

# Bridging Academic and Vocational Pathways in Upper Secondary Education: Comparative Perspectives from Estonia and the United States

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## Abstract

This article examines transformations in upper secondary vocational education in two countries – Estonia and the United States – focusing on the status and perception of vocational education and developments in curricula. A qualitative document analysis of policy reports, academic studies, and national statistics was conducted to compare how each country is bridging academic and vocational learning. Our findings indicate that well-designed reforms can play a key role in reshaping vocational education to promote flexibility and coherence between the vocational and academic tracks. The results show that in the USA, Career and Technical Education (CTE) programs have managed to significantly increase the interest and participation of young people in vocational education programs, and the latest data shows 85% of all high school graduates took at least one career and technical education course. Their experience serves as an important input for the further reform in Estonia.

**Keywords:** vocational education, Career and Technical Education, Estonia, United States, VET curricula, reforms

## 1. Introduction

In recent years, vocational upper secondary education has received renewed attention as education systems are increasingly being aligned with the demands of rapidly evolving labor markets. Both Estonia and the United States, despite their differing educational traditions and scales, are currently looking for vocational education leading to purposeful and economically viable careers. Estonia is undertaking significant reforms aimed at enhancing the quality, accessibility, and relevance of vocational education (Education Strategy, 2020; Loogma et al., 2019; Ümarik et al., 2014). In the U.S., major reforms over the past 30 years have improved the accessibility and quality of career and technical education (CTE) courses and programs (Zirkle, 2021).

The distinction between general and vocational orientations in secondary education has its roots in 20th century Europe, with the expansion of upper secondary systems, and it still dominating in many countries (Stronati, 2023). Providing both academic and career-focused learning pathways enables countries to achieve two important aims: first, it supports students in exploring and pursuing their personal interests by offering a variety of educational choices; and second, it helps meet the demands of the labor market by directing students toward practical training programs that build skills employers are looking for (OECD, 2010). On average, 37% of upper secondary students across the OECD are enrolled in vocational education, although participation rates vary widely from one country to another (Stronati, 2023). In the U.S., the first federal legislation to provide financial support to states for then-vocational education, the Smith-Hughes Act of 1917, provided funding for the development and delivery of educational programming in agricultural, industrial, and home economics fields, as well as teacher training. The goal of this legislation was to prepare students for employment, particularly in occupations that could be pursued directly after high school. This goal has remained a part of all related legislation through the remainder of the 20th century and into the 21st, although there are additional goals that are part of present-day efforts (Zirkle, 2024). Today, CTE is embedded within comprehensive high schools and dedicated career centers, offering a diverse array of courses to the majority of American high school students.

Estonia, by contrast, has traditionally maintained a more separated system. After completing the compulsory 9 years of basic education (grades 1–9), Estonian students choose between two distinct options: general upper secondary education (gymnasium) or vocational education. General upper secondary (academic track) is a three-

year program that prepares students for the national exams and university entry. Upper secondary vocational education, often lasting three years (now being extended to four), combines general education with professional training and can lead either to direct employment or further studies. For many years, vocational education has struggled to compete with the academic gymnasium route: only about one-quarter of basic school graduates have opted for vocational upper secondary programs in the past decade (Urmann et al., 2025; Education Eye, 2025). Deeply rooted cultural biases favoring academic education have reinforced this trend (Loogma et al., 2019). As a result, vocational schools in Estonia have faced low enrollment and a perception of being a “second choice.” This situation is now changing through an ambitious reform agenda. The Estonian Education Strategy 2021–2035 calls for learning options that respond to societal and labor market needs, with more integrated general and vocational upper secondary education identified as a key mechanism to achieve this (Education Strategy, 2020). In practice, Estonia is moving toward consolidation of post-basic pathways by establishing regional education centers that merge vocational schools and general upper secondary schools (Ministry of Education and Research, 2025). This structural unification aims to enable resource sharing (teachers, facilities) and provide students with more diverse learning paths within a single institution.

Comparing the Estonian and U.S. approaches offers valuable insights into how different contexts address common challenges: increasing student engagement, ensuring equity, improving resource efficiency, and preparing learners for both employment and further education. The U.S. experience of offering CTE within comprehensive high schools (as well as through specialized career centers and magnet programs) serves as a longstanding example of coexistent pathways in a mostly unified setting. Estonia’s current reforms represent a bold effort to import some of this integrative logic into a system that historically separated the tracks. By examining the goals and early outcomes of recent changes in each country, this article identifies opportunities for mutual learning and cross-national inspiration. Ultimately, aligning academic and vocational pathways at the upper secondary level is seen as vital for addressing the economic imperative of facilitating meaningful transitions into the workforce and higher education in the 21st century (Stronati, 2023).

This study aims to explore how Estonia and the United States are bridging academic and vocational pathways in upper secondary education through recent reforms in curriculum, qualifications, and institutional design. The analysis is guided by the following research question: What major changes have occurred in the upper secondary vocational education systems of Estonia and the United States in terms of status and curricular developments. The discussion part explores how these changes contribute to the integration of academic and vocational pathways and what lessons can be drawn for developing a more coherent and unified approach to upper secondary education.

## **2. Integrating Academic and Vocational Learning**

In most OECD countries, upper secondary education is organized into distinct academic and vocational tracks. There are some exclusions (Canada, Ireland, New Zealand, and the United States) where students have access to vocational options within comprehensive secondary schools (OECD, 2024). At the same time, there is a growing need to integrate these two systems, combining the added value of both academic education and more practical vocational training. Therefore many countries are re-examining educational policies and structures underpinning their training systems to determine ways of making vocational education more responsive and efficient (Clayton & Harris, 2018). In order to meet the needs of the ever-changing world of work, countries are reforming their education systems to increase coherence between the vocational and academic tracks (Persson Thunqvist et al., 2019; Clayton & Harris, 2018). In some cases there are tendencies to move of upper secondary education in the direction of a more tracked system of programmes and qualifications (Parry, 2017). On the other hand, we can find numerous examples where academic and general education have been brought together with vocational education (Polidano & Tabasso, 2016) often referred as the ‘unification’ or integration of academic and vocational learning (Raffe, 2003). According to Raffe (2003), unification measures within upper secondary education can be broadly categorized into three types, each addressing a different dimension. The first type, an integrative approach seeks to construct a new, cohesive educational model. Notable examples include the implementation of career clusters and career academies in certain U.S. high schools, as well as initiatives within the dual systems of Germany and Austria. Another instance of curricular integration is the incorporation of key competencies or transferable skills into both vocational and academic programs, fostering a shared foundation of learning outcomes. The second type addresses organizational structures, aiming to reduce institutional separation between academic and vocational tracks. In many countries, upper secondary education is segmented into distinct pathways (academic, vocational, or technical). Unification in this context involves efforts to connect or consolidate these pathways, either through the establishment of integrated upper secondary institutions or by situating unified programs alongside traditional track-based schools. The third type of unifying measure aims to reduce the distance between

vocational and academic learning in longitudinal terms. This could involve recognizing vocational qualifications for university entry or providing bridges from academic programs into technical training later in one's career.

Comparative education research has highlighted both the potential benefits and difficulties of integrated approaches (Raffe, 2003; Grubb, 2006; Polidano & Tabasso, 2016; Wallenborn & Heyneman, 2009). On one hand, providing multiple learning modes and a broad skill base can motivate a wider range of students and better prepare them for complex careers. Integration can also promote social equity by avoiding early tracking that channels disadvantaged students into lower-status routes. On the other hand, integrated models can be hard to implement: they may require more resources (to deliver both academic and vocational content), teacher retraining, and overcoming institutional inertia. There is also the risk of attempting to be “all things to all people”, potentially diluting the focus of vocational programs or overloading students. The experiences of countries like Norway and Sweden – which in the 1990s lengthened vocational programs and added academic subjects to make them more like general education – show mixed results in terms of student outcomes and employer satisfaction (Persson Thunqvist et al., 2019). These cases underline that integration is not a one-size-fits-all solution; it must be carefully tailored to context.

### 3. Methodology

This study employs a qualitative document analysis (Bowen, 2009) of a wide range of sources to investigate recent reforms in upper secondary education in Estonia and the United States. The analysis in this article draws on international literature, national policy documents, and statistical reports to identify key dimensions of ongoing reforms. Firstly, a review of literature was conducted to ground the study in existing knowledge of vocational education and training (VET/CTE) systems. Sources included journal articles and books on the history and evolution of vocational and career-technical education in the U.S. (e.g., Zirkle, 2017; 2021) and analyses of vocational education developments in Estonia (e.g., Loogma et al., 2019; Musset et al., 2019; Urmann et al., 2025). These provided background on the status quo and the challenges identified by scholars. Secondly, key policy and strategy documents from both countries were collected. For Estonia, this included the national Education Strategy 2021–2035 (Ministry of Education and Research, 2020) and recent government proposals on vocational education reform (Ministry of Education and Research, 2025). For the United States, relevant documents included federal legislation (such as the Strengthening Career and Technical Education for the 21st Century Act, commonly known as Perkins V) and publications from the U.S. Department of Education and associations like the Association for Career and Technical Education (ACTE). Thirdly, statistical data sources were analyzed to capture quantitative trends. In the Estonian case, national education statistics were accessed through the Education Eye portal (Haridussilm) and report by the Estonian Education Quality Agency (2025). For the U.S., data from the National Center for Education Statistics (NCES) – including the Condition of Education reports – were used to obtain metrics such as the percentage of high school students taking CTE courses and demographic breakdowns. These data help illustrate changes in participation and attainment associated with vocational programs.

The analysis was comparative and thematic. Documents from both countries were coded for key themes corresponding to the research questions: (1) the status and public perception of upper secondary vocational education; (2) curricular reforms and program design changes; (3) the development of labor market-oriented qualifications and qualification frameworks. A cross-case comparison was then conducted, examining similarities and differences in how Estonia and the U.S. are addressing each theme.

Document analysis as a method allowed triangulation of information – for example, policy intentions were cross-referenced with statistical trends and findings from independent research. This strengthens the validity of the conclusions by ensuring they are not based on a single source or perspective.

### 4. Results

#### 4.1 *Changes in the Status of Vocational Secondary Education in Estonia and the U.S.*

Attempts to integrate general and vocational education in Estonia date back to the 1960s with the establishment of a new type of vocational secondary school - the polytechnic production training school. These institutions aimed to combine academic instruction with practical vocational training, reflecting broader trends in educational reform focused on bridging the gap between school and the labor market. However, the model failed to achieve its intended objectives due to the limited scope of academic subjects offered (Kelder, 1979). A similar approach was applied in general upper secondary schools, where “production training” was introduced to strengthen connections between education and working life by combining theoretical instruction with practical occupational training (Karjahärm & Sirk, 2007). Yet, because these additions largely came at the expense of humanities subjects, students' academic competencies were compromised, and the centrally directed reforms were ultimately deemed unsuccessful. Consequently, a significant divide between general (academic) and vocational education persisted.

Feedback from the labor market and lifelong learning sectors consistently indicated that vocational education graduates occupied a relatively disadvantaged position compared to higher education graduates in terms of wages, employment, and social mobility, pointing to a form of historical path dependency (Loogma, 2022).

After Estonia regained independence in 1991, comprehensive education reforms were implemented, allowing for diversification and modernization of the vocational education system. Notably, the proportion of work-based learning in VET programs was increased, curricula were shifted to a competency-based format, and greater flexibility in learning pathways was introduced (Cedefop, 2020; Musset et al., 2019). The Vocational Education Institutions Act of 2013 initiated a reform (2013–2015) that made studies more practical and aligned curricula more closely with labor market needs. Vocational curricula became outcome-based and were linked to the National Qualifications Framework, and a credit point system compatible with the European Credit System for VET (ECVET) was adopted. These changes improved the structure and quality of VET, laying groundwork for a more robust system.

Although vocational upper secondary education plays a crucial role in the learning trajectories of many young people in Estonia, it has not developed into a competitive alternative to general upper secondary education (Urmann et al., 2025). Over the past decade, only about one-quarter of basic school graduates have opted for vocational secondary education (Education Eye, 2025). Despite a number of reforms during last decade—including the introduction of outcome-based VET curricula, a new quality assurance system, and the implementation of the labor market forecasting tool OSKA - these efforts have not significantly improved the attractiveness of vocational education or increased enrollment in VET pathways. As Loogma et al. (2019) suggests, deeply rooted cultural beliefs and societal perceptions continue to shape the image of vocational education in Estonia. These perceptions tend to favor academically oriented general education over vocational education, contributing to its relatively low status and appeal.

Today, Estonia's vocational secondary education is undergoing a new wave of transformation aimed at elevating its status. The central goal is to make vocational upper secondary education a competitive, equivalent alternative to general education in gymnasium. This entails guaranteeing that vocational students can acquire a solid general education alongside vocational skills, so they are not disadvantaged in accessing higher education. Currently, vocational education is offered in a network of 35 institutions (most publicly funded), and approximately 98% of vocational study places are financed by the state, making VET tuition-free for learners (Ministry of Education and Research, 2025). Vocational schools are being repositioned as innovation hubs closely tied to industry needs. Stronger partnerships with employers, new public relations campaigns, and the aforementioned regional education center model will be employed to shed the outdated image of vocational education. Early signs indicate a shift in perception: applications to vocational programs have begun to rise, and the media has reinforced the message that vocational secondary education can serve as a strong alternative to general upper secondary school (Laasi-Õige, 2025). However, achieving the target of 40% vocational enrollment by 2035 will likely require sustained policy support.

In the United States, vocational education at the secondary level has undergone a significant evolution in status over the last few decades. Historically, vocational programs in American high schools were often viewed as a “second-class” education for students deemed non-college-bound. Common issues included outdated equipment, substandard facilities, teachers without adequate industry experience, and curricula that did not keep pace with workplace needs (Zirkle, 2017). Vocational courses (woodworking, auto mechanics, etc.) were sometimes stigmatized as programs for students with lower academic achievement, reinforcing social stratification. By the late 20th century, however, several converging forces drove a reexamination of this model. The 1980s and 1990s brought rapid technological change, and a growing “skills gap” in the labor force, which highlighted the need for a more skilled workforce beyond the college-educated. At the same time, educational accountability movements in the 1980s (e.g. Spurred by the report *A Nation at Risk*) put pressure on the education system, including vocational programs, to demonstrate quality outcomes.

One of the most visible changes was a rebranding of vocational education as “Career and Technical Education (CTE).” In the late 1990s and early 2000s, educators and policymakers began using the term CTE to better convey the evolving nature of these programs (and in 2006, the federal Perkins Act officially replaced “vocational” with “CTE”). The curricular goals of CTE expanded: modern CTE programs still train students in technical skills for entry-level jobs, but they also strive to prepare students for higher education and lifelong learning. This is reflected in the widespread integration of academic content into CTE. Many CTE courses now incorporate mathematics, science, literacy, and other academic skills in applied contexts – for example, a culinary arts program might include lessons in chemistry (food science) or a construction technology program might teach geometry concepts through

carpentry projects (Zirkle, 2017). As a result, the academic rigor of CTE courses has increased, making them more relevant and beneficial even for students who might later pursue a college degree.

Another major change in status has come from improved connections between high school CTE and postsecondary opportunities. Across the U.S., a variety of mechanisms have been put in place to create seamless pathways: dual credit and dual enrollment programs allow high school CTE students to earn college credits (often through community colleges) while still in high school. Articulation agreements ensure that completing certain high school programs or earning industry certifications gives advanced standing in college or apprenticeship programs. For instance, a student completing a high school IT program might earn a certificate that is recognized by an industry association or get credit at a technical college. These arrangements underscore that CTE is no longer a dead-end track; instead, it can be the first step in a longer educational journey. Today, 85% of all U.S. high school graduates had taken at least one CTE course during their schooling, indicating the broad reach of CTE into the student population (Career and Technical, 2024). In many high schools, college-bound students take CTE electives (such as computer science, engineering, or health science courses) alongside their Advanced Placement classes, and students aiming for the workforce take academic classes to ensure basic competencies.

The relationship between CTE programs and employers has also strengthened the status of vocational learning in the U.S. historically, while most high school vocational programs had advisory committees of local business representatives, these were sometimes perfunctory; employers often took a hands-off approach, expecting schools to “train the students” without much direct involvement (Zirkle, 2017). In recent years, with industries facing skilled labor shortages and recognizing the need for early talent pipelines, businesses have become far more engaged. Work-based learning opportunities such as job shadowing, internships, and cooperative education placements have proliferated in secondary CTE. For example, high school students in a manufacturing program might spend a day a week interning at a local factory, or summer internships might be offered to students in healthcare or IT academies. These partnerships benefit students (through real-world experience and networking) and employers (by cultivating future employees and informing curriculum content). Such close collaboration with industry adds credibility to CTE programs and helps keep them up-to-date with current technology and practices. To sum up, the U.S. has seen three decades of positive change in high school vocational education. As Zirkle (2017, 335) emphasizes, “significant progress has been made on changing the image and public perception of vocational education”, transforming it into a more respected and integral part of secondary schooling.

#### *4.2 Developments in Curricula in Upper Secondary VET in Estonia and the U.S.*

Recent years have brought significant curricular changes to Estonian upper secondary vocational education as part of the broader reform to integrate academic and vocational learning. One of the headline changes is the development and implementation of new national curricula for vocational secondary education (Kutsekeskhariduse riiklik, 2025). Rather than narrowly specialized courses of study, the new curricula are designed to be broader in scope and more flexible in structure, providing students with a balance of general knowledge and vocational specialization. Each new curriculum typically consists of a three-stage model: an initial phase where students explore a broad field, a middle phase focusing on comprehensive general and vocational knowledge, and a final phase of specialized training in a specific occupation. For example, a broad curriculum in the field of information and communication technology (ICT) might allow a student to sample basic IT, networking, and programming topics first, then build general competencies in computer science and mathematics, and finally specialize in, say, cybersecurity or software development in the later part of the program (Kutsekeskhariduse riiklik, 2025).

The development of the new curricula is guided by current labor market forecasts (Rosenblad et al., 2023), aiming to balance the demand for labor in key professional fields with the supply of vocational education and training. There has also been a marked shift in the clustering of vocational specializations. Many fields of study that stood out in the previous decade due to high demand and large enrollment numbers are no longer relevant in the context of today’s labor market. In response to these changes, new sectoral curricula were developed. These curricula, slated for launch in 2025, cover fields such as bio- and chemical industry technology, construction technology, beauty and wellness services, information and communication technology, sustainable business management, logistics and warehouse management, metal machine processing technology, communications and network technology, textile product design and technology, food technology, tourism and hospitality services, industrial digital technology and visual media technology (Kutsekeskhariduse riiklik, 2025).

The inclusion of areas like biotechnology, sustainable business, and industrial digital technology demonstrates a strategic orientation toward emerging sectors (e.g., biotech and Industry 4.0) rather than the traditional trades alone. Each curriculum was developed in close collaboration with employers in that sector to ensure that the skills taught

match what companies currently need. The process involved working groups where industry experts and vocational educators jointly determined learning outcomes and content. By clustering multiple related occupations under a broader curriculum (for instance, merging several small specializations into one “tourism and hospitality services” curriculum), Estonia aims to give students a foundational versatility and then let them specialize, which also allows adjustments as labor market demands evolve.

Another major curricular change is the extension of the duration of vocational upper secondary studies from 3 years to 4 years. This reform is directly tied to the goal of integrating academic education into vocational programs. With an extra year, vocational schools can significantly increase the amount of general academic content delivered, bringing it on par with general upper secondary education. The new 4-year curriculum devotes more time to subjects like languages, mathematics, natural sciences, and social studies. The rationale is that the additional academic grounding will improve students’ key competences – critical thinking, communication, scientific literacy, etc. – which are essential for adaptability and further learning. It also directly addresses a critique from recent evaluations that vocational programs were not sufficiently supporting development of students’ general competencies (Estonian Quality Agency for Education, 2025).

Estonia’s curricular reform also emphasizes personalized learning paths and flexibility (Education Strategy, 2020). Recognizing the diverse learning needs of vocational students (who include both 16-year-old basic school graduates and adult learners in the same programs), the curricula are designed with elective components and modules that can be tailored. For younger students, there may be more foundational modules, whereas adult learners might skip basics and focus on advanced practical skills, with recognition of prior learning when applicable.

Furthermore, new curricula place a stronger emphasis on practical training in industry settings. The reformed curricula allow, in addition to the mandatory internship, an additional practical training opportunity within an elective module. Here, students can “enhance their existing professional competencies and develop new ones, as well as improve general skills needed for working life” (Kutsekeskhariduse riiklik, 2025, §9). This is complemented by updated training facilities and laboratories in schools, where students can practice on modern equipment before starting their internships.

In summary, Estonia’s recent curricular changes in upper secondary VET aim to create a coherent, future-oriented educational experience that combines the best of both worlds: robust general education and high-quality vocational training. By broadening and updating curriculum content, extending the duration for depth, and embedding flexibility and work connections, the reforms hope to produce graduates who are both academically competent and vocationally skilled - and who have a genuine choice between entering the labor market or continuing to higher education upon graduation.

In the United States, changes in high school CTE curricula over the past decade have largely centered on modernization, integration, and relevance. Given the decentralized nature of U.S. education, curriculum standards for CTE are set at the state (or even local) level, but there are national frameworks and trends that have shaped curricula across states.

One of the initial changes to improve U.S. CTE in the 1990’s was focused on academic integration, the inclusion of key concepts and skills from mathematics, the natural sciences and other general education areas, into CTE curricula (Zirkle, 2017). For decades, vocational education (as it was then called) focused almost exclusively on technical skill development. However, as a result of technological change and the ever-evolving needs of the workplace, CTE curricula has pivoted to place more focus on academic skills and specifically how these subjects interface with the technical skills found in all CTE courses and programs.

As a result of the increased emphasis of the academic aspects within CTE, closer connections between secondary and postsecondary institutions have emerged, particularly with the U.S. system of two-year community and technical colleges. Dual credit options, where students can simultaneously earn credit toward high school graduation requirements as well as college credit (typically for entry-level, first year courses). This provides an incentive for students to continue their education. The dual credit approach is attractive from a time standpoint, as it can reduce the time to complete a degree, and also from a financial perspective as it can reduce the amount of tuition required in a degree program. These efforts have resulted in highly connected and articulated pathways from high school CTE to more advanced programs at the two-year college level.

While the reach of CTE has grown into the postsecondary system in the U.S., there has been a parallel push to introduce CTE into lower grade levels within the U.S. secondary system. Historically, the middle grades within the K-12 system (generally grades 6–8) have not been among the grade levels offering CTE, instead focusing on primary academic subjects such as English, the natural sciences, mathematics and social studies, along with

physical education and personal health. However, research has shown that the middle grades are a critical time for building self-awareness, learning about potential careers, and developing a plan for reaching future goals (Bishop & Harrison, 2021; Callahan, et al., 2019; Main & Whatman, 2023). Without these skills, students can also be unprepared for high school. Grade nine (entry into high school) is a critical time, as this is the grade level at which the greatest number of students drop out of high school. Courses at these grade levels have the goal of career exploration in order to discover work environments and understand the various aspects of the workplace (Ohio Department of Education, 2022) and are designed to be aligned with CTE courses and programs at the high school level.

With the long-standing CTE presence at the high school level, the addition of dual credit courses and articulated degree programs at the postsecondary level and a new emphasis on middle school CTE, many states have been able to create well-constructed career pathways. The culmination of many years of work, the career pathways concept grew out of work in the late 1990's when several organizations, including the U.S. Department of Education, the U.S. Office of Vocational and Adult Education and the National Association for State Directors of Career Technical Education Consortium (now known as Advance CTE), began the development of “career clusters”, a revised organization of 16 career and technical education courses and programs (Zirkle, in-press). These career clusters were developed to encourage the creation of inclusive, industry-responsive, and learner-centered career and technical education courses, programs and experiences. A recent update of these clusters was completed in late 2024 following 2 years of input and validation, Advance CTE released a modernized framework (Advance CTE, 2025) containing 14 clusters and 72 subclusters that serve as a guide for states to organize their CTE courses and programs. The 14 clusters are drawn primarily from North American Industry Classification (NAIC) codes and Standard Occupation Classification (SOC) codes, while the subclusters are groupings of occupations with similar skills within the cluster (Advance CTE, 2025). Figure 1 illustrates these clusters and subclusters.

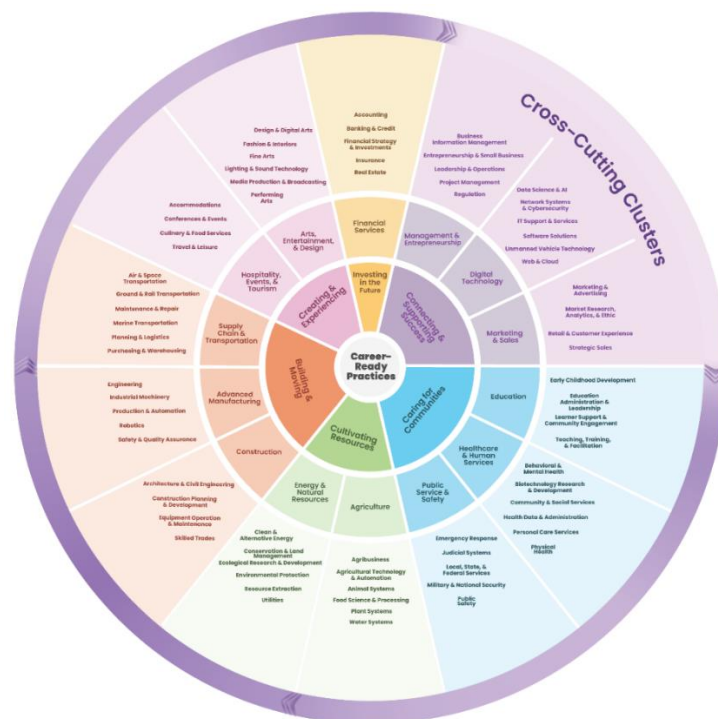


Figure 1. U.S. National Career Clusters Framework

Note. Figure from Advance CTE (2025) <https://careertech.org/career-clusters/>

It is from these career clusters that the efforts to create clear career pathways of CTE coursework were initiated. These connected courses begin with exploratory courses in middle school, then in high school, the courses become more and more comprehensive and rigorous as the student moves through the “cluster” of courses. A possible middle/high school sequence might look like the following (using healthcare as the career cluster):

1. Introduction to Health Careers (middle school grades 7–8)

2. Health Science and Technology (high school grade 9)
3. Principles of Allied Health (high school grade 10)
4. Lifespan Development (high school grade 11)
5. Human Anatomy and Physiology (high school grade 12) (Zirkle, in-press)

This arrangement provides the student the opportunity to obtain a high level of knowledge and skills, both academic and technical. At this point, the student is prepared to begin entry-level employment or continue onto postsecondary education at a community college or university.

One additional characteristic of the career clusters framework is a set of “cross-cutting clusters” (Advance CTE, 2025). These clusters are not specific industry sectors like the career clusters, rather they are skills, knowledge and abilities that are relevant and valued within all of the career clusters. Examples of these cross-cutting skills include digital technology, management and entrepreneurship and marketing and sales. These embedded skills, knowledge and abilities are also prevalent within the Estonian curriculum, which also emphasizes similar cross-cutting themes.

One additional characteristic holds high importance within the recent reforms of CTE within the U.S. educational system. The increasing emphasis placed on work-based learning experiences as part of the curriculum has grown considerably in the last few years. While U.S. postsecondary institutions (particularly four-year universities) have a long history of integrating internships, cooperative learning opportunities and other similar real-world experiences within degree programs, it is only recently that a focus on offering these experiences at the secondary level has come into view. A significant skilled labor shortage across the U.S. has encouraged (or in some cases, required) business and industry to become more involved with secondary-level CTE in different ways, such as providing input on curriculum, facilities and equipment. However, the most impactful involvement has come via offering students the opportunity to gain real-world work experience as part of their secondary CTE education and training. Many states have begun to require these experiences as a metric of program completion. In Ohio, for example, students must complete 250 hours of work-based learning aligned with their CTE program of study (Ohio Department of education and Workforce, 2025). These experiences provide students with practical, hands-on training within an actual company or organization and are designed to supplement school-based learning while also offering higher-level learning opportunities.

In summary, the U.S. secondary CTE system has accomplished many improvements that have helped significantly diminish the perception of a “second-class” education. The system now has expanded to middle schools and improved connections to higher education. The system has also vastly improved its connection to the workplace and employers through an invigorated focus on work-based learning. U.S. CTE has always offered a gateway to entry-level employment, but through the inclusion of relevant and rigorous academic connections, the system also prepares students for postsecondary education.

## 5. Discussion

Efforts to integrate academic and vocational pathways in upper secondary education reflect broader international trends aimed at strengthening permeability between tracks, improving labor market relevance, and addressing issues of equity. The cases of Estonia and the United States illustrate different but complementary strategies, offering important insights into how curricular and organizational reforms can contribute to a more unified approach to secondary education.

### 5.1 *Integration of Academic and Vocational Pathways*

Both Estonia and the United States have implemented reforms that align with Raffe’s (2003) three dimensions of unification: integrative, organizational, and longitudinal. At the integrative level, the embedding of academic content within vocational curricula has been central. In the U.S., the rebranding of vocational education as career and technical education (CTE) marked a significant shift toward programs that combine rigorous academic instruction with applied technical skills (Zirkle, 2017; Career & Technical Education, n.d.). Similarly, Estonia’s outcome-based curricula, aligned with the National Qualifications Framework, aim to ensure that vocational students are not disadvantaged in terms of academic competencies (Cedefop, 2020).

Organizational reforms also demonstrate how integration is pursued structurally. In the United States, dual credit and articulation agreements reduce the institutional divide between high schools, community colleges, and industry certifications, creating clear pathways for students to transition between levels of education (Zirkle, in press). Estonia has consolidated vocational provision into a network of state-funded institutions and regional education centers, thereby enhancing access and policy coherence, although the division between gymnasiums and vocational schools remains stronger than in the U.S. (Urmann et al., 2025).

Longitudinal unification has proven particularly challenging. In the U.S., CTE is increasingly viewed as a launchpad for higher education as well as employment, supported by expanded employer partnerships and widespread student participation (Center for Instruction, 2025). In Estonia, despite successive reforms, entrenched cultural hierarchies continue to privilege academic education, limiting the attractiveness of vocational pathways (Loogma et al., 2019; Education Eye, 2025). These experiences underscore that unification is not solely a matter of policy or curriculum but also depends on shifting societal perceptions of vocational education.

### 5.2 Curricular Developments in VET

Curricular reforms further illuminate how integration is pursued through design and content. In Estonia, the introduction of new national curricula in 2025 reflects a deliberate move toward breadth, flexibility, and responsiveness to labor market needs (Kutsekeskhariduse riiklik, 2025). The three-stage model, in which students progress from broad exploration to specialized training, offers both academic grounding and occupational versatility. Extending program duration from three to four years enables vocational schools to deliver general education content equivalent to gymnasiums, thereby addressing critiques of insufficient academic preparation (Estonian Quality Agency for Education, 2025). Curricular clustering, such as merging small specializations into broader sectoral programs, further enhances adaptability in line with labor market forecasts (Rosenblad et al., 2023).

In the United States, career clusters provide a parallel curricular framework. Modernized in 2025, the system now organizes CTE into 14 clusters and 72 subclusters derived from labor market classifications (Advance CTE, 2025). These clusters structure pathways that begin with exploratory courses in middle school and culminate in advanced, industry-aligned courses in high school, thereby combining academic depth with vocational specialization (Zirkle, in press). The inclusion of cross-cutting competencies, such as digital literacy and entrepreneurship, parallels Estonia's emphasis on transferable skills embedded across curricula (Kutsekeskhariduse riiklik, 2025).

Work-based learning constitutes a further point of convergence. Estonia's reformed curricula expand opportunities for industry-based practice beyond mandatory internships, while U.S. states increasingly require significant hours of work-based training for program completion (Ohio Department of Education and Workforce, 2025). These developments reflect a shared recognition of the need to integrate school-based learning with real-world experience, both to enhance student competencies and to strengthen ties with employers (Bishop & Harrison, 2021; Main & Whatman, 2023).

The comparative analysis yields three key insights for advancing more unified upper secondary education systems. First, integration is most effective when it expands rather than narrows student opportunities, ensuring that vocational pathways provide robust academic preparation alongside occupational training. Second, coherence across educational levels and close collaboration with employers are crucial to sustaining the credibility and relevance of vocational education. Third, cultural perceptions remain a decisive factor: while the U.S. has successfully rebranded and repositioned CTE as a mainstream option, Estonia continues to confront entrenched hierarchies that limit vocational education's attractiveness despite extensive reforms.

These findings reinforce the argument that integration is not a one-size-fits-all solution but a multidimensional process shaped by national contexts (Persson Thunqvist et al., 2019; Raffe, 2003). Estonia's reforms highlight the importance of structural and curricular depth to establish equivalence between pathways, while the U.S. case underscores the value of systemic frameworks and permeability across educational levels. Both cases confirm that achieving parity of esteem between general and vocational education requires not only curricular innovation and organizational reform but also long-term cultural change.

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