

Integrating 21st-Century Skills Into Career and Technical Education Classrooms: A Literature Review

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Abstract

This descriptive review investigates how 21st-century skills are integrated into career and technical education (CTE) classrooms to prepare students for the modern workforce. In Virginia, these competencies are articulated as the “5Cs”: critical thinking, creative thinking, communication, collaboration, and citizenship. The research question was, What key ideas does existing research identify about integrating core competencies into K–12 CTE instruction? Grounded in experiential learning theory and the 5Cs framework, the analysis of contemporary literature identifies key challenges and effective strategies for implementing these skills in K–12 CTE contexts. Drawing on 72 quality sources and the *Profile of a Virginia Graduate*, the review highlights effective strategies in instructional design, equity-driven practice, and CTE teacher preparation. Findings emphasize how certain techniques (e.g., structured reflection, authentic, hands-on learning) strengthen both technical proficiency and competency-based development. A Virginia-based case of CTE teacher preparation illustrates how these approaches operate within a state policy context. Collectively, this synthesis clarifies practical ways to align CTE instruction with 21st-century educational and workforce demands.

Keywords: Career and technical education, 5Cs, Instructional strategies, Teacher preparation, 21st-century skills, Virginia

Introduction

This descriptive review examines how 21st-century skills are integrated in career and technical education (CTE) classrooms with particular attention to practices relevant to the workforce. The purpose of this review was to describe contemporary literature on the integration of competency-based skills in K–12 CTE classrooms, with attention to how these practices prepare students for participation in the global workforce and postsecondary education. The research question guiding this review was: What key ideas does existing research identify about integrating core competencies into K–12 CTE instruction?

This practice-oriented synthesis draws on literature, theory, and workforce-relevant frameworks. A Virginia case of CTE teacher preparation is included to illustrate a state-level application. The review considers CTE’s evolving role through the 21st-century “5Cs” framework, the *Profile of a Virginia Graduate* (hereafter *Profile*), and experiential learning theory, with emphasis on Virginia’s implementation of critical thinking, creative thinking, communication, collaboration, and citizenship (Virginia Department of Education [VDOE], 2022). It also highlights effective instructional strategies, equity considerations, and implications for CTE teacher preparation,

practice, and research. Collectively, these elements provide a foundation for understanding how CTE educators can intentionally cultivate 21st-century skills through experiential learning. In today's rapidly evolving workforce, students need more than technical proficiency—they require transferable skills such as communication and critical thinking (Gregoire-Smith, 2023). CTE classrooms provide a unique space for integrating these 21st-century competencies by blending technical instruction with opportunities to apply broader skills in real-world contexts. CTE teachers are expected to demonstrate both technical expertise and modern competencies to ensure students are future ready (Stephens, 2015). As critical thinkers, teachers must also be culturally, socially, and globally skilled; empathetic; and pedagogically prepared for the demands of teaching (Dado et al., 2024). Yet program closures and difficulty retaining occupationally licensed teachers, especially in high-demand fields, have contributed to a significant CTE teacher shortage (Kosloski et al., 2022).

At the classroom level, teaching life-ready knowledge and skills to high school students remains challenging (VDOE, 2022; Virginia Ed Strategies, 2020). Teachers coming from industry often lack preparation in competency-based classroom pedagogy, limiting their ability to effectively integrate technical and holistic skill development (Dykzeul, 2017; Stephens, 2015). These challenges underscore the need for instructional strategies that build both technical proficiency and the broader competencies required for success beyond high school (Van der Bijl & Oosthuizen, 2019).

Policy frameworks reinforce the expectation that CTE programs will prepare high school students for postsecondary education and the workforce by developing future-ready skills (Perkins V, 2018; VDOE, 2022). These educational frameworks outline requirements for technical and employability competencies, while states codify 21st-century skills (Strengthening Career and Technical Education for the 21st Century Act [Perkins V], 2018; VDOE, 2022). However, a persistent policy–classroom gap highlights the need for clearer implementation guidance and adequate resources aligned with CTE program goals (Virginia Ed Strategies, 2020). Perkins V (2018) describes CTE as secondary and postsecondary programs in high-demand fields (e.g., agriculture, education, health sciences, transportation) that integrate technical and academic instruction, which is echoed by Association for Career and Technical Education (ACTE, 2025) and National Center for Education Statistics (NCES, 2024). Virginia's educational policy framework (VDOE, 2022), which mandates competency development across K–12 classrooms, is used here to contextualize CTE. The *Profile* codifies these competencies into five areas—the 5Cs (VDOE, 2022)—which are required across all K–12 instruction, including CTE (Dado et al., 2024).

This article now turns to background elaboration and the state-level case, followed by the theoretical framework, methods, findings, discussion, implications, and conclusion. The authors are a Virginia-based professor and practitioner who research CTE and 21st-century learning.

Background Elaboration

CTE has become a comprehensive education pathway that prepares students for college and careers (Tucker & Hughes, 2020). Employer demands for workers with technical proficiency and broader workplace competencies have intensified (Rojewski & Hill, 2017). CTE educators with

limited pedagogical backgrounds struggle to incorporate vital soft skills (e.g., communication) into demanding technical curricula (Dykzeul, 2017; Graham, 2020; Gregoire-Smith, 2023; Jacques & Potemski, 2014; Stephens, 2015; Stone, 2017).

CTE programs in middle and high schools and postsecondary institutions are crucial for preparing students for college and career success (Stone, 2017). Stigmas of CTE persist (Matthews, 2022) even though evidence-based research indicates that CTE course engagement increases the likelihood of on-time graduation and postsecondary entry (Blackwell, 2023; DeFeo, 2015; Dougherty, 2018; Tucker & Hughes, 2020). Despite CTE's evolving nature and potential benefits, CTE constraints remain due to its historical stratification of race and class, negative cultural perceptions, outdated stereotypes of manual labor, and current concerns about career pathways to high-wage jobs and advancement (Holzer & Baum, 2017). In the past, much of the CTE system in the United States—then known as vocational education (“voc ed”)—was of inconsistent quality, providing limited practical preparation and often leading students into low-wage, entry-level positions (Holzer & Baum, 2017).

Yet CTE participation enhances students' postsecondary success and employability by building skills for competitive job markets (Blackwell, 2023; Matthews, 2022; Pierre-Louis, 2022). Moreover, CTE programs offer learners from disadvantaged backgrounds with pathways for upward mobility (Holzer & Baum, 2017). The need for instructional models to guide soft skills development in CTE classrooms is pressing—employers demand these skills across all sectors. Similarly, research on CTE consistently identifies critical thinking, communication, and collaboration as essential for success in technical roles (Career Readiness Competencies Employer Survey, 2025; Gregoire-Smith, 2023; NCES, 2024).

Virginia, A State-level Case

In the United States, 21st-century competencies are defined in various ways, and in Virginia these are formalized as the 5Cs (VDOE, 2022). As educational leaders in this state, we had interest in examining the state's policy framework, in particular the *Profile* and its description of knowledge and core skills (the 5Cs). The *Profile* emerged from legislative efforts in Virginia to align educational outcomes with high-demand workforce expectations and contemporary skills (VDOE, 2022). Outlined in this education policy framework are the knowledge, skills, and attributes students should attain before graduation relative to academic content, workplace readiness, civic engagement, and career exploration. The 5Cs, central to this vision, reflect global competencies crucial for postsecondary success (Nycum & Mullen, 2024).

The VDOE (2022) highlights a subset of 21st-century skills known as the 5Cs. *Critical thinking* involves analyzing information objectively, making reasoned judgments, and evaluating multiple perspectives to solve problems and reach logical conclusions. *Creative thinking* encompasses generating innovative ideas, approaching problems from different angles, and developing original solutions that reflect curiosity and imagination. *Communication* refers to expressing ideas clearly in multiple formats, listening actively, and adjusting one's communication style and content to suit various audiences and purposes. *Collaboration* entails working effectively within diverse teams, contributing constructively to shared tasks, valuing different viewpoints, and assuming joint responsibility for outcomes. *Citizenship* emphasizes understanding civic

responsibilities and engagement in actions, such as community service projects, which apply technical and professional skills to make meaningful contributions in areas like infrastructure, healthcare assistance, and public awareness.

The 5Cs are mandated learning outcomes embedded across all relevant K–12 content areas. Thus, CTE teachers are required to blend technical instruction with learning that fosters problem-solving, ethical reasoning, innovation, and collaboration (VDOE, 2022). Nycum and Mullen’s (2024) research in a high school demonstrated that project-based learning (PBL) can foster these skills, particularly when tied to authentic assessments and real-world applications.

Virginia’s 5Cs Framework With CTE Examples

The following table describes the 5C competencies and CTE classroom examples.

Table 1

Virginia’s 5Cs Framework With CTE Examples

Competency	Description	CTE Examples
Critical Thinking	Analysis of technical problems, evaluation of solutions based on industry standards, and reasoned judgments made in practical contexts.	Culinary students evaluate food quality based on professional standards and safety. Healthcare students analyze patient symptoms and determine appropriate care protocols.
Creative Thinking	Innovative problem-solving, design thinking, and the ability to envision and implement novel solutions to technical challenges.	Digital media students develop original advertising campaigns. Construction students design alternative building solutions with limited materials.
Communication	Technical writing and documentation, precise verbal instructions, interpretation of technical information, and effective presentation of ideas.	Instructional technology students document network configurations. Agriculture students present findings from crop experiments.
Collaboration	Teamwork in laboratory and project settings, responsibilities organized around skills and expertise, and efforts coordinated to achieve goals.	Cybersecurity students work in teams to identify and patch vulnerabilities. Business students develop group marketing plans for local business.
Citizenship	Workplace ethics, professional responsibility, industry codes of conduct, and societal implications of technical work.	Public safety students follow legal and ethical guidelines during training. Environmental technology students consider sustainability impacts.

Note. Graham (2020); Reed et al. (2021), Theobald et al. (2018); VDOE (2022); Walker (2021)

Theoretical Framework

In the United States, 21st-century learning frameworks have guided state education agencies in developing pathways that districts adapt locally (Battelle for Kids, 2024; Buckle, 2025). The Partnership for 21st Century Learning's (P21, 2019) framework—featuring 12 key skills—has been widely translated, with critical thinking, communication, collaboration, and creativity emerging as core competencies. These “Four Cs” entered K–12 practice, and some districts adopted the *Profile*, a related reform focused on lifelong learning readiness (Battelle for Kids, 2024). To prepare graduates for college and careers, the Four Cs are integrated into key subjects like language arts and supported through active learning. In Virginia, this work incorporates academic and professional competencies, the Four Cs, and the state's own 5Cs as outlined in the *Profile* (Reed et al., 2021). Learning, literacy, and life skills all fall under the broader category of 21st-century skills (Buckle, 2025).

Experiential learning theory also underpins many CTE instructional practices by emphasizing active engagement, reflection, and application. Dewey (1938) advocated learning through occupations that blend academic and practical knowledge, while Kolb's (1984) learning cycle—concrete experience, reflective observation, abstract conceptualization, and active experimentation—mirrors typical CTE environments such as labs, projects, and work-based learning.

CTE instruction aligned with 21st-century skills and experiential learning fosters critical and creative thinking (Reed et al., 2021), prompting students to evaluate outcomes, generate solutions, and apply learning to real-world contexts (Clark et al., 2010; Stone, 2017). Such experiential approaches also cultivate collaboration and communication skills essential for teamwork and interpersonal competence (Graham, 2020).

Methods

A descriptive review approach was used, relying on qualitative synthesis and thematic analysis of selected sources (Paré & Kitsiou, 2017). The aim was to identify patterns, trends, and gaps in the literature on integrating 21st-century skills in K–12 CTE classrooms. The goal was to describe a representative body of sources rather than conduct a comprehensive search, as required in a scoping review (Paré & Kitsiou, 2017). However, like scoping methods, the process involved setting inclusion and exclusion criteria and appraising study quality. From 2023 to 2025, searches via a university's remote library—using databases such as EBSCOhost and Google Scholar and terms (*classroom implementation, CTE, 5Cs, instructional strategies, teacher preparation, 21st-century skills*)—guided source selection. The initial search yielded 94,900 sources.

Inclusion criteria required that sources (articles, books, reports) be peer-reviewed and address CTE instruction, 21st-century skills, or Virginia's 5Cs. To ensure currency, publications from 2014–2025 were included, with Dewey (1938) and Kolb (1984) added as foundational exceptions. Most studies were from the United States, though select international research was incorporated to broaden the global framing of competencies. Exclusion criteria removed studies lacking research rigor (e.g., clear design, conceptual grounding, replicable methods, credible

results) or direct relevance to CTE instruction. After screening 265 abstracts, 72 sources met criteria and were coded.

Quality appraisal emphasized peer-reviewed scholarship and reports from national research organizations and policy groups that demonstrated methodological transparency and relevance to CTE practice. To reduce bias and strengthen rigor, both authors independently coded the selected sources, focusing first on instructional strategies, teacher preparation, and policy frameworks related to 21st-century skills and the 5Cs. Following Miles et al.'s (2020) coding procedures, initial codes (21cL = 21st-century learning, etc.) were generated from the research question, search terms, and literature reviewed. Line-by-line coding then assigned labels (e.g., PBL = project-based learning) to relevant data segments. Multiple Zoom sessions held from 2023 to 2025 were used to compare interpretations and refine themes until consensus was reached.

Establishing Trustworthiness and Ensuring Rigor

To ensure trustworthiness and analytic rigor, the review followed Lincoln and Guba's (1985) criteria of credibility, transferability, dependability, and confirmability. Credibility was supported through independent coding and collaborative consensus, while transferability was strengthened by drawing on state, national, and international sources. Dependability and confirmability were enhanced through transparent documentation of search terms, screening decisions, and theme development. These steps created a systematic and reliable process for analyzing how future-ready skills are taught in CTE classrooms. The analysis was further informed by influential studies relevant to CTE and by including international research to contextualize issues within and beyond Virginia.

A chart (Table 1 is an abbreviated version) was created to enhance transparency and ensure a precise presentation of the key sources. Moreover, we met three times via Zoom with two faculty in educational leadership and one in CTE. After independently reviewing the methods, source selections, and full table, the team met to discuss the thematic analysis. Their feedback confirmed that the authors' interpretations were consistent and that the synthesis was accurate and systematic. Ongoing database searches through October 2025 ensured that sources remained current. Independent and collaborative review, multiple-reviewer agreement, and consensus-based analysis strengthened the credibility of the findings. Quality criteria were met by incorporating both scholarly and practical CTE sources and adhering to research standards for thoroughness and transparency (Toronto & Remington, 2020).

Delimitations and Limitations

Research on 21st-century skills in CTE classrooms remains limited, which narrowed the scope of this review. Existing studies addressing CTE instruction include Graham (2020), Imperatore and Hyslop (2018), Silver et al. (2023), Vacca et al. (2021), and Van der Bijl and Oosthuizen (2019). The Virginia-centered focus further restricted attention to national and international contexts. More broadly, the literature analyzed in this review was constrained by several common limitations: reliance on self-reported data, small samples, narrow geographic focus, indirect applicability to CTE contexts, an overemphasis on PBL and work-based learning, and limited representation of CTE's diverse K–12 populations. Collectively, these methodological

weaknesses may impede progress in CTE practice and restrict the field's ability to develop adaptable instructional frameworks.

Findings

This review analysis on 21st-century skills integration in CTE learning environments identified four themes: (a) instructional design for 5Cs integration, (b) professional development (PD) and teacher preparation, (c) equity and learning culture, and (d) student engagement and classroom management.

Instructional Design for 5Cs Integration

Deliberate instructional design is central to embedding the 5Cs. Industry-relevant tasks promote communication, creative problem-solving, and critical thinking, while structured reflection—such as journaling and peer feedback—deepens cognitive processing and reinforces critical thinking (Ferand et al., 2022). Work-based learning and PBL support application of technical and employability skills, and authentic assessments measure proficiency and competencies like collaboration and citizenship through ethical reasoning (Harris et al., 2021; Walker, 2021). These practices reflect the pedagogical shift from isolated technical instruction to integrated learning that supports the broader goals outlined in the *Profile*.

CTE instructional practices require innovative strategies to address diverse student needs (ACTE, 2025; NCES, 2024; Walker, 2021). Effective CTE programs integrate practical skills and rigorous academic content, and they also challenge persistent misconceptions that CTE is academically weak and limits access (Matthews, 2022; Tucker & Hughes, 2020). High-quality programs blend rigorous academics with hands-on experiences and align with standards connecting CTE and academic learning (ACTE, 2025; Mukuni & Price, 2016; NCES, 2024).

Rojewski and Hill's (2017) curriculum alignment framework emphasizes both technical and broader life competencies, offering a strong theoretical foundation for learning, including skills such as Virginia's 5Cs. Imperatore and Hyslop (2018) also identified core elements of high-quality CTE programs, such as curriculum, instruction, assessment, and professional development, through their review of innovative practices and a framework aligned with the 5Cs.

CTE instructional practices encompass a range of strategies to teach theoretical knowledge and practical skills, including reading, writing, comprehension, assessment and feedback, pedagogy, and differentiation (Graham, 2020; Vacca et al., 2021). Developing literacy skills is especially crucial in CTE classrooms, as these competencies prepare students for success in both postsecondary education and the modern workforce. Literacy instruction across CTE strengthens comprehension and content learning (Silver et al., 2023; Vacca et al., 2021). Common strategies include interactive lectures, labs, PBL, demonstrations, guided practice, and whole-group discussion, though research on implementation can lack specificity (Imperatore & Hyslop, 2018; Rojewski & Hill, 2017; Walker, 2021).

PBL consistently promotes 5Cs development through authentic tasks and reflective practice (Clark et al., 2010; Nycum & Mullen, 2024; Reed et al., 2021). Through authentic projects that

mirror workplace tasks, students naturally engage in critical thinking, creative problem-solving, communication, and collaboration. In PBL situations, structured reflection (a) facilitates understanding of abstract concepts when linked to associated experiences and examples, and (b) helps with developing transferable knowledge and skills (Clark et al., 2010). Reed et al.'s (2021) qualitative analysis of instructional strategies connected problem-based learning to Virginia's expectations for graduates. Small-group work, student choice, peer collaboration, and teacher modeling were identified as key strategies. Virginia's 5Cs were deliberately built into these experiential practices, and study results were localized to the state.

Building on this research, Nycum and Mullen (2024) explained that senior projects effectively integrated the 5Cs through authentic, career-focused learning. Although not limited to CTE settings, this qualitative analysis demonstrated practical ways the 5Cs can be embedded in project-based instruction. Similarly, Ferand et al. (2022) found in agricultural education that experiential and reflective learning—particularly structured, STEM-integrated reflection—enhanced student motivation, technical knowledge retention, and collaboration on complex tasks. These concrete examples of STEM-based and reflective practices highlight their broader relevance for CTE instruction, including effective implementation of the 5Cs.

Examining CTE classroom instructional strategies, Walker (2021) identified frequently used approaches: questioning, guided practice, demonstrations, lab activities, and whole-group discussions. Interactive lectures, lab activities, and PBL were considered particularly effective for developing technical skills and broader competencies (e.g., the 5Cs). Walker's results benefited from a large sample (over 1,000 teachers) but relied on self-reported data. Qualitative measures were not used, which could have led to teacher identification of strategies beyond the predetermined categories.

Assessment strategies in CTE instruction allow for information to be collected on how and what students learn. Authentic and diverse assessments enable teachers to adjust their instructional methods and encourage engagement (Vacca et al., 2021). CTE environments are ideal for assessing student knowledge through practical applications (Harris et al., 2021). According to ACTE (2023), teaching vocabulary, reading, and writing presents difficulty in hands-on CTE programs, especially in diverse, underprepared classrooms. However, essential literacy skills build the foundational knowledge students need to strengthen their technical and employability skills in CTE. High-quality CTE teaching uses a multifaceted approach that integrates innovative teaching strategies, literacy instruction, technology, and authentic assessment methods (Matthews, 2022; Walker, 2021). By combining hands-on learning with rigorous academic content, CTE instruction helps learners prepare for challenges in postsecondary education and careers (Harris et al., 2021; Nycum & Mullen, 2024; Silver et al., 2023).

Collectively, the literature suggests that effective 5Cs integration requires intentional design that blends authentic application, structured reflection, literacy-rich instruction, and aligned assessment rather than treating the competencies as add-ons.

PD and Teacher Preparation

Implementing 21st-century competencies requires PD aligned to pedagogy and industry standards, particularly for teachers transitioning from industry (Matthews, 2022; Stephens, 2015; Van der Bijl & Oosthuizen, 2019). Effective PD for early-career teachers includes professional learning communities (PLCs), job-embedded coaching, cross-disciplinary collaboration, and industry partnerships, grounded in experiential learning (Jacques & Potemski, 2014). Teacher resilience and supportive school cultures (vision for 5Cs, mentoring, reflective practice) are linked to persistence and instructional quality, especially amid workforce and pandemic-related pressures (ACTE, 2021; Moosa, 2020; Reed et al., 2021; Smith & Soricone, 2021; Wiggins et al., 2024).

PD in the CTE field targets teacher and student growth through experiential learning (Clark et al., 2010). Research consistently emphasizes the importance of this dual focus—the development of knowledge, skills, and capabilities for both educators and learners over time—for the viability of CTE programs (Graham, 2020; Van der Bijl & Oosthuizen, 2019; VDOE, 2022; Walker, 2021). Teachers’ growth and ability to facilitate experiential learning aligned with workforce expectations and postsecondary study is key to student success (Moosa, 2020).

Given the practical and team-based approaches in many CTE courses, COVID-19 greatly affected these teachers (Walker, 2021). Complications ensued from the demands of new online applications, reduced student motivation in remote settings, restrictions on hands-on learning, and burnout and health concerns (Smith & Soricone, 2021). CTE educators experience unique stressors in staying current with industry standards, integrating technical and academic content, and preparing students for changing workforce demands (ACTE, 2021). From interviews with 10 CTE teachers, Stephens (2015) identified challenges faced by industry professionals transitioning into teaching: difficulties with pedagogy, classroom management, and academic content integration.

However, in Tennessee, post-pandemic interviews with 15 CTE teachers identified several resilience-related characteristics that support job persistence: “passion, support, adaptability, positivity, boundary setting, time management, and autonomy” (Wiggins et al., 2024, p. 56). Reed et al. (2021) found that support structures and PLCs are critical for building teacher resilience and sustaining retention.

Nonetheless, the transitional struggle faced by CTE teachers reinforced the need for PD that is consistent with Kolb’s (1984) experiential learning theory. Research on CTE teacher preparation emphasizes persistent challenges, especially for new teachers from industry with technical expertise but little pedagogical training (Dykzeul, 2017). The scope of PD in CTE extends beyond traditional content expertise to literacy skills and other competencies often associated with courses and preparation outside CTE. Graham’s (2020) research on CTE teacher beliefs about motivating students to write underscored the necessity of folding literacy skills into CTE curricula. Similarly, Walker’s (2021) study of CTE instructional strategies highlighted the need for continuous PD that equips teachers with effective pedagogical approaches across various skills. PD connecting technical content with broader competencies, including writing, appears particularly impactful (Graham, 2020; Stone, 2017).

Teacher PD models in CTE include PLCs, job-embedded coaching, collaboration with core-subject teachers, industry–education partnerships, and workshops that link technical content with 21st-century competencies (Jacques & Potemski, 2014; Walker, 2021). Developmental opportunities that position teachers as decision makers in collaborative learning communities, along with work-based learning experiences such as apprenticeships, remain essential for aligning instruction with industry expectations (VDOE, 2022). Moosa’s (2020) study of learner engagement in higher education further suggests that PD promoting reflective practice can strengthen both teaching and student outcomes.

Across the literature, comprehensive, integrated PD is viewed as essential for preparing teachers and students for evolving workforce and educational demands (Graham, 2020; Van der Bijl & Oosthuizen, 2019; Walker, 2021). Such PD enhances teacher qualifications, pedagogy, and industry relevance while broadening meaningful work-based learning opportunities (Moosa, 2020; VDOE, 2022).

Equity and Learning Culture

Equity debates remain central to current CTE policy, research, and practice. To address access gaps and expand opportunities for participation in high-quality CTE programs, several states have adopted targeted policies. These policy strategies include “securing equitable resources” (e.g., offering tuition-free college attendance); “expanding geographic access to CTE opportunities” (e.g., using information systems to identify where CTE and work-integrated learning opportunities are available or limited); and “[tackling] barriers to entry into CTE programs of study” (e.g., examining entrance requirements to identify who may be adversely affected and implementing strategies to promote equity) (New Skills for Youth, 2023, p. 2).

Equity frameworks emphasize high-quality, workforce-aligned experiences and the removal of structural barriers like tracking and resource disparities (New Skills for Youth, 2023). The Equity Framework for CTE Research (Equity in CTE Workgroup, 2022) uniquely addresses research in the CTE field. The values this framework makes explicit are: (a) students must have workforce-aligned “high-quality CTE experiences”; (b) background characteristics should not limit access to CTE programs; (c) data collection and analyses should focus on identifying and addressing institutional barriers to CTE participation; and (d) CTE research ought to employ diverse methods to address a range of research questions. Beyond access and inclusion, other systemic equity issues also involve tracking—which has historically separated vocational and academic education—along with stigma, funding disparities, and policy structures (Equity in CTE Workgroup, 2022).

Educational equity and inclusivity are important considerations for integrating the 5Cs in CTE instruction. CTE benefits diverse learners, including students with disabilities, English Learners, and low-income students, particularly when instruction is differentiated, culturally responsive, and flexible (ACTE, 2025; Blackwell, 2023; Dougherty, 2018; Equity in CTE Workgroup, 2022; Grosz et al., 2022; New Skills for Youth, 2023; Theobald et al., 2018; Tucker & Hughes, 2020; Vacca et al., 2021).

Research also links exemplary 5Cs implementation with improved student engagement, learning, and performance outcomes. When students perceive learning as relevant through hands-on, meaningful tasks, their motivation and attendance improve (Dougherty, 2018; Theobald et al., 2018). Collaborative spaces with engagement, reflective practice, and academic as well as social learning are descriptors of effective classrooms (Moosa, 2020; Walker, 2021).

Equity, inclusivity, and diversity in CTE are critical components that address the needs of highly diverse student populations (ACTE, 2025; Dougherty, 2018; Theobald et al., 2018). CTE programs have been found to significantly benefit various groups, including those with disabilities, from low-income backgrounds, and English Learners (Blackwell, 2023; Dougherty, 2018; Dykzeul, 2017; Theobald et al., 2018). To promote diversity and inclusivity in CTE programs, ACTE (2025) recommended that learning environments support all students. At the core of equitable CTE programs is recognizing that diverse learners require differentiated approaches to instruction and support (Vacca et al., 2021).

A longitudinal study in Washington State tracked 5,122 students with learning disabilities and found that those enrolled in concentrated CTE programs were more likely to graduate on time and secure postgraduation employment (Theobald et al., 2018). Although the single-state focus limits generalizability, the large sample and design strengthen the evidence that CTE supports positive outcomes for diverse learners and reinforces skills such as citizenship and collaboration.

Vacca et al. (2021) argued that equity and inclusivity in CTE extend beyond demographic diversity to include instructional practices. Their work emphasized differentiated strategies, such as scaffolding and collaborative group work, which support varied learner needs. These approaches are especially relevant in CTE, where diverse students benefit from equity-centered, tailored instruction. In Massachusetts, Dougherty (2018) found that high-quality CTE programs improved on-time graduation rates, particularly for low-income students, suggesting CTE can be a lever for social mobility. Although strengthened by a rigorous methodology, the study's findings raised equity concerns, as variation in school application and admission rates remained unexplained.

Despite the benefits of strong and equitable CTE instruction, CTE programs are still often viewed as academically weak, inconsistent across settings, and primarily serving underperforming students (Matthews, 2022). Such negative perceptions also position CTE as a track for non-college-bound or marginalized populations (Blackwell, 2023). Tucker and Hughes (2020) found in interviews with 16 core subject teachers that cultural and perceptual barriers persist, underscoring the need to address these obstacles to fully implement the 5Cs. Such studies heighten awareness of barriers (cultural and perceptual) that undermine student inclusion and modern skills implementation.

For international and immigrant learners, targeted supports and CTE pathways can accelerate workforce entry (Gautam et al., 2016; Pierre-Louis, 2022). Examples of inclusive CTE instructional strategies are “critical thinking, relationship-building, and resiliency through flexibility” (Fitz, 2024, para. 3–5). The scope of equity and inclusivity in CTE extends to program structure and accessibility (Theobald et al., 2018), as well as flexibility. Flexible

programs can improve enrollment and completion, though implementation conditions need more study; thus, Grosz et al. (2022) recommended that CTE programs be structurally changed to enhance student outcomes and accessibility, further promoting equity and inclusivity. However, the conditions under which programs become more flexible were not examined.

Comprehensive approaches to inclusivity and diversity in CTE are crucial for preparedness in the modern world (Blackwell, 2023; Dougherty, 2018; Fitz, 2024; Theobald et al., 2018). By addressing diverse needs, challenging societal stigmas, and implementing inclusive practices, CTE programs contribute to educational equity and positive futures (ACTE, 2025; Blackwell, 2023; Dougherty, 2018). Integrated approaches to equity in CTE strengthen instructional strategies and program structure while potentially altering damaging stereotypes (Grosz et al., 2022; Tucker & Hughes, 2020; Vacca et al., 2021).

To understand how CTE programs affect different student populations, researchers have examined the impacts of support systems (e.g., response to intervention) as well as how policies shape CTE program structures and their capacity to meet diverse learner needs (Blackwell, 2023; Dougherty, 2018; Theobald et al., 2018).

Student Engagement and Classroom Management

Student engagement and classroom management, which impact learner motivation, instructional relevance, and academic outcomes, are critical factors in CTE programs. The graduation rates of low-income CTE students from ninth grade onward had improved, perhaps owing to the relevance of real-world learning (Dougherty, 2018). Similarly, Dykzeul (2017) found that work-based learning had enhanced students' math and reading abilities within CTE high school programs in California, based on 105 responses from students, leaders, and teachers.

Hands-on learning environments are linked to higher engagement, attendance, and improved graduation and postsecondary outcomes (Dougherty, 2018; Theobald et al., 2018). Work-based and PBL strengthen participation and skill development (Dykzeul, 2017; Walker, 2021). Effective classrooms use modeling, small-group work, student choice, and peer collaboration, aligned with the 5Cs (Moosa, 2020; Reed et al., 2021).

Walker's (2021) survey study with 1,000 CTE teachers in nationwide schools in the United States seems particularly revealing of instructional strategies in use. To promote student engagement and close a skills gap in workplaces, PBL, interactive lectures, and lab activities were the most frequently used strategies in these CTE classrooms. Variations from one context to another acknowledged more instructional strategies: demonstrations, guided practice, on-the-job training, questioning, and whole-group discussion. CTE strategies varied in accordance with teacher preference, location, curriculum differences, and subject area.

Together, these studies highlight the value of hands-on, student-centered, and reflective instruction for fostering engagement in CTE classrooms, while also underscoring the need to challenge CTE stereotypes, promote equity, align instruction with essential competencies, and build schoolwide support for competency-based learning across content areas.

Discussion

Source analysis revealed themes that clarify key ideas for embedding skills in K–12 CTE instruction. In Virginia, the *Profile* reinforces CTE’s role in comprehensive education and calls for intentional development of the 5Cs alongside technical skills (VDOE, 2022). Yet teaching 21st-century skills remains challenging across contexts.

Instructional approaches to competency integration most commonly include PBL, work-based learning, academic integration, authentic assessment, and technology-enhanced instruction. Walker (2021) found that CTE teachers preferred certain methods, among them PBL, for co-developing technical and vocational skills. Stone (2017) accentuated the value of high-quality, work-based learning experiences that connect classroom instruction to labor markets.

Importantly, CTE programs benefit students with disabilities (Theobald et al., 2018), English Learners (Pierre-Louis, 2022), and low-income populations (Dougherty, 2018). People from lower socioeconomic backgrounds are attracted to these programs because they provide practical, marketable skills, industry-recognized credentials, and pathways to higher-paying jobs that may offer financial stability (Taylor et al., 2020). Moreover, the integration of academics and hands-on learning with real-world application is advantageous for those lacking the finances for traditional postsecondary education (Taylor et al., 2020). Students also like that engagement is actively fostered through practical experiences that connect their interests, career goals, and professional contexts (Dougherty, 2018; Dykzeul, 2017).

However, misconceptions about CTE (Blackwell, 2023) limit access for some students (Walker, 2021), justifying targeted PD and policy change. Regarding attitudinal barriers, some core-subject teachers who otherwise support CTE and recognize the value of multiple postsecondary pathways still tend to encourage students to pursue a traditional four-year college route over CTE options (Tucker & Hughes, 2020). This preference often reflects long-standing cultural norms that equate academic pathways with higher status and broader opportunity, as well as limited awareness of the rigor, workforce relevance, and postsecondary value embedded in modern CTE programs (Blackwell, 2023; Matthews, 2022). Consequently, teachers may unintentionally reinforce stereotypes that position CTE as a less attractive option, shaping student perceptions and influencing course-taking decisions despite growing evidence of CTE’s positive outcomes (Dougherty, 2018).

Implications for Preparation, Practice, and Research

To strengthen preparation and practice, the literature indicates that preservice programs and ongoing PD must model integration strategies that blend pedagogy, technical content, and soft-skills development while connecting instruction to students’ lived experiences. Teacher resilience, particularly among career switchers, remains an issue that calls for schoolwide support structures, mentoring, and collaborative professional cultures.

Teacher preparation pathways are distinctive for many CTE educators. Van der Bijl and Oosthuizen (2019) identified gaps in teacher qualifications and preparation, while Dykzeul (2017) and Graham (2020) emphasized the importance of mentoring, collaborative planning, and industry–education partnerships in supporting the integration of academic and technical skills in

CTE courses. For these efforts to have lasting impact, instructional design must be grounded in equity commitments, experiential learning, and robust teacher preparation.

In practice, career switchers—like other novice CTE teachers—require intensive exposure to, and targeted PD on, pedagogy, academic content integration, and classroom management. Because CTE environments support both theoretical and practical competency development, teachers must understand how to link academic instruction with opportunities to build technical skills (Vacca et al., 2021; Virginia Ed Strategies, 2020).

Financial considerations also shape teacher retention and CTE programs. Inadequate compensation remains a major contributor to attrition, particularly for educators transitioning from higher-paid industry careers (Walker, 2021). Limited funding for essential but costly instructional tools (robots, etc.) can constrain pedagogical innovation and the adoption of modern teaching methods. Administrative support further affects working conditions and the extent to which 21st-century skills can be effectively implemented (VDOE, 2022). Addressing instructional barriers—such as challenges in communication, critical thinking, creativity, collaboration, and digital literacy—Mutohhari et al. (2021) concluded that administrative support and PD should play a central role in scaffolding these competencies.

Research is needed that examines CTE teachers' experiences with skills integration and the types of supports they find most valuable. Additional inquiries could explore how teachers embed 21st-century skills across disciplines, how equity and learning culture influence student outcomes, how administrators support CTE instruction, and how digital technologies shape competency expectations. Pursuing these directions will help the academic community develop a more contemporary and comprehensive understanding of future-ready learning. We also recommend that the research community further clarify and differentiate 21st-century skills by examining specific competencies. Toward this aim, we propose several guiding questions: (a) How do CTE teachers embed critical thinking in instruction? (b) How is creative thinking reflected in CTE practices? (c) In what ways do educators integrate communication skills? (d) How is collaboration fostered in CTE learning environments? (e) How are citizenship and related civic competencies incorporated into CTE classrooms?

Conclusion

In keeping with our purpose and research question, this review contributes to the field's understanding of 21st-century skills integration in CTE classrooms that prepare K–12 students for a global workforce and postsecondary education. Our synthesis of findings highlighted instructional design for 5Cs integration, PD and teacher preparation, equity and learning culture, and student engagement and classroom management. A field-level takeaway underscores the need to shift away from siloed technical training to integrated, experiential, literacy-rich instruction. Evidence issues in CTE research can be summed up as self-reported data, small samples, single-state focus, and thin implementation detail, particularly concerning CTE instruction.

Our synthesis also revealed that instructional approaches grounded in experiential learning consistently promote the integration of technical and broader competencies. We encourage

readers to build on our search to more fully understand how CTE can fulfill its dual promise: delivering rigorous technical training while cultivating the competencies that define career and civic readiness. The research underscores that effective CTE programs are not only technical in nature but also equity-oriented, student-centered, and intentionally designed to foster 21st-century skills across diverse contexts.

Education stakeholders may find our results useful for stimulating ideas about cohesive, collaborative approaches to competency integration in CTE. More broadly, this review synthesis illustrates how 21st-century learning can serve as a foundation for thriving in complex, global contexts. Competency-based learning not only equips students with technical expertise but also with the adaptability, problem-solving, and civic awareness demanded by modern life. A key takeaway is that transformative practice cultivates 21st-century learning and produces college- and career-ready graduates. On a cautionary note, schools need stronger, unified commitments to competency-based learning and strategies for actively addressing stereotypes that limit CTE participation. With continued collaboration and innovation, CTE programs can expand their impact and open new pathways for every learner to thrive.

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