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The Development of an Integrated CTE Platform in Support of Workforce Training - Wyoming CTE Datahub

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This study addresses persistent challenges in Career and Technical Education (CTE) systems related to fragmented program information, limited visibility of training pathways, and insufficient integration of labor-market data. In Wyoming, these challenges are amplified by a dispersed population and a workforce heavily reliant on middle-skill occupations. To address this gap, the study presents the design and development of the Wyoming Career and Technical Education (CTE) Datahub, a centralized, web-based platform that consolidates postsecondary CTE program offerings and aligns them with workforce demand indicators. Using a descriptive, data-driven methodology, publicly available program data from community colleges were compiled, standardized, and reclassified into eight Wyoming-specific CTE clusters. Labor-market and wage data were integrated from national and state sources to contextualize educational pathways. The resulting platform features interactive tools, including a CTE cluster wheel, career interest profiler link, institutional filters, and program matrices that enable users to explore programs by career field and college. Findings indicate that integrating program-level data with labor-market information in a single digital environment improves transparency, usability, and alignment between education and workforce needs. The study demonstrates the potential of centralized CTE data platforms to support informed decision-making for students, educators, counselors, and policymakers, while offering a scalable model for other states seeking to strengthen education-to-workforce systems.

Keywords: career and technical education (CTE), workforce development, digital platform, data visualization, workforce training

Introduction

Over the past few years, there has been a clear shift in how education and career readiness are discussed worldwide. Across the United States and in many regions, there is growing recognition that a four-year college degree is no longer the only pathway to a successful career. In Wyoming, for example, only about 38 percent of jobs require a bachelor's degree or higher, among the lowest rates in the country (Lamby, 2024). This trend indicates a rising demand for careers that prioritize practical training, technical skills, and work-ready credentials (Haviland & Robbins, 2021).

This shift opens a broader conversation about Career and Technical Education (CTE). CTE programs are designed to connect learning with the labor market by providing students with targeted, industry-aligned skills in sectors such as construction, energy, agriculture, healthcare, and advanced

manufacturing. These are skills vital not only to Wyoming's economy but also to many other regions around the world. As Carruthers et al. (2024) note, "Given its forward-looking employment focus, CTE is often part of the bridge between K–12, college, and the workforce, playing a role in state and local efforts to improve K–12-to-workforce pipelines." This alignment ensures that technical training remains responsive to evolving labor-market needs.

Despite the recognized value of Career and Technical Education (CTE), access and visibility remain significant challenges across the United States. In many states, CTE offerings are distributed among school districts, community colleges, and independent training providers, each maintaining separate catalogs, registration systems, and data reporting processes. According to Advance CTE (2019), "Most states have disparate, disjointed data systems and multiple collection processes for different program areas… making tracking learners as they transition from high school to postsecondary education and the workforce harder for state policymakers." This fragmentation not only complicates program navigation for students and families but also limits the ability of educators and policymakers to monitor program distribution, workforce alignment, and learner progression across institutions.

Lindsay et al. (2024) note that "future research should focus on improving the visibility and usability of CTE information systems so that students, families, and practitioners can better understand available options and make informed choices." However, while prior studies have identified persistent challenges related to coordination and accessibility within CTE systems, there remains limited documentation of how integrated, statewide digital platforms can be designed to consolidate program information and align educational offerings with labor-market data in practice. The Wyoming CTE Datahub was developed in direct response to this gap, consolidating statewide program data into a centralized, user-focused platform. Rather than evaluating learner outcomes, this study examines the design and development of a statewide CTE information system and its role in improving access, transparency, and workforce alignment.

This study examines how the Wyoming CTE Datahub was developed and its role in the larger context of workforce development and educational access. While its focus is state-specific, the issues of fragmented data systems, labor-market misalignment, and educational inequity resonate broadly. By documenting the platform's development process, functional structure, and intended use, this paper offers design-oriented insights that may inform similar efforts nationally and internationally. To better situate this discussion, the next section reviews existing literature on the role of CTE in workforce development and explores key themes that frame this study's approach.

Guided by these challenges, this study is structured around the following research questions: RQ1: How can a centralized, statewide digital platform be designed to consolidate and visualize postsecondary CTE program information in a way that improves accessibility and transparency? RQ2: In what ways does the design and functionality of the Wyoming CTE Datahub support alignment between educational offerings and labor-market demand?

Literature Review

The concept of Career and Technical Education (CTE) is explored in this section as a critical framework for enhancing workforce readiness and educational access. The discussion is structured around four thematic areas: the importance of CTE as a pathway to career readiness, skilled labor shortages and industry demands, digital tools that support statewide coordination in CTE systems, and access barriers and information gaps in CTE navigation. These interconnected themes collectively frame the analytical foundation of this study, providing a structured lens through which the Wyoming CTE Datahub is examined in subsequent sections.

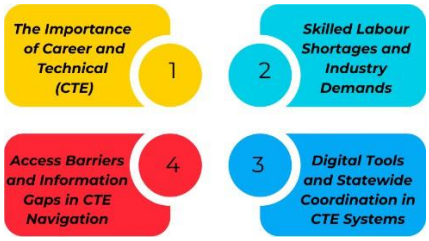

Figure 1. Conceptual framework of the Literature review

Importance of Career and Technical Education (CTE)

CTE plays a pivotal role in building a skilled workforce at both national and state levels. “Workforce development and career and technical education (CTE) have long provided reliable pathways to middle skill jobs and a gateway to the middle class” (Haviland & Robbins, 2021). According to Lindsay et al. (2024), more than 8 million secondary students and 3.4 million postsecondary students participated in CTE programs across the United States during the 2021–22 academic year. By integrating academic instruction with technical skills training, CTE prepares learners for industries ranging from manufacturing to healthcare and information technology. Rigorous causal evidence further indicates that students in high-quality CTE programs are 7–10 percentage points more likely to graduate on time than similar peers (Dougherty, 2018). Complementing this, Bishop and Mane (2004) observed that students who concentrated in occupational programs were significantly more likely to complete high school and were also more likely to be employed full-time and earn higher wages one year after graduation. Collectively, these studies underscore that well-structured CTE pathways not only improve academic persistence but also enhance post-graduation labor-market success.

These findings highlight the importance of ensuring that CTE opportunities are both visible and accessible to prospective learners, particularly at the postsecondary level where program navigation is often decentralized.

Skilled Labor Shortages and Industry Demands

Across the United States, employers continue to report persistent labor shortages in key technical fields, with the Q 4-2021 NAM survey listing “the inability to attract and retain a quality workforce” among top challenges, cited by 82.7% of manufacturers (NAM, 2021). National projections further underscore the magnitude of the gap, with 2.1 million manufacturing jobs expected to be unfilled by 2030 (Deloitte & The Manufacturing Institute, 2021). These conditions are evident across regions; for example, Wyoming’s labor market is characterized by tightness and employers are struggling to fill positions, reflecting a pattern that is prevalent across the country (Lamby et al., 2024).

In this context, aligning education and training systems with workforce demand has become a central policy priority, particularly in rural states where labor-market mismatches between educational supply and local labor demand can have outsized economic impacts (Georgetown University Center on Education and the Workforce, 2024 ; McGuinness, 2025). CTE programs are often positioned as a key mechanism for addressing these gaps by preparing learners for in-demand occupations through applied, industry-aligned training.

Digital Tools and Statewide Coordination in CTE Systems

Digital integration has become a central strategy for improving transparency and coordination across CTE systems. Statewide platforms that visualize and connect program and labor-market data mirror what Masiello et al. (2024) describe as “the promise of learning analytics dashboards in education is

to collect, analyze, and visualize data with the ultimate ambition of improving students' learning." These dashboards demonstrate how data-driven tools can support students, educators, and policymakers in making informed educational choices. Similarly, Carruthers et al. (2024) emphasize that alignment across education systems requires coordinated data infrastructure that allows stakeholders to evaluate program outcomes, workforce relevance, and geographic distribution.

Without centralized digital tools, CTE information remains fragmented across institutions, limiting its usability for statewide planning and student decision-making.

Access Barriers and Information Gaps in CTE Navigation

While CTE programs are widely available, many students face barriers to finding and accessing them. Many states still maintain disjointed data systems and multiple collection processes that make it difficult for students and policymakers to track transitions from secondary to postsecondary education (Advance CTE, 2019). Such fragmentation limits the availability of reliable and comprehensive program information and disproportionately affects rural and first-generation students, who often face additional barriers related to limited guidance, institutional knowledge, and support structures (Scott et al., 2016; Coppens et al., 2026). These informational gaps are compounded by structural challenges: "Rural community college students, in particular, continue to face obstacles in accessing postsecondary education, as these students are challenged by living in areas with weak economies, traveling long distances to get to schools, poor educational preparation, and inconsistent access to technology" (Scott, Miller, & Morris, 2016). Consequently, rural status itself remains a predictor of reduced educational participation, with "the rural–nonrural enrollment gap primarily reflecting disparities among low- and middle-SES students" (Wells et al., 2023). Collectively, this literature demonstrates how fragmented data systems and place-based inequities intersect to limit CTE access and navigation, reinforcing social and economic divides and underscoring the need for unified, user-centered data platforms that support equitable program discovery and decision-making.

Research Methodology

This study adopted a descriptive design-oriented research approach centered on the compilation, organization, and comparative analysis of Career and Technical Education (CTE) program data from Wyoming's community colleges. The goal was to develop a centralized, web-based directory that not only catalogs available CTE offerings but also aligns them with labor market demand and wage data, thus supporting informed educational and workforce planning across the state, as illustrated in figure 2 presents, which presents an overview of the methodological framework which guided each stage of the project from data collection to platform development.

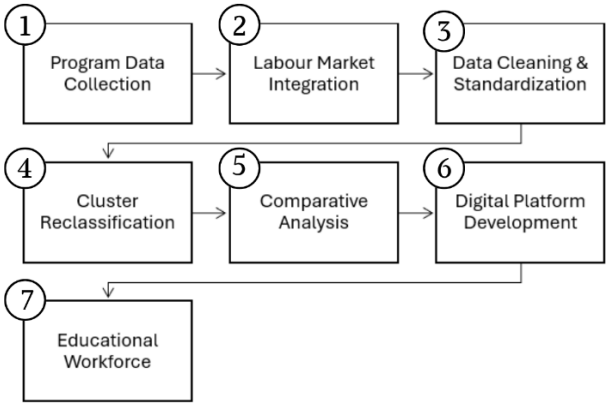

Figure 2. Methodology Framework of Research Study

Data Collection and Integration

Program data were collected from publicly available academic catalogs and institutional websites representing all Wyoming community colleges. Certificate, associate degree, and short-term credential programs meeting CTE criteria were identified and cataloged. In parallel, labor-market and wage data were obtained from national and state sources, including the U.S. Bureau of Labor Statistics and Wyoming workforce agencies, to support alignment between educational offerings and employment demand.

Data Cleaning, Standardization, and Framework Development

To ensure consistency across institutions, the dataset underwent a structured cleaning and standardization process. Duplicate programs were reconciled, naming inconsistencies were resolved through standardized descriptors, and non-CTE offerings were removed. Programs were then mapped into Wyoming's eight customized CTE clusters, reflecting regional workforce priorities and program distribution patterns.

A key methodological step involved reclassifying the national 16-cluster CTE framework into an eight-cluster structure tailored to Wyoming's workforce landscape. This framework development process included reviewing program titles across institutions, comparing them against national cluster definitions, and iteratively grouping programs based on topical similarity and regional labor-market relevance identified during data collection. Figure 3 illustrates this reclassification process, documenting the transition from the national model to the Wyoming-specific cluster structure used throughout the platform for navigation, filtering, and program mapping. This reclassification represents a core design decision intended to enhance usability, relevance, and interpretability for statewide users.

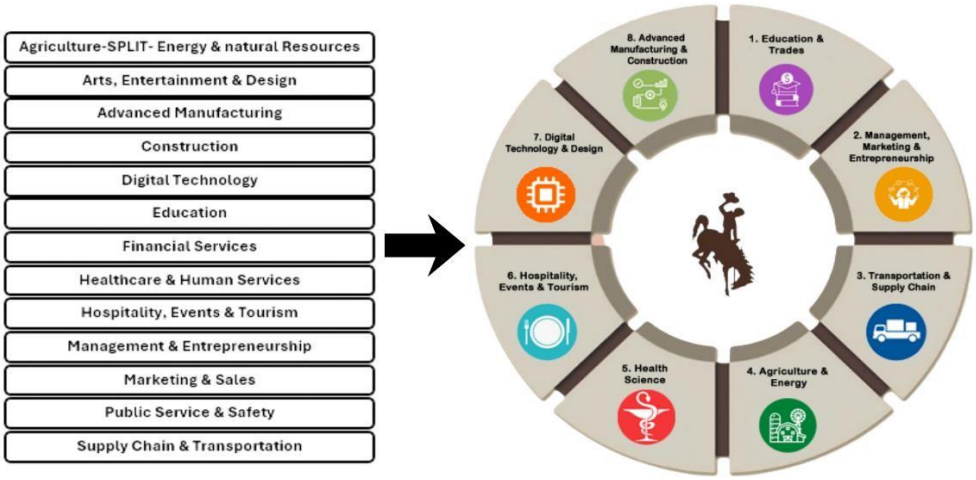

Figure 3. CTE Cluster Framework Reclassification

Platform Design and Development

Following data preparation, the standardized dataset was integrated into a web-based platform designed to support intuitive navigation and comparative analysis. Core platform features include a cluster-based navigation structure, program-by-institution matrices, embedded labor-market data, and external career exploration tools. Platform development proceeded iteratively, with functionality

refined to support diverse users including students, parents, counselors, educators, and workforce professionals.

Validation and Limitations

Formal usability testing and learner outcome evaluation were beyond the scope of this study. However, internal reviews were conducted to verify data accuracy, functional consistency, and alignment with stated design objectives. As a result, findings should be interpreted as design-oriented insights rather than empirical measures of platform impact, and future research may build upon this foundation through user testing, outcome analysis, and longitudinal evaluation.

Study

Building upon the methodological framework, this section documents the functional structure and user navigation of the Wyoming CTE Datahub, illustrating how program, institutional, and labor-market data are integrated into a single digital platform. The system was developed to address the data fragmentation identified during earlier phases of this project and to align educational offerings with Wyoming's workforce needs. In doing so, the Datahub responds to what Annor and Jacobs (2025) identify as a key barrier in workforce systems, "limited training visibility and weak inter-institutional linkages in rural labor markets, which hinder equitable access to opportunities". Rather than reporting empirical outcome measures, this section demonstrates platform functionality through feature-based walkthroughs and representative use cases.

The Landing Page Overview

When students, parents, or career counselors explore opportunities within Wyoming's community colleges, the Wyoming CTE Datahub serves as their entry point. Upon visiting the site, users are welcomed by an interactive landing page featuring the CTE cluster wheel, which visually organizes all eight Wyoming specific clusters (Figure 4). This user-friendly interface draws from CEDEFOP (2020), which emphasizes that clear visual organization and user-centered design increase engagement in digital career platforms. The landing page is intentionally structured to reduce cognitive load and support rapid orientation for users with varying levels of prior knowledge. Users can interact with the wheel by selecting a cluster of interest, for instance, "Advanced Manufacturing and Construction." For users who may not yet know their area of interest, the landing page includes an embedded O*NET "My Next Move" Interest Profiler link that reads "Explore Career Interests at My Next Move Interest Profiler." This feature introduces users to a short questionnaire that helps identify potential career paths aligned with their strengths and preferences. By combining self-assessment with program-level data, the platform supports an informed, data- driven exploration approach that aligns with Annor and Jacobs's (2025) argument that career exploration systems must integrate education, labor-market information, and learner self-assessment to close training gaps.

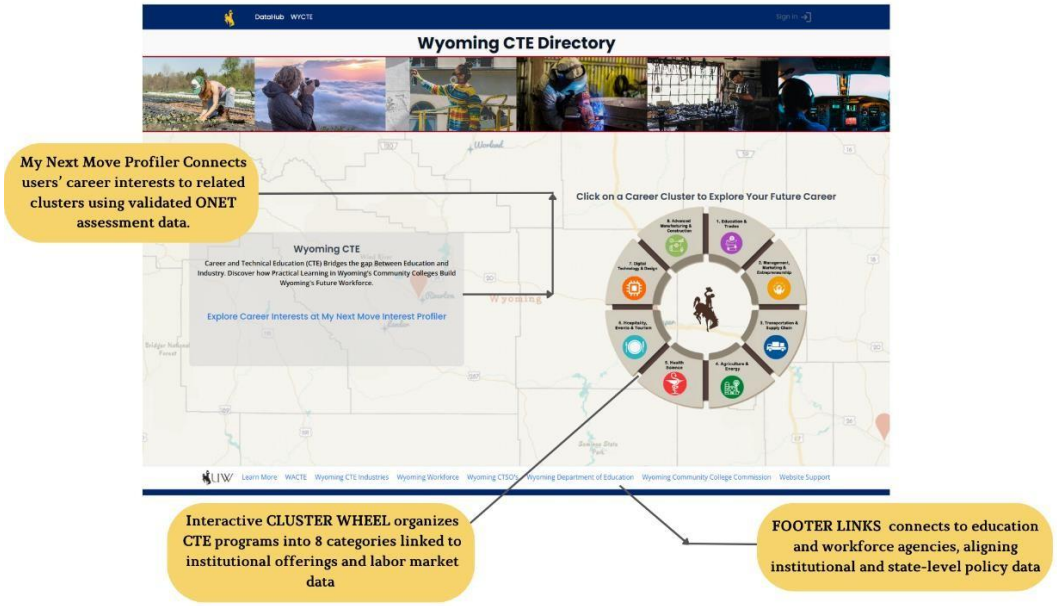

Figure 4. CTE Directory Landing Page

Cluster Navigation and Program Mapping

After selecting a cluster (for example, Advanced Manufacturing and Construction), users are directed to a dynamic, program-by-institution matrix that displays which Wyoming colleges offer programs under that cluster. Check marks indicate program availability, and each mark is hyperlinked to the respective college's program homepage, providing instant access to course descriptions, admission requirements, and credential outcomes. This structure addresses previously identified access barriers by consolidating dispersed institutional information into a single navigable interface.

Consistent with the OECD's (2023) emphasis that digitized education-to-workforce systems are critical for bridging regional access disparities and aligning technical education with emerging labor needs, this cluster-based structure supports transparency and efficiency in program search and comparison. For rural learners and advisors, the matrix reduces reliance on informal knowledge networks and minimizes the need to consult multiple institutional systems.

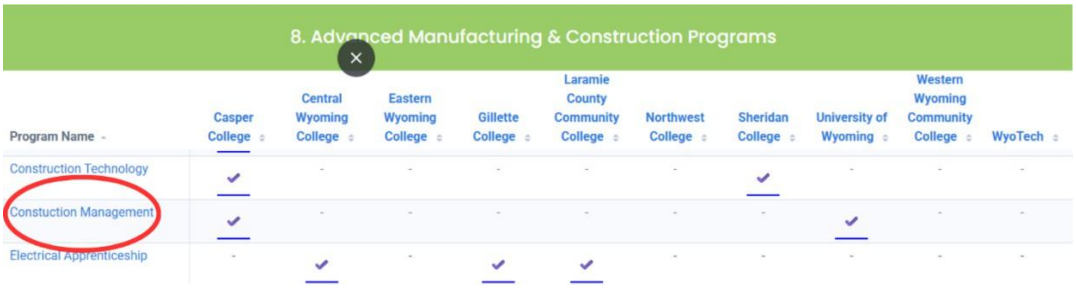

Figure 5. Advanced Manufacturing and Construction Program Matrix (Cluster Navigation Page)

Program-Level Insights and External Data Integration

When a user clicks on a specific program name, such as Construction Management, they are redirected to external data from the U.S. Bureau of Labor Statistics (BLS), including employment trends, wage data, and projected job growth (Figure 6). This integration connects academic pathways to occupational outcomes, reinforcing the relevance of CTE programs in workforce preparation. For example, the BLS (2024) reports that construction managers earn a median annual wage of approximately $106,980 nationally, underscoring the economic value of aligned technical education pathways.

By embedding live occupational data directly into the Datahub, the system transforms from a static catalog into a dynamic decision-support tool. As noted by Annor and Jacobs (2025), linking real-time labor-market data to program-level visibility strengthens both institutional planning and individual decision-making.

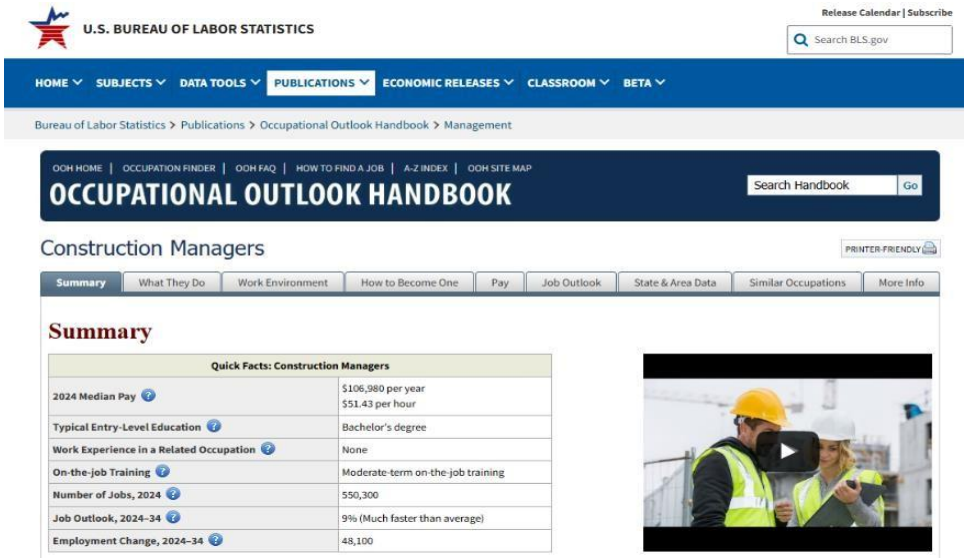

Figure 6. U.S. Bureau of Labor Statistics Wage and Employment Data for Construction Managers

Conclusion

This study presented the development of an integrated Career and Technical Education (CTE) platform designed to consolidate and visualize Wyoming's postsecondary CTE programs within a single, user-friendly digital environment. The project responded to a clear need for greater visibility, connectivity, and accessibility in workforce education by transforming fragmented institutional datasets into a centralized, interactive information system.

Addressing the study's guiding questions, the findings demonstrate that a unified, statewide digital platform can improve access to CTE program information, enhance transparency in program availability, and strengthen alignment between educational offerings and labor-market demand. The Wyoming CTE Datahub functions both as a web-based information hub and as a data framework for comparative analysis, enabling stakeholders to make data-informed decisions about workforce development and educational planning.

The platform's core tools, including the cluster wheel, career profiler, institutional filters, and program matrices, work together to simplify how users' access and interpret CTE programs across Wyoming's community colleges. For students and parents, the Datahub provides a clear pathway for exploring viable career options. For counselors and educators, it supports evidence-based advising and program coordination. For policymakers and workforce agencies, the platform offers a consolidated mechanism for monitoring program distribution, workforce alignment, and regional training capacity.

Beyond its immediate context, the Wyoming CTE Datahub serves as a scalable model for how digital data systems can support education-to-workforce alignment in rural states. While developed for Wyoming, the platform illustrates design principles that may be relevant to other states seeking to improve coordination, visibility and alignment within CTE systems. By integrating institutional program data with wage and employment information, the platform enhances Wyoming's capacity for adaptive, data-driven workforce planning while addressing longstanding challenges related to fragmented information systems.

This study is design-oriented and therefore does not evaluate learner outcomes or platform effectiveness through formal user testing**.** As a result, findings should be interpreted as insights into platform development and system design rather than empirical measures of impact. Future research may build on this foundation by incorporating usability testing, learner outcome analysis, employer feedback mechanisms, and longitudinal evaluation of workforce alignment outcomes.

Ultimately, this study demonstrates that when digital infrastructure is applied strategically to workforce education systems, accessibility, efficiency, and equity can be meaningfully improved. The Wyoming CTE Datahub represents more than a technical solution; it reflects a forward-looking approach to building a transparent and responsive education-to-workforce pipeline that strengthens Wyoming's human capital and supports sustainable economic growth.

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