employer relationship provides students with exposure to workplace employability skills, application of academic content in the real-world setting, and collaboration with adults with an established career in the students' desired career field. Employers often serve as advisors or mentors to CTE teachers to ensure curriculum is relevant to current and future knowledge and technologies in the workplace. Employers can provide information about career opportunities and skill sets needed for specific

jobs, mentor students, serve as judges of student work for industry-level competitions, and even provide donated equipment. Employers may also offer externships for teachers during the summer to keep relevant with ever changing work place standards. It is the CTE instructor's responsibility to create, manage, and foster these employer relationships. It can be difficult to balance this responsibility with all of the other responsibilities as a teacher but these relationships are imperative to ensure that students obtain the most current and relevant content. Employer/teacher relationships are not a necessity for core academic content courses (National Association of State Directors of Career Technical Education Consortium, 2014).

Articulation Agreements/Dual Enrollment

A large number of CTE courses offer post-secondary education credit for students who are looking to expand their education after high school. These credits can be issued via articulated agreements or dual enrollment credits and are a direct path for students to continue on with their educational journey in a variety of fields at specific educational institutions. Since CTE courses are industry-based, they can be structured to ensure that the curriculum and instruction are aligned with the post-secondary pathways that would be needed to be successful in a specific career field. This alignment helps to provide a clear direction for post-secondary education and training.

The partnership between post-secondary and CTE courses helps to ensure that the curriculum aligns with entrance standards and content, academic rigor, and level of skills needed for students' success. CTE teachers and post-secondary faculty work together to ensure that course content is equivalent and can be transferred via articulation or dual enrollment. An articulation agreement is specifically designed to create a seamless and successful transition for students moving from a CTE course into a post-secondary institution in a specific career path.

Based on CTE statistics from the Department of Education (2019) "the most common CTE activity or feature was work-based learning opportunities, such as on-the-job training, internships, practicums, clinical experiences, or cooperative education (77 percent); followed by CTE courses that earned both high school and postsecondary credits, sometimes referred to as "dual credit" or "concurrent credit" (73 percent); mentoring by local employers (65 percent); and student-run enterprises or services (55 percent)" ("CTE data story", 2019, p. 6).

There is an opportunity to earn college credit from core academic courses that are identified as Advanced Placement (AP) courses. These courses offer college-level courses in the high school that the student attends. AP is "a program of classes developed by the College Board to give high school students an introduction to college-level classes and also gain college credit before even graduating high school. These courses are more difficult than the usual high school class and also require passing an AP exam at the end of the year to gain the college credit" (National Society of High School Scholars, 2018, p. 1). The exam must be passed with a 4 or 5 to be awarded potential college credit, although some schools also accept a passing score of 3. While there are a variety of differences between articulated credit, dual enrollment, and AP courses, they all offer opportunities for high school students to earn college credit.

Curriculum Standards

One of the substantial differences between CTE and academic common core courses is the curriculum standards. Although each content area has industry standards that a CTE instructor strives to meet, there are very few CTE courses that have a required curriculum that is taught from one course to the next or even one high school to the next, in the same district. Unlike academic courses that align with CCSS, CTE courses do not have a unified direction from state or federal education departments as to what standards must be covered. Some states

have adopted Career Technical Education standards (CTES) or Common Career Technical Core standards (CCTC) that assist districts with ensuring that their schools meet the current industry standards and trends. These standards have been developed by a diverse group of teachers, business and industry experts, administrators, and researchers. Forty-two states and the District of Columbia participated in the development stage of the CCTC, which was coordinated by the initiative for Advance CTE. These standards were not built from scratch but built upon the foundation of the National Career Clusters Framework that states have been using to help organize their CTE programs since the early 2000s (Advance CTE, n.d).

These career clusters have been validated over the years by industry-recognized professionals, secondary and post-secondary educators, and key CTE stakeholders. For example, the California State Plan for Career Technical Education (2021) guides California's CTE programs. The plan states, "CTE programs are dynamic; curricula need to stay current with rapid changes in the workplace, requiring ongoing updates and learning on the part of CTE faculty. The adoption of the English Language Arts and Mathematics Common Core State Standards furthered the need to revise and align the CTE Standards with this new academic core" (p.62). These standards are not full curriculum plans or maps but a guideline for CTE teachers and school districts to ensure that they have an outline to guide their planning "Standards themselves don't increase student achievement. Crosswalks and curriculum maps don't equate to a successful implementation until the purpose and meaning of the standard comes alive to students through effective and engaging instruction. Ideally, that occurs when the learning experience is situated in real-world, authentic contexts like those in CTE courses and programs" (Pearson, 2019, p. 3).

While there are standards for grade-specific goals in ELA and mathematics, these standards do not define how the material should be taught or what material is used to teach the content. It is up to the state department of education to determine what and how these standards should be met. For example, the Department of Education in Minnesota has developed the Minnesota K-12 Academic Standards. These standards define expectations for the educational achievement of public-school students across the state in grades K-12. "The standards and benchmarks are important because they: 1) identify the knowledge and skills that all students must achieve by the end of a grade level or grade band; 2) help define the course credit requirements for graduation; and, 3) serve as a guide for the local adoption and design of curricula. Student mastery of the standards is measured through state and local assessments" (Minnesota Department of Education, n.d, para. 1). State standards are in place for English language arts, mathematics, science, social studies and physical education, and art. Minnesota adopted the CCSS for English Language Arts in 2010 but did not elect to adopt CCSS standards for Mathematics, although the standards will be reviewed in 2021-2022 (Minnesota Department of Education, n.d).

Stigma

Differences are not only in qualifications, relationships between employers, and curriculum standards but in the reputation of CTE courses. This reputation is not only about the content that is delivered within the walls of a CTE classroom but who and what CTE courses represented in the past. These courses have obtained a reputation, in the educational world, as courses that are geared towards students who do not have a future path in post-secondary education or are just geared to teach students how to work. "Although there has been something of a resurgence of CTE programs in the United States in recent years, the stigma attached to this

type of education still exists...While CTE programs are commonplace and successful in European countries, in the United States they have long been inaccurately viewed as an option solely for those not suited to academic pursuits, and for troubled and at-risk youth. This kind of misinformation continues to stigmatize CTE, even as the facts present a quite different and powerful narrative" (DelGuidice & Luna, 2014, para. 5).

This stigma has hindered the relationship between teachers, parents, and school staff. Mississippi State University Research and Curriculum Unit completed a study on key stakeholders' thoughts and opinions on CTE. As part of the study, samples of residents and educators were surveyed to determine the perception of CTE and what these courses contained. The surveys that were used in both groups, residents, and educators, were not identical but they were similar in the questions asked. They both addressed CTE opinions, benefits of CTE participation, and the ability of CTE to successfully prepare students for college and careers. The first phase of the study surveyed 403 residents by phone and or email. Forty-five percent of Mississippi residents surveyed were unable to name one single CTE course that was offered at their local high school and when asked to identify CTE courses in general, the respondents only listed manual labor and trade fields such as welding and HVAC. When asked which type of students benefit from CTE courses, forty-four percent identified disadvantaged students. Disadvantages ranged from students who were not college-bound, students in poverty, or even students with poor grades. There was little mention of specific career-driven students that could benefit from these courses. Not only did respondents fail to see that college-bound students can take these courses, but they also were unaware that students can receive college preparatory diplomas for taking these courses.

The second phase of the study surveyed a little over 2300 Mississippi educators, administration and staff; seventy percent were teachers. Out of these educators, twenty percent of them were not sure if their district offered CTE courses. For educators that were aware of the CTE courses, about half of them rated the Mississippi CTE program quality as excellent or Good and one third felt that the quality was poor. There was a direct correlation of the educators who felt the quality was poor to the uncertainty of the district offering courses in CTE. Twelve percent of educators surveyed also identified that college-bound students were slightly or not at all likely to take or benefit from CTE course participation. When asked who would benefit from these courses, the overwhelming response was at-risk students or students who were most likely to just enter the workforce after high school (Jordan et al., 2016). The misperception of educators and residents in Mississippi is just a small sampling of how the stigma of CTE courses can alter one's perception.

The content within CTE and academic courses are rigorous and complex, yet CTE's misperceived reputation leads to frustration for CTE teachers. The stigma that surrounds CTE has been covered in a body of literature that discusses the need and purpose for higher education. "The literature, of course, draws an imaginary line between those who believe that the purpose of higher education is for the civic good of society, while others believe that higher education must offer society a valuable utility and a more practical use, thus, offering society a more economic advantage. People who enroll in CTE are stigmatized under the perception that they do not have the academic intellect to conceptualize the civic purpose of higher education" (Gauther, 2020, p.1).

Integration

  This section will review the research from states that have currently adopted the integration of common core standards into their CTE courses and CTE content into academic core courses. Although a large number of states have not recognized the importance of collaboration and integration with CTE and academic core classes, a handful of states have begun the process of bridging them. A review of the literature found that several states are integrating CCSS into CTE standards and academic courses.

California

  Revised California Model Curriculum Standards (CMCS) make direct connections to CCSS. Based on documents outlining the CTE standards model for California, CTE programs are "Organized into California's 15 high-employing industry sectors, the CTE standards are designed to assist schools in developing curriculum and measuring student achievement. Each standard is aligned with one or more Common Core English language arts and mathematics standards, Next Generation Science Core Ideas, and history/social studies standards. This alignment identification will guide teachers in integrating instruction, adding application and performance to academic content, engaging more students, and improving outcomes" (California Career Technical Education, 2013, p. ii).

Oregon

  Created a diverse group of educators and stakeholders that included state directors of CTE, CTE teachers and high school core educators on the CCSS stewardship team (explain the team) to help create the CTE and common core academic partnership.

  In 2020, Oregon adopted a CTE Program of Study Quality Rubric, created in 2019, that was built around five core elements and aligned them to the Association for Career and

Technical Education's (ACTE) High Quality CTE Program of Study framework. The 5 core elements are then sub-divided into Program of Study (POS) elements identified in the rubric as: Rigorous Integrated Content, Engaged Learning, Coherent Curriculum, Partnerships, Credentials, Facilities and Equipment, Continuous Improvement, Career Development, Education and Employability, Access and Equity, and Professional development. Looking deeper into the POS for Rigorous integrated content, there is a direct correlation with CTE and core academic content teachers integrating core academic content into CTE courses through content and collaboration (Oregon CTE Program of Study, 2019).

Ohio

In 2012, the Ohio Department of Education and the Ohio Board of Regents participated in the High School Higher Education Alignment Initiative, in which 14 partnerships were created to work on aligning curriculum in ELA and math CCSS standards. Three-quarters of these partnerships included CTE representation or were modeled to make CTE the focus. Then in 2013, Ohio engaged core content and CTE teachers in a three-year process to revise the 16 clusters to ensure that the clusters are integrated with state standards and the CCSS. No additional information was found on the outcome of this initiative in the research.

New York

Beginning in 2015, New York began to allow students to graduate with a CTE diploma, which can often partner with local colleges to provide Associates Degree upon high school graduation. This program integrates core academic courses, CTE courses and skills assessments to ensure that students are prepared for the next path in life.

New York Department of Education (NYDE) contains a division known as CTE Technical Assistance Center (TAC) dedicated to assisting CTE programs, in both secondary and

post-secondary, to ensure that the state carries out its mission of improving the quality, access and delivery of CTE programs. One of the goals of CTE TAC is to assist with the integration of New York State common core learning standards within CTE courses, specifically ELA and mathematics.

Georgia

Georgia thoroughly linked their math standards to their CTE programs. The CTE courses have been cross-walked, so that it is clear to see which standard in the Plumbing I course links to a math course at the high school level (Georgia Department of Education, 2008). Georgia is slightly different from some of the other states by including process standards within its math standards and referencing these in the cross-walked CTE documents (Georgia Department of Education, 2009).

Nebraska

Nebraska has also cross-walked their math standards and CTE standards in grades four, eight and twelve with the CTE standards (Nebraska Department of Education, 2003). The specific math language of the standards is used, and there is a clear connection between the CTE standard and the academic standard.

Wisconsin

In 2010, State Superintendent Tony Evers adopted the CCSS in ELA, Mathematics, and Literacy in all subject areas, including CTE. His initiative indicates that CTE instructors will need to ensure that they are knowledgeable about what CCSS are addressed in their classrooms and ensure that these standards are met or at least integrated into their instruction and curriculum. The Wisconsin Department of Public Instruction (2013) created universal standards for Technology and Engineering that consists of an in-depth map to assist educators in connecting

career and technical education in the common core state standards based on the adoption of the CCSS. This map focuses on disciplinary literacy and mathematical standards (Wisconsin Standards, 2013).

Minnesota

The Department of Education in Minnesota identifies the relationship of CCSS and CTE courses in their description and outline of their CTE courses. "Career and Technical Education (CTE) programs are a sequence of courses that integrate core academic knowledge with technical and occupational knowledge and skills to provide students a pathway to postsecondary education and careers. CTE teaches transferable workplace skills in applied learning contexts to provide opportunities to explore high-demand career options, and gives students the technology and skills needed for success in adult life" (Minnesota Department of Education, 2021). As of February 2021, the state has adopted a Career and Technical Education Credit equivalency map that assists districts in determining the number and type of core credits that can be obtained through a CTE course. See Appendix C for Career and Technical Education Credit Equivalency map.

As more and more states adopt CCSS and CCTC standards, additional opportunities begin to emerge that should increase collaboration between general education and CTE. "The goal of ensuring that all students graduate from high school ready for college, careers and life has taken hold in every state across the nation. Yet all too often, the focus on "college readiness" and "career readiness" remains in two distinct silos, even though there is little question that reading, writing, communications and mathematical reasoning are all core skills for success in postsecondary education, in the workplace and for citizenship and that educators across all

disciplines should help students develop, deepen and refine these core skills" (Meeder &

Sudreth, 2012, p.3).

Concerns Faced by Implementation of Standards

As with all changes, there are concerns that come with implementation of common core

standards into CTE courses and CTE standards into common core courses, such as the time it

would take to cross-disciplinary teams, professional development for all involved, and the

identification of standards that will work within both content areas. These concerns, along with

the cost and the current stigma of career and technical education courses, have led to decreased

implementation and participation in the relationship between CTE and CCSS. According to Janet

Bray, Executive Director of ACTE, "Common core state standards implementation presents

tremendous opportunity for CTE and academics to better align to improve student career

readiness, but too many states and school districts are neglecting this important connection

point" (2012, para. 4).

Intersections and Career and College Readiness

Now that literature surrounding the intersections (commonalities and differences) has

been explored, understanding how intersections such as the commonalities and differences of

CTE can assist high school students with career and college readiness is reviewed. These

intersections can help to identify and create a plan to assist students with the preparation to

become career college-ready ready. By combining learning from both content areas and

collaboration with teachers of both CTE and core academic courses, schools can align their

coursework and teach using cross-disciplinary projects that tackle real-world problems. An

example of a cross-disciplinary problem is in an Automotive Technology classroom where both

teachers, mathematics and CTE, would be present while students begin to examine two tires. The

students begin by reading the information off of the sidewall of each tire, explain the meaning of this information and then calculate the tire sizes. This exercise involves mathematical conversion integrating the CCSS for mathematics, taken from pg.60 of the Common Core Standards for Mathematics, about Reason Quantitatively and using units to solve problems. One can see how this content is relevant to both Automotive technology and mathematics, and incorporates a real-world example that students can understand. The lesson doesn't just stop at the calculation of tire sizes but can continue to discuss sizes of tires versus distance of travel per size.

Once discussion ensues, then there can be a demonstration by using tape or a marker to test out the distance that the tire can rotate. Once rotation has been reviewed, additional math standards become involved and discussions continue with students, demonstrating a robust connected lesson between both math and Automotive Technology (Richner, 2014). "When learning is contextualized, learning activities and the actual physical environment provide scaffolding structures which propagate knowledge construction, facilitate long term memory encoding, and promote organization for memory recall" (Clifford & Wilson, 2000).

An approach to incorporating learning standards in both content areas is being used in California, in over 40 of its communities, known as Linked Learning. This program engages their students by making education relevant and rigorous. It combines "strong academics, career-based classroom learning, real-world workplace experience and personalized student support. Linked Learning connects coursework and technical training to career pathways such as digital media arts, engineering, green energy, health sciences, and law and justice" (Hoachlander & Steinhauser, 2015, para. 7). This program encourages and recognizes all paths that students may explore after high school and builds upon the skills and academic core knowledge needed for any of them.

An example of multidisciplinary instruction created by ConnectEd is a set of integrated, problem-based curriculum units. These units were developed in partnership with the National Consortium on Health Science and Technical Education and are available to use in the focus areas of Biomedical & Health, Engineering, Law & Justice and Design Resources. These units can be taught in collaboration with both content area teachers and CTE instructors and help to ensure that a variety of standards are met. These ready to use resources allow teachers to focus on teaching content collaboratively without having to create everything from scratch (National Consortium on Health Science and Technical Education, 2019)

Focusing on the commonalities should not be the only part of intersections that is reviewed to assist students in successful growth. Knowing and understanding the divisions that can occur between both content areas, districts can begin to end the isolation of CTE from academics and create a new approach that integrates the two, leveraging the best of both worlds and making each mutually reinforcing of the other. "Standards themselves don't increase student achievement. Crosswalks and curriculum maps don't equate to a successful implementation until the purpose and meaning of the standard comes alive to students through effective and engaging instruction. Ideally, that occurs when the learning experience is situated in real-world, authentic contexts like those in CTE courses and programs" (Pearson, 2019, p. 3).

Intersections to Assist High School Teachers

Intersections can be used to assist high school teachers in preparing students for college and career readiness. Richner (2014) says that collaboration between academic core teachers and CTE teachers is an important component to how and what students are able to learn. An added benefit in collaboration would be the enhancement of the educators' grasp of their area of training and expertise, as well as an introduction to a new area of content knowledge. This

collaboration can provide professional development in a new content area, contacts in the career field that can assist in guest speakers or field trips that can benefit both students and teachers, and a new way of teaching common core standards.

In addition to the use of cross-disciplinary teams to gain technical training and industry contacts, teacher partnerships foster an environment of collaboration and demonstrates to students that partnerships in all areas of a career field can benefit all stakeholders, not just ones who have a direct interest in the content. These stakeholders are students, teachers of both core academic courses and CTE courses, administrators, counselors, parents, industry professionals and the general public. Not only will these stakeholders' benefit, the use of cross-disciplinary teams can be used as a model for other schools.

Richner (2014) identified a few challenges that could hinder the integration of CCSS into CTE courses, specifically mathematical standards. These challenges focused on teacher collaboration, cross disciplinary teams, and the ability for CTE teachers to interpret content that correlates with the mathematical standards. Richner (2014) explained that this is where content maps and collaboration with a certified math teacher could assist in successful collaboration.

Re-Envisioning CTE

States are beginning to utilize research from the intersections to re-envision CTE in various ways. Although there are a variety of intersections (commonalities/differences) that need to be addressed by states that have CTE programs, there has been a strong initiative to work towards an overall revamping of CTE programs due to the passing and implementation of the Strengthening Career and Technical Education for the 21st Century Act, also known as Perkins V. States are taking a closer look at these programs and how they can be used to strengthen students' ability to be career and college ready. "States overwhelmingly have recognized the need

to systemically and meaningfully attend to the issue of equity to better support each learner. They also are building upon Perkins and CTE's legacy of connecting systems, promoting collaboration with and alignment of education and workforce development systems. This focus is especially evident in states' bold statewide visions for CTE. Many states also have taken up the challenge of reconfiguring their accountability frameworks to signal what they value most within their CTE systems" (State of Career and Technical Education, 2020, p.3). New information about how states are revamping CTE programs is beginning to emerge but there has been a lot of conversation about the flexibility of this restructure per state and how states can learn from each other.

According to the report developed by Advanced CTE, one of the key intersections (commonalities/differences) is the need for qualified CTE teachers. Not only is finding qualified teachers imperative but ensuring that these teachers have a strong collaboration with faculty and staff at their corresponding school. "Recruiting, developing and retaining qualified teachers and faculty are critical for CTE programs to be successful. As noted previously, instructors are among the most important in-school factors that contribute to the success of learners. No single policy or strategy will fully address the challenges facing states with regards to this issue" (2020, para. 5). As mentioned above, California, Ohio, and Oregon have identified the need for collaboration and were working on the collaboration, prior to the passing of the Strengthening Career and Technical Education for the 21st Century Act (Perkins V). Since the passing of this act, there are new states who are beginning to understand the importance of collaboration and what this relationship could mean for their educators and local communities. For example, Missouri is developing a new professional learning community to help CTE teachers and academic faculty learn from each other and from those in industry. "CTE Teachers are Teachers

of Math, Literacy and Science in CTE not Math, Literacy and Science teachers" (Shafer, 2016, slide 4). This is why collaboration with other faculty will only strengthen students' comprehension of core academic content.

During the 2016-17 school year, the CTE Technical Assistance Center of New York completed a study of the Academic Integration Practices in 13 school districts and Boards of Cooperative Education Services (BOCES) which was overseen by two retired BOCES CTE directors. These individuals were contracted to serve as consultants and assist in the development and execution of a survey and visitations. The study sought to identify the level of integration of academics into CTE programs, and create a baseline to establish a set of concentrated activities, supports, and resources to assist schools, districts, and BOCES in the implementation of effective academic integration. The survey's used in this study focused on five elements: Program Model, Planning for Instruction, Implementation of Instruction, Post Instruction, and Program Assessment. There was also an area on the survey that elicited additional comments and suggestions from participants.

Once the surveys were completed, the consultants followed up with lengthy phone conversations and local visitations to ensure accurate and comprehensive information was obtained. Survey results and information were then organized into the following: (1) System Elements of Academic Integration: Curriculum, Implementation, and Effectiveness, and (2) Teacher Elements of Academic Integration: Co-Planning, Co-Teaching, and Co-Assessing. Additional information was added on the strengths, weaknesses, and the potential for professional development for each element. The consultants and the CTE TAC Center Specialist identified key findings of academic integration design that served as enhancers or inhibitors to successful implementation.

The findings were consistent with the need for academic integration, especially English language arts (ELA), math, and science concepts. Co-planning is essential in ensuring that CCSS are met and can be inserted into the CTE curriculum. "Curriculum is the basis of the integrated model. It is impacted by several elements in the approval process, including the involvement of academic teachers in the crosswalk of the academic and CTE content, meeting the requirements for program approval, and the support for CTE teachers in the implementation" (Shafer et al., 2017, p. 5).

Chapter III: Discussion and Conclusion

The purpose of this thesis was to explore the literature available on CTE programs, the relationship between CTE and common core academic standards, and the integration of these standards into CTE courses. This purpose was further broken down into guiding questions to identify the intersections, how these intersections impact the implementation of academic standards, and what states and school boards are currently executing the implementation of CCSS onto CTE and CTE content into core academic courses. Chapter III summarizes the literature review, presents a professional application, and concludes with limitations and recommendations for further research.

Summary of the Literature Review

To answer the guiding questions, literature was reviewed in four main areas: commonalities of academic and CTE courses, differences and reputation of CTE courses from core academic courses, current integration of CCSS into CTE courses, and concerns faced by implementation of CCSS into CTE courses.

Commonalities of CCSS Academic Courses and CTE courses

There are a variety of commonalities between CCSS and CTE standards that can positively impact student achievement. In both academic core courses and CTE courses, students are required to meet standards that are outlined by a governing authority, whether this is the state department of education or industry-recognized certification boards. Additional commonalities such as the use of varied assessments and the presentation and endorsement of the honor code and ethical implications are found in both CTE and core academic courses. Experiential learning theory (Dewey, 1938; Kolb, 1984) is an additional commonality that is found in both CTE and academic core courses. Understanding that learning is not a one-way linear process but includes

application and experiences helps to ensure that teachers can deliver content in a way that allows students to obtain, retain and apply knowledge.

Differences and Reputation of CTE courses from academic courses

Although there are a variety of similarities in core academic and CTE courses, there are stark contrasts as well. Although both core academic courses and CTE courses require teacher education and training to teach within the classroom, there are distinct differences for CTE teachers. CTE courses are considerably more focused on career content skills and application of specific career content knowledge and this focus drives the qualifications of the teacher. Since CTE courses are focused on specified career areas, these courses offer opportunities for students to participate in various work-based learning activities such as job shadowing, service learning, internships, and apprenticeships. These work-based based learning activities allow for students to work with local employers, strengthening the student/employer relationship. This relationship provides students with exposure to workplace employability skills, application of academic content in a real-world setting, and collaboration with adults who have an established career in the students' desired career field.

Another difference is the way that college credit can be obtained for CTE courses compared to academic core courses such as AP courses and how CTE articulated credits are a direct path for students to continue on with their educational journey in a specific career field. CTE courses are industry-based, allowing them to be structured to ensure that the curriculum and instruction taught are aligned with post-secondary pathways needed for a specific career field. Although each CTE content area has industry standards, there are very few CTE courses that have a required curriculum that is taught. CTE courses do not have a unified direction from state or federal education departments as to what standards must be covered.

Differences between core academic courses and CTE courses are not only found in qualifications, relationships between employers and curriculum standards but in the reputation of CTE courses. This reputation is not only about the content that is delivered within the walls of a CTE classroom but what who and what CTE courses represented in the past. These courses have obtained a reputation, in the educational world, as courses that are geared towards students who do not have a future path in post-secondary education or are just geared to work. This stigma has hindered the relationship between teachers, parents, and school staff.

Integration of CCSS into CTE courses

A review of research from states that have currently adopted the integration of common core standards into their CTE courses and CTE content into common core courses was discussed in Chapter 2. Although a large number of states have not recognized the importance of collaboration and integration with CTE and academic core classes, a handful of states such as California, Oregon, Ohio, New York, Georgia, Nebraska, Wisconsin, and Minnesota have begun the process of bridging them. As more and more states adopt CCSS and CCTC standards, additional opportunities begin to emerge that should increase collaboration between general education and CTE.

Concerns Faced by Implementation

As with all changes, there are concerns that come with implementation of CCSS into CTE courses and CTE standards into academic core courses, such as the time it would take to create cross-disciplinary teams, professional development for all involved, the identification of standards that will work within both content areas, as well as completing cross credit analysis of academic courses and CTE courses at the high school level. These concerns, along with the cost

and the current stigma of career and technical education courses, have led to decreased
implementation and participation in the integration between CTE and CCSS.

Professional Application

A critical challenge affecting the workforce in the United States is the skills gap,
particularly among jobs that require either a high school diploma, postsecondary certificate, or
associate's degree. As automation and globalization change the way we work, the gap for
qualified workers becomes larger. In 2018, Congress reauthorized existing federal legislation
with updates and retitled the legislation to Strengthening Career and Technical Education Act for
the 21st Century (Perkins V). This legislation supports CTE programs whose main purpose is to
assist with this critical challenge. With each reauthorization and review of the Carl D. Perkins
Act, Congress has expanded definitions of integration with the intention that learning becomes
relevant, rigorous, and effective in preparing students for a career and/or college. CTE programs,
in secondary educational settings, provide an important pathway for students to gain career-
related skills in specific pathways. Not only do students obtain technical skills in a specified
career, they obtain soft skills, literacy, and academic content in an interactive learning
environment. "Approximately 78% of students concentrating in CTE courses enroll in post-
secondary education full-time immediately after graduating. About 62% of those students plan to
pursue a bachelor's degree or higher, and half of all CTE concentrators go on to earn some type
of postsecondary credential or certificate" (Bolin, 2021, p. 8). The implementation of CCSS into
CTE courses and CTE content into academic courses will allow students to strengthen their
academic skills needed to succeed in any path. This multidisciplinary approach can better
prepare students for additional educational opportunities as well as prepare them for any number
of future paths.

The Minnesota Employment and Economic Development released an Executive Summary on hiring difficulties in Manufacturing, based on information gathered via surveys and employer information (Leibert, 2019). This study examined employers' hiring experiences in fourteen skilled production-related occupations in manufacturing firms in Minnesota during 2018 through 2019. These occupations were chosen because of strong evidence of shortages in these fields and growing numbers of vacancies. One of the recurring comments was based on the skills gap and what actual skills are needed. Based on this report, some of the biggest skill gaps are mechanical aptitude, such as using hand tools and all levels of mathematical knowledge. "Strengthening math instruction and adding vocational courses at the high school level could help develop these skills and expose students to manufacturing careers" (Leibert, 2019, p.2).

Although the Minnesota Department of Education (2019) has had a strong push for CTE programs at the secondary and post-secondary level, there has been a stronger push to improve career and technical education and create opportunities to enter high-skill, high-wage, or in-demand employment for all learners since the passing of Strengthening Career and Technical Education for the 21st Century Act (Perkins V). This Act provides an increased focus on the academic achievement of CTE students, strengthens connections to experiential learning and work-based learning opportunities, and increases emphasis on student progress toward earning industry-recognized certificates and postsecondary credentials. Currently the Minnesota Department of Education does not have a crosswalk or plan that integrates CCSS into CTE courses or CTE content into academic core courses. The insertion of CCSS into CTE courses and CTE content into core academic courses will assist in the Minnesota Department of Education initiative to enhance student learning academic achievement.

The implementation of CCSS into CTE courses will provide an opportunity for rethinking and redefining the roles of literacy, mathematics and science across all curricular platforms. Some states have already begun to work at strengthening the relationship and integration of core academic content and CTE courses and are finding success. Based on the available research literature, data suggests that there is a need for the intermingling of CCSS into CTE courses, depending on the content within the course. With the implementation of CCSS, there has been a shift in how educators can help students master content needed for their future. This shift has provided the opportunity to focus on ensuring students are college and career ready. This focus is not only in the requirements of literacy and mathematics across the curriculum but in ensuring that students can apply the information learned in real life context. These changes can help create the ideal partnership between core academic courses and CTE courses and allow for a redesign of education to create the potential for an ideal partnership between core academics and career-technical education to re-design education (Walker, 2013).

There are significant challenges remaining in achieving integration in all 50 states due to the amount of time needed to review CTE course content and identify how CCSS can intermingle with current courses. There are additional concerns with the cost of integration, including collaboration and professional development for faculty and the lack of pre-existing models of how to integrate CCSS into CTE to review (Meeder & Suddreth, 2012).

Limitations and Recommendations for Further Research

There are some important limitations to the topics researched in this thesis such as the amount of current information centered around CTE and content, state implementation, impact of CTE stigma, and the actual integration of CCSS into CTE courses.

There is a limited amount of current information published about the integration of academic content into CTE courses or even current information about updates to CTE programs in general. Changes or reviews seem to be centered around legislation, causing a lack of continuous updates and changes to CTE programs. "The integration of career and technical education (CTE) and academic curricular content that capitalizes on natural and inherent connections represents a challenge for CTE professionals" (Spindler, 2011, p.iii). More research about the benefits and obstacles from integrating CCSS into CTE courses, as well as the integration of CTE content into core academic courses, is needed. Integration of CTE and academic curricula is a process that moves concepts found in both classes to an interdisciplinary lesson or unit. This research would assist in identifying which courses already contain overlapping content and how to successfully integrate this content, as well as obstacles that can occur when trying to integrate. Identification of CCSS standards that correlate with CTE courses will help drive additional research into the feasibility of cross-crediting high school level courses.

Even with the limited information about the integration of academic content in CTE courses, there are still questions about the content and standards that are currently covered in CTE courses. CTE course content is often driven by industry standards but what is taught in these courses can differ greatly from one location to another. These variances can lead to uncertainty of unified content within specific courses. CTE courses taught in one location, in the same state, can be different than the same course in a neighboring district. Understanding that this limitation exists allows for further research into how to unify content taught within the same CTE courses.

Another limitation is the inadequate amount of research that is available from states in regards to current implementation on what each state is doing to meet the legislative requirements of CTE programs, especially with the new changes implemented in the Strengthening Career and Technical Education for the 21st Century Act (Perkins V). There was research on the intersections of CTE courses and core academic courses but it will soon be outdated because it is based on Perkins IV instead of the Strengthening Career and Technical Education for the 21st Century Act (Perkins V). Further research is needed to determine how to support states in mapping CCSS and CTE standards. This would help eliminate inconsistencies in how CCSS and CTE standards are implemented from state to state, school district to school district, and school to school. Continued research, both at the national and state levels, is needed to assess the success or failure of the implementation of CCSS into CTE courses and CTE content into core academic courses.

Research revealed that there were additional limitations of implementation based on stigma, but it did not identify ways to improve the reputation of CTE programs so that the stigma can be removed. Discrepancies in the way that CTE is perceived serves as a significant barrier to providing equitable access to CTE programming. Promotional campaigns such as CTE Awareness Month are working on changing the negative perception of CTE and the content within the course but there is a long way to go to ensure that CTE has accurate positive recognition to ensure all students have the opportunity to make an educated decision about their high school courses and post-secondary choices. Additional research on the impact of CTE stigma and how to educate stakeholders on the contents of modern-day CTE courses will assist in enhancing the reputation of CTE courses.

Conclusion

The purpose of this literature review was to introduce the history of CTE, identify the current educational pathways that are offered at the secondary level and identify the need for students to be college and career ready after graduation. The research then led to taking a deeper look into the ability to integrate core academic standards into career and technical education courses and the concerns and obstacles that would surface while attempting this integration. A guiding question and three related sub-questions were used to review the literature surrounding CCSS, CTE standards and the integration of these within secondary education. The need for integration is visible in the research but the implementation of CTE and CCSS is not as simple as just inserting CCSS standards into CTE courses. Reviewing the intersections that occur with both CTE and academic core courses, identifying limitations and funding concerns, and ensuring that there is time allocated to complete the implementation is imperative to successfully integrate core academic standards into CTE courses.

Changes are occurring at the government level with updates to the Strengthening Career and Technical Education for the 21st Century Act (Perkins V), but there is also a stronger push for collaboration and accountability in states, school districts, and individual schools to ensure the implementation can occur. Now is the time to review the research and act on implementing the framework for success within cross-disciplinary teams, stronger professional development for all parties and collaboration between academic and career-focused teachers. Breaking down existing barriers will allow CTE courses to be a viable and valuable partner in a student's pursuit of college and career readiness.

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Appendix A

Figure 1

Minnesota Department of Education: Minnesota Career Fields, Clusters and Pathways

Note. The Minnesota Career Fields, Clusters & Pathways chart identifies the framework of

foundation knowledge and skills, career fields, career clusters, and career pathways. From

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Appendix B

Table 1

Oregon CTE Program of Study Quality Rubric

Standards and Content				
Element	**Level 1**	**Level 2**	**Level 3**	**Level 4**
Rigorous Integrated Content Integrates rigorous technical and academic content.	Students in CTE classes do not have the opportunity to complete rigorous core academic course work that is applicable to career interests.	Students in CTE classes have limited opportunities to complete rigorous core academic course work that is applicable to career interests.	Students in CTE classes have numerous opportunities to complete rigorous core academic course work that is applicable to career interests.	Students in CTE classes complete rigorous core academic course work that is applicable to career interests.
	CTE teacher does not integrate core academic content into CTE courses as a natural part of the curriculum.	CTE teacher occasionally integrates core academic content into CTE courses as a natural part of the curriculum.	CTE teacher integrates core academic content into CTE courses as a natural part of the curriculum.	CTE and core academic content teachers integrate core academic content into CTE courses through collaboration as a natural part of the curriculum of both core courses and CTE courses.

Engaged Learning Engages students through instructional strategies that are relevant, authentic, and meet the needs and interests of all students	Instruction is teacher-centered where students generate answers to teacher questions.	Instruction uses a project-based approach with projects designed by the teacher.	Instruction uses a project-based approach with projects designed by teachers using input from students.	Instruction uses a project-based approach with projects defined by student career interests and student/community needs.
	Student learning is not connected to aspects of school and community resources.	Student learning is occasionally connected to aspects of school and community resources.	Student learning is frequently connected to aspects of school and community resources	Student learning in CTE dissolves boundaries between school and community.
	Assessments are not connected to important industry-based standards.	Assessments address important industry-based standards.	Assessments address important industry-based standards and provide feedback to students and teachers resulting in improved practice.	Assessments are tailored to student interest and address important industry-based standards providing feedback to students and teachers resulting in improved practice.

*Coherent Curriculum Aligns to industry-recognized standards and sequenced to prepare students for their next steps.	One or more courses are offered that potentially align with industry-recognized standards and prepare students for their next education and career steps.	Program is working toward a full sequence of curriculum that is aligned with industry-recognized standards. Courses are partially sequenced to prepare students for their next education and career steps.	Full implementation of curriculum aligned to industry-recognized standards and taught in sequenced courses to prepare students for a postsecondary credential and career.	Curriculum aligned to industry-recognized standards and taught in sequenced courses to prepare students for a postsecondary credential and career is fully implemented and an institutionalized, integral part of the school's CTE offerings.
	Courses are not consistently offered and there is no plan to work toward a CTE Program of Study.	A minimum of 1 high school credit is consistently offered with a plan to work toward a CTE Program of Study.	A minimum of 2 high school credits are offered in an approved CTE Program of Study	A minimum of 3 high school credits are offered in an approved CTE Program of Study.
	No connection to related postsecondary education.	Program has identified possible post-secondary alignment.	Program is aligned to post-secondary opportunities through collaboration.	High schools and college work together to transition students smoothly from program entrance through to completion and employment.

		Alignment and Articulation		
Element	**Level 1**	**Level 2**	**Level 3**	**Level 4**
Partnerships Actively engages employer and educator partners to develop, enhance, and support the CTE program in a manner that is sustainable.	Partnerships not established.	Partnerships are informal with partners involved in program design and development.	Partnerships are somewhat formalized with partners involved in program design, development, and implementation.	Partnerships are formalized with agreements with partners involved in program design, development, implementation, and evaluation.
	Program does not support partners.	Program supports partners by helping students become aware of career pathways associated with the partners.	Program supports partners by opening opportunities for partners to provide career-related activities such as Career Related Learning Experiences, job shadows, mentorships, etc.	Program supports partners through participation in partner activities such as community college advisory committees and local Workforce Investment Board meetings.

Oregon Equity Lens: How have you intentionally involved stakeholders who are also members of the communities affected by the strategic investment or resource allocation? How do you validate your assessment?

Credentials Links instruction to meaningful college credit or industry credentials that can lead to high wage and high demand occupations.	Program is in the process of researching appropriate and available certifications.	An appropriate industry credential is identified and available to program completers.	Some program completers earn an industry credential, or combination of credentials, that are approved by ODE.	A high percentage of program completers earn ODE approved industry recognized credentials, or a combination of credentials, that increase their employability in that industry.
Oregon Equity Lens: What it the potential impact of the resource allocation and/or strategic investment to underserved groups?				
*Facilities and Equipment Provides students with safe access to facilities and equipment that are appropriate to the type of	Provides basic facilities and equipment for elective coursework	Provides basic facilities and equipment needs while planning to upgrade to industry standard that are appropriate for workforce needs	Provides industry standard facilities and equipment that are appropriate for workforce needs	Provides and maintains specialized equipment used to meet industry standard certification and/or local workforce needs

instruction and reflect workforce needs.	Facilities, equipment and environment do not reflect the diverse needs of ALL students	Facilities, equipment and environment reflect needs of students that are traditional participants in the program	Facilities, equipment, and environment reflect needs of ALL students	Facilities, equipment, and environment reflect needs of ALL students
	Basic safety and cleanliness standards that are appropriate for a classroom	Basic safety and cleanliness standards that are appropriate for a classroom while learning and implementing industry guidelines	Teaches and adheres to safety and cleanliness standards that are aligned to industry guidelines	Teaches and adheres to safety and cleanliness standards that are aligned to industry guidelines; gain industry specific certification of compliance

Oregon Equity Lens: *How does the investment or resource allocation advance opportunities for historically underserved students and communities? Who are the racial/ethnic and underserved groups affected? What is the potential impact of the resource allocation and/or strategic investment to these groups? How will you modify or enhance your strategies to ensure each learner and communities' individual and cultural needs are met?*

Accountability and Evaluation				
Element	**Level 1**	**Level 2**	**Level 3**	**Level 4**
Continuous Improvement Revises the program of study based on student performance, economic demand, and employer requirements.	LEA data are available. CTE-specific data are not available.	CTE-specific data are collected and submitted.	CTE-specific data are collected and submitted.	CTE-specific data are collected and submitted.
		Instruction and program decisions are made regardless of program data	Data are frequently used to inform instructional decisions.	Data are frequently used to inform instructional decisions. No programmatic decisions are made without consulting data.

Oregon Equity Lens: What data and how are you collecting data based on race, ethnicity, and native language? How does the investment or resource allocation advance opportunities for historically underserved students and communities?

Student Support Services				
Element	**Level 1**	**Level 2**	**Level 3**	**Level 4**
*Career Development Provides accurate and timely information and support that will help students identify, pursue, transition, and complete pathways to future careers.	Occasional career development activities are available to support students in exploring career options and opportunities.	Limited career development activities are available to support students in exploring career options and opportunities.	Career development activities are available coordinated to support students in exploring career options and opportunities.	A system of comprehensive career development is coordinated and sequenced to promote and support the career decision making and planning of all students both prior to entering and during the program of study.
	Personalized education and career plan exists but are mostly reflective; No career development tools and activities are used	Limited implementation of a personalized education and career plan; Some career development tools and activities are used	Most CTE students have a personalized education and career plan; Career development tools are used regularly	Each CTE student in the program of study has a personalized, multi-year education and career plan, utilizes career development tools and activities that reflect student interests, preferences and abilities, and informs course selection and planning for further education and careers.

Students are not provided with information on CTE programs and activities, post-high school application procedures and related career opportunities	Students are provided limited information on CTE programs and activities, post-high school application procedures and related career opportunities	Most CTE students are provided information on CTE programs and activities, post-high school application procedures and related career opportunities	Students in the program of study and their parents/guardians, as appropriate, are provided accurate and timely information on: CTE programs and activities, postsecondary options and post-high school application procedures, and related career opportunities.
CTE teachers and guidance, counseling and advisement professionals do not collaborate	CTE teachers and guidance, counseling and advisement professionals collaborate on a limited basis	Most CTE teachers and guidance, counseling and advisement professionals collaborate to provide information to students about CTE programming	CTE teachers collaborate with guidance, counseling and advisement professionals to ensure access to current CTE program information and training, regional occupation trends, and current career information resources in order to assist students in education, career planning and decision-making.

Oregon Equity Lens: What is your commitment to professional learning for equity? What resources are you allocating for training in cultural responsive instruction? Hat data and how are you collecting data on race, ethnicity, and native languages to inform practices?

Education for Employability Builds student employability skills through student leadership and work-based learning.	Students learn basic information and academic content	Teachers identify and create curriculum that helps students develop employability skills	Program explicitly incorporates employability skills into the CTE curriculum	Program provides work-based learning opportunities that help students develop and master employability skills
	No student organizations are active within content area	Student leadership organizations are identified and instructor/advisor is working towards establishing local chapter	Student leadership organization is established and active	Students actively develop leadership skills through student organizations and competitive events.
	Limited leadership opportunities	Instructor informed about CTSO opportunities and leadership opportunities exist	CTSO not fully integrated into coursework but students are involved in leadership activities	CTSO integrated into coursework of the program and promotes development of a leadership portfolio
	Limited inclusion of employability skills	Discussion of employability skills	Employability skills addressed but not explicit in the curriculum.	Explicit incorporation of employability skills throughout the CTE curriculum

	Students learn about workplace as part of classroom instruction (speakers, videos, field trips)	Short-term work-based learning opportunities (job shadows, career fairs)	Students have access to long-term work-based learning that is not coordinated (internships)	Clear coordinated process for students to engage in long-term work-based learning (internships).

Oregon Equity Lens: Does the decision being made ignore or worsen existing disparities or produce other unintended consequences? Who are the racial/ethnic and underserved groups affected?

Access and Equity Provides all students and their families with appropriate knowledge and experiences to help make informed education and career decisions.	Access to Program of Study is limited.	Program of Study is available to all students.	Program of Study has identified potential barriers and is designed for all students to succeed.	Programs of Study are a central part of school or district equity strategy. Every student is able to fulfill their potential.
	Students in CTE class(es) are not representative of students in the school or district.	Students in Program of Study are somewhat representative of students in the school or district.	Students in Program of Study are representative of students in the school or district.	Programs of Study positively impact local industry representation.

CTE student outcomes are not equitable; opportunity gaps are reflected among CTE students.	Some CTE student outcomes are equitable; some opportunity gaps are reflected among CTE students.	CTE student outcomes are equitable; there are no opportunity gaps reflected among CTE students.	CTE student outcomes are equitable and contribute to the elimination of opportunity gaps in school or district and local industry.

Oregon Equity Lens: What are the barriers to more equitable outcomes? (e.g. mandated, political, emotional, financial, programmatic or managerial?) What is the impact of eliminating the opportunity gap? Who are the racial/ethnic and underserved groups affected? What is the potential impact of the resource allocation and/or strategic investment to these groups?

Professional Development			
Element	**Level 1**	**Level 2**	**Level 3**	**Level 4**
Professional Development Promotes instructor professional growth that aligns with	No evidence that professional development is linked to teaching practices in CTE courses.	Limited evidence that professional development is linked to teaching practices in CTE courses.	Regular evidence that professional development is linked to improvement of teaching practices in the CTE program.	Clear evidence that professional development is linked to innovation and development of quality teaching practices in the CTE program.

long-term program goals.	No CTE professional development plan.	CTE professional development is evident but may not be linked to a formal plan.	A CTE professional development plan is clearly documented.	A CTE professional development plan is clearly documented and was developed using input from partners.
	Professional development goals, plans, and participation are loosely tied to CTE.	Professional development goals, plans, and participation are loosely tied to documented CTE program goals.	Professional development goals, plans, and participation are somewhat aligned to documented CTE program goals.	Professional development goals, plans, and participation are clearly aligned to documented CTE program goals.

Oregon Equity Lens: *What is your commitment to professional learning for equity in CTE? What resources are you allocating for training in culturally responsive instruction?*

Note: This rubric was developed by educators and administrators and is a tool to identify the existing status of programs in order to create goals for improvement. In general, level 3 represents the target for an approved CTE Program of Study. From the Oregon Department of Education. (2019). *Oregon CTE program of study quality rubric*. Oregon Department of Education. (https://www.oregon.gov/ode/learning-options/CTE/resources/Documents/Program%20Quality%20Rubric.docx). Copyright 2019 by Oregon Department of Education.

Appendix C

Figure 2

Minnesota Department of Education Career and Technical Education Equivalencies

mn DEPARTMENT OF EDUCATION

Career and Technical Education (CTE) Credit Equivalency

Content	Academic Standards	Credits	Credit Equivalency	Teacher Licensure
Math	• Number and Operation • Algebra • Geometry and Measurement • Data Analysis and Probability	3 Credits	A CTE course may fulfill a **Mathematics credit** (Minn. Stat. § 120B.024, subd. 2, c) for Algebra 2 or its equivalent Note: Algebra 1 is not a high school course for graduation.	Teachers must have a Tier 3 or 4 CTE license in the subject they teach and have passed the relevant Minnesota Teacher Licensure Exam (MTLE) for Math (Minn R. 3505.1150, subp. 2).
Science	• Nature of Science and Engineering • Earth and Space Science • Physical Science • Life Science • Chemistry or Physics	3 Credits	A CTE course **may not** fulfill the Biology requirement (Minn. Stat. § 120B.024, subd. 2, b). A CTE course may fulfill the **Chemistry or Physics credit and the elective Science credit** (Minn. Stat. § 120B.024, subd. 2, b).	Teachers must have a Tier 3 or 4 license in the subject they teach and have passed the relevant Science MTLE licensure test (Minn R. 3505.1150, subp. 2). Agriculture teachers do not have to take the MTLE (Minn. Stat. § 120B.024, subd. 2, d).
Arts	One of the arts areas (dance, music, media arts, theater, or visual arts) • Artistic Foundations • Create or Make • Perform or Present • Respond or Critique	1 Credit	A CTE course may fulfill an **Art credit** (Minn. Stat. § 120B.024, subd. 2, c).	Teachers must have a Tier 3 or 4 CTE license in the subject they teach and have passed the relevant Art MTLE licensure test (Minn R. 3505.1150, subp. 2). Note: for Media Arts courses, districts are encouraged to use the Visual Arts MTLE.
Social Studies	• U.S. History • Geography • Government and Citizenship • World History • Economics	3.5 Credits	An agriculture or business CTE course may fulfill the one-half **Economics credit** in Social Studies (Minn. Stat. § 120B.024, subd. 2, a).	Teachers must have a Tier 3 or 4 CTE license in the subject they teach; there is not a requirement for teachers to have passed the Social Studies MTLE licensure test (Minn R. 3505.1150, subp. 2).
Language Arts	High school students must satisfy all English and Language Arts standards	4 Credits		No CTE courses currently fulfill a Language Arts requirement.
Health	High school students must receive instruction in health education at least once	Local control	There is not language in statute for a state-level credit, but standards must be delivered as one of the elective credits.	No CTE courses currently fulfill a Health requirement.

Table 1: Use of Career and Technical Education (CTE) to meet Minnesota Graduation Requirements

Note. Table was created to determine CTE credits used to meet Minnesota Graduation Requirements. From Minnesota Department of Education. (2021). *Career and technical education (CTE) credit equivalency* [Table]. (https://education.mn.gov/mde/dse/cte/). Copyright 2021 by Minnesota Department of Education.