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Research Report

From bright spots to a system: Measuring education-employment linkage in Colorado career and technical education

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KOF Swiss Economic Institute

From bright spots to a system:

Measuring education-employment linkage in
Colorado career and technical education

Dr. Ursula Renold, Dr. Katherine Caves, Dr. Thomas Bolli, and Jutta Buergi

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CEMETS

Center on the Economics and Management of Education and Training Systems

From bright spots to a system:

Measuring education-employment linkage in Colorado career and technical education

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The KOF EELI survey was conducted anonymously, so we cannot thank respondents by name. However, we would like to take this opportunity to express our extreme gratitude to the **respondents who spent time and energy thoughtfully filling out the questionnaire**. We are measuring a big concept, and the questionnaire was no easy feat. We hope to further express our appreciation by using the responses to improve the questionnaire for the next phase of the KOF EELI. This report would not exist without your help.

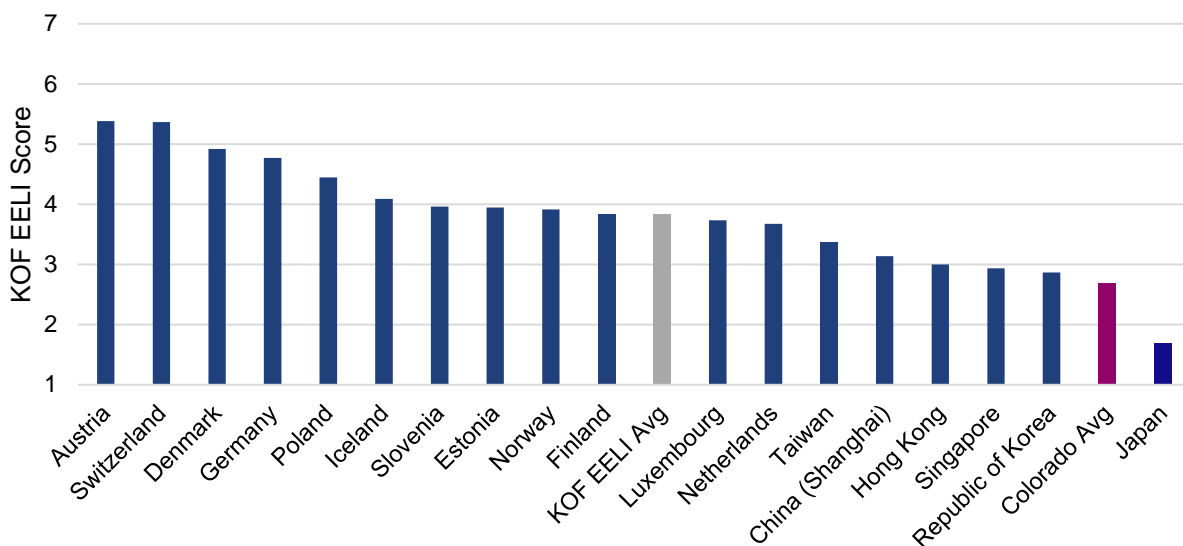
Executive summary

Education-employment linkage is the degree to which actors from the education and employment systems cooperate to provide vocational education and training (VET). It includes workplace learning, business-led curricula, and all other employer engagement. This study uses the **KOF education-employment linkage index** (KOF EELI) developed by the KOF Swiss Economic Institute at ETH Zurich to measure linkage intensity at all points when actors from the education and employment systems interact while designing, applying, and updating VET curricula.

The KOF EELI is correlated with young people's success on the labor market and their quality of employment. Young people's labor market outcomes like employment, working conditions, smooth transitions into work, and skills matching tend to be best when linkage is high. These outcomes are less strong when either education or employment actors make decisions without input from the other system. This report measures education-employment linkage in Colorado's high school career and technical education (CTE) programs in order to assess the strength of Colorado's programs in the context of international VET systems.

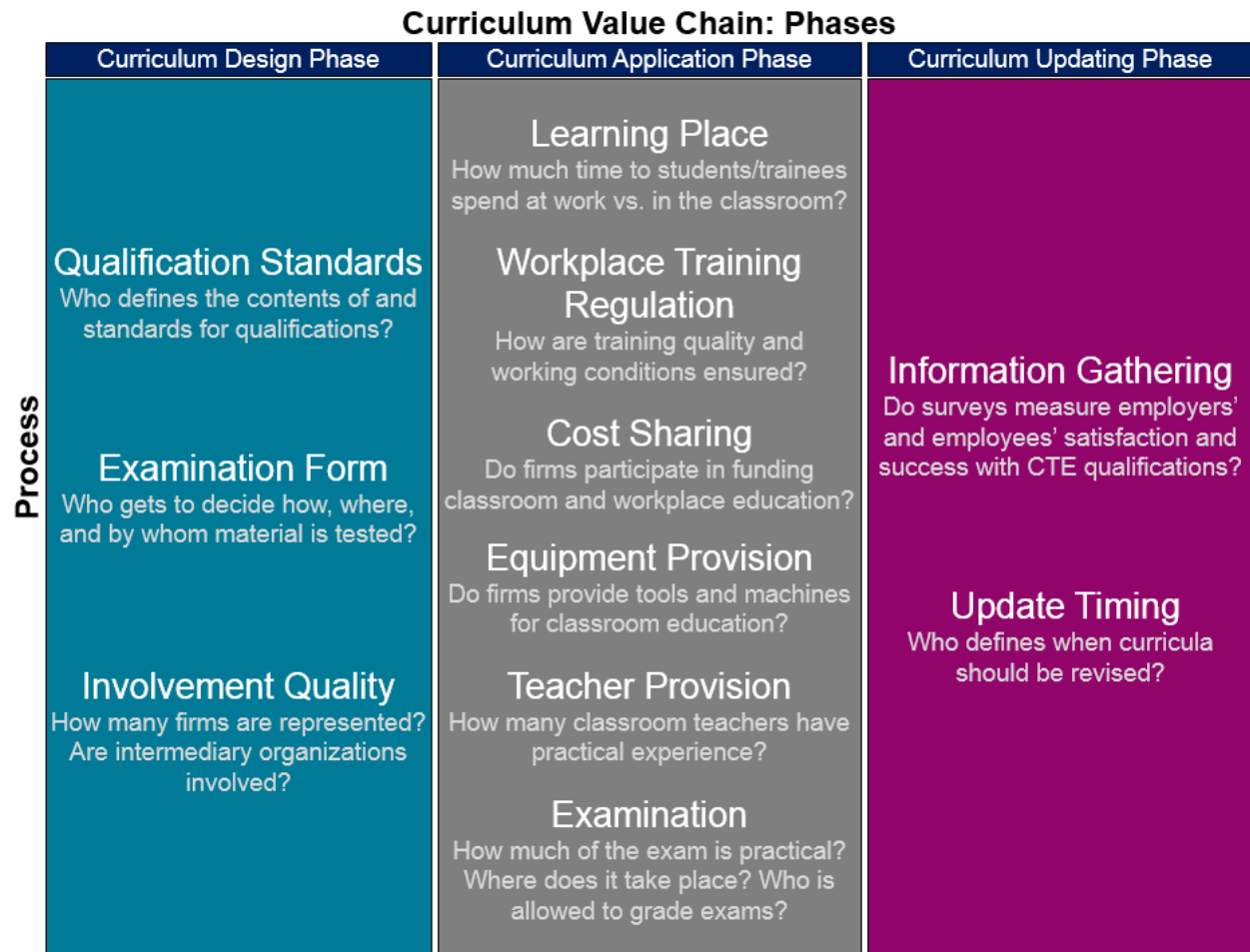
Compared to the 18 countries with KOF EELI scores, **Colorado's KOF EELI score is very low:** 2.69 in a one- to seven-point range (Figure i). At this time, Colorado CTE is contained almost entirely in the education system. A number of regional initiatives invite employers into CTE, but these are disconnected bright spots. The lack of linkage between Colorado's education and employment systems for CTE is well understood; when surveyed experts were asked to rate overall linkage subjectively instead of through the index, they scored Colorado even lower at 2.60.

Figure i: KOF EELI scores in international comparison



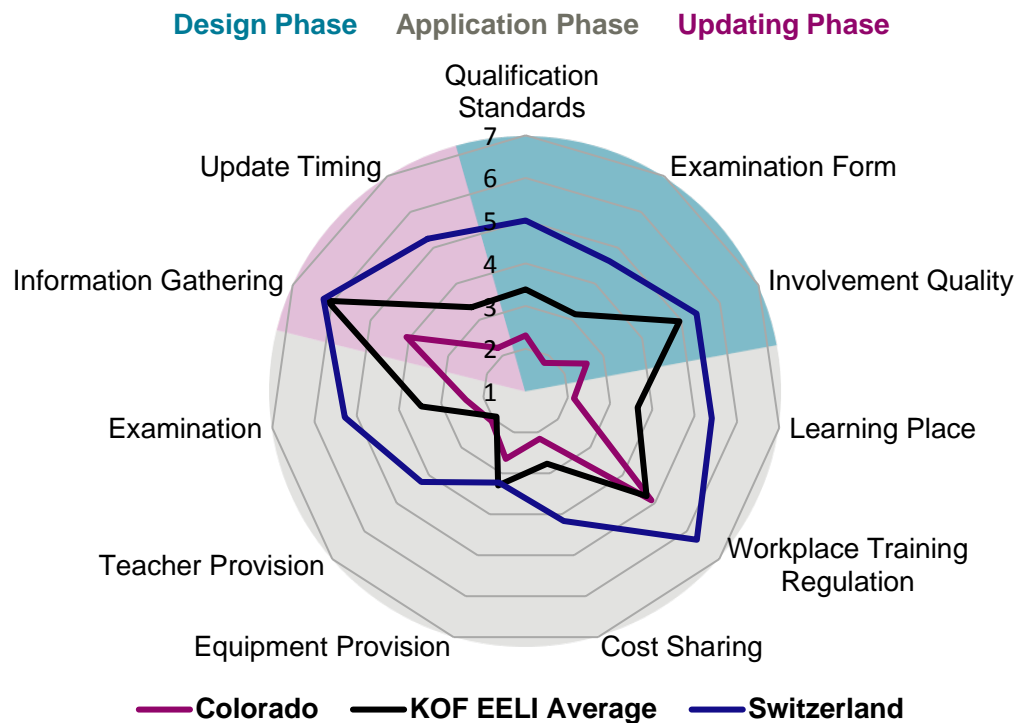
The KOF EELI measures linkage in three phases, each broken down into a number of processes and features to enable cross-country comparison. The three phases of the Curriculum Value Chain (see Renold et al., 2015) are **curriculum design** or the creation of VET curricula, **curriculum application** or program delivery, and **curriculum updating** or collecting feedback and revising curricula to keep up with technological change. Each of these phases entails a number of processes, shown in Figure ii, which are themselves aggregated from specific features where education and employment actors can connect and cooperate.

Figure ii: Phases and processes in the KOF EELI



Compared to the average of all 18 countries with KOF EELI scores and the top-performer benchmark of Switzerland (chosen because it has the highest score with high-quality data, see Renold et al., 2016), Colorado has much lower scores at the process and feature levels as well as overall. Figure iii displays Colorado in international comparison at the process level. Colorado scores generally low and is below the KOF EELI average and top-performer benchmark throughout. It is furthest from international benchmarks in the design phase, shows mixed results in the application phase when its CTE programs are delivered, and struggles in the curriculum updating phase—especially when it comes to allowing employers to decide when updates should take place.

Figure iii: Colorado's process scores compared to the KOF EELI average and Switzerland



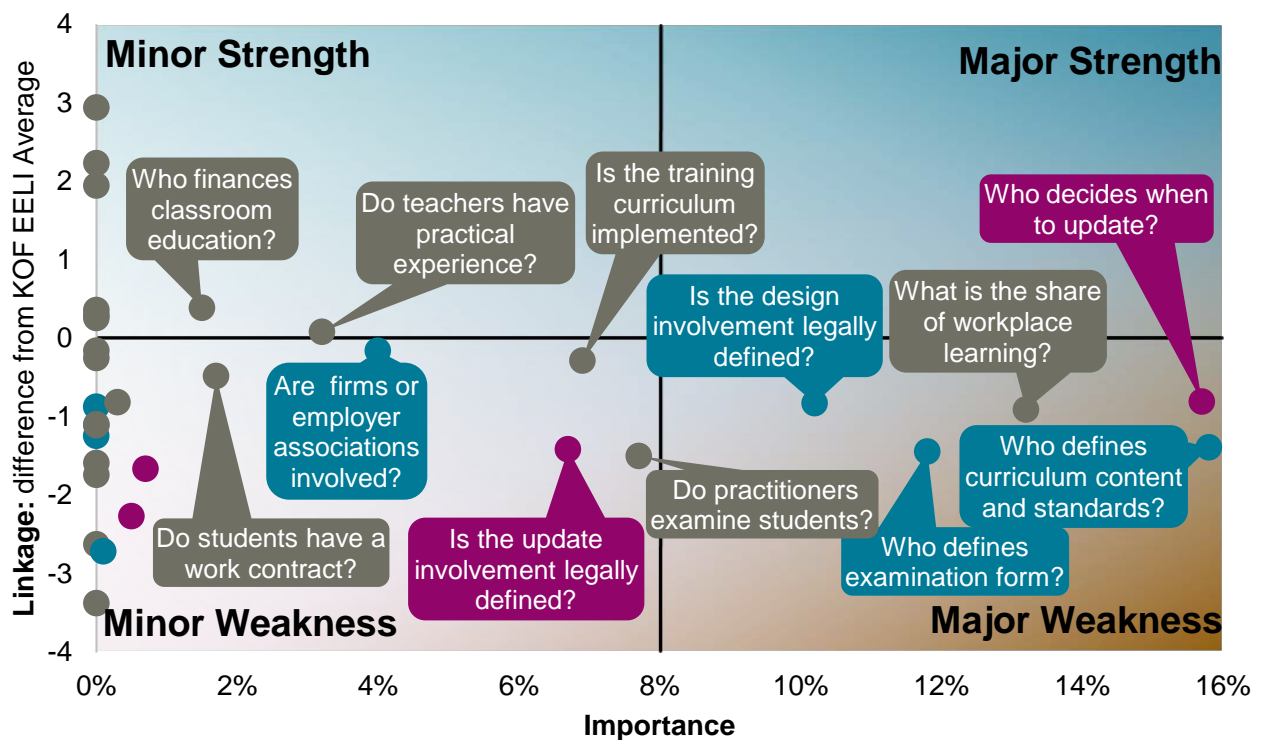
How to read this figure:

- Scores closer to the center are lower; scores closer to the edge are higher. **Higher Scores are better.**
- Colors: **Design phase**, **application phase**, **updating phase**.
- Each **corner of the spiderweb** represents a **process**.

The KOF EELI shows how important processes and features are by weighting them according to regression analysis of international experts' responses (see Renold et al., 2016). **In Colorado, the most important features have very low scores.** Student time spent on workplace learning, employers' engagement in designing qualification standards, and employers' power to determine the timing of curriculum updates are all very important according to international experts. However, these important features are the features where Colorado scores far below the KOF EELI average. They are shown in the bottom right quadrant of Figure iv, which plots the importance of each feature on the x axis and Colorado's score relative to the international average on the y axis. Features in the bottom right quadrant are major weaknesses.

Another important implication shown in Figure iv is that many features of education-employment linkage—including Colorado’s highest scores—are not important for improving linkage and therefore young people’s labor market outcomes. Cost sharing for the financing of classroom education and training regulations like work contracts might be close to or above average in Colorado, but they are not considered relevant by the surveyed experts. Colorado needs to focus on the most important features of education-employment linkage to provide the best opportunities for young people, businesses, and the state economy as a whole.

Figure iv: CTE features in Colorado by importance and KOF EELI score



How to read this figure:

- Scores closer to the bottom are lower relative to the international average, so **higher points are strong points** for Colorado. They are also the points where Colorado is outperforming the 18-country KOF EELI average.
- Weights to the right are heavier, so **points on the right are more important**.
- The most relevant quadrants are the **top right** (Major Strengths) and the **bottom right** (Major Weaknesses)
- The less relevant quadrants are the **top left** (Minor Strengths) and the **bottom left** (Minor Weaknesses)
- Colors: **Design phase**, **application phase**, **updating phase**.

Exploring regional differences and differences between education-system respondents and employment-system respondents shows that Colorado's regions are generally similar, though the Northwestern part of the state scores slightly higher than the others. Responses from education and employment are also similar, though employers report having a larger role in CTE than education actors report they do. Overall, **Colorado's CTE experts from both the education and employment systems agree that there is little coordination or cooperation between the two systems when it comes to CTE design, application, and updating.**

There are a number of factors that might explain why Colorado's linkage is so low. Whether it be resistance or failure to act, **something is preventing a statewide systematic cooperative partnership for CTE.** One problem could be an absence of change agents with the knowledge and perspective necessary to make statewide change—the many bright spots and local linkages in Colorado imply this may be the case. **Employers will rationally resist if training is a net cost to them.** Similarly, **educators will rationally resist when they fear losing power and resources**, or do not see the benefit of including employers. Employment actors are better poised to train practical skills, have resources like industry experts and cutting-edge equipment on hand, and know what skills the labor market needs. Educators have teachers and curriculum developers on hand, and know the skills and abilities of their students. **Partnership is better for all involved.**

Specific recommendations:

Increase & improve **workplace learning** in all programs:

- Students spend **more time in the workplace**
- Continue improving **curricula** for workplace training

Increase & legally define **employer partnership and leadership** on:

- Designing **qualification standards**
- Designing **certification examinations**
- **Hosting and grading** certification exams
- **Initiating** curriculum updates

Based on these findings, in-depth analysis of the features within each process, and a case study of the current CTE system in Colorado, we recommend that Colorado **focus on increasing workplace learning in CTE programs**, ideally to 50-80% but at least to 25% of students' time. The state should continue to strengthen workplace training regulations. **Employers should have input and power** in designing content standards and certification exams. In addition, employers should be able to grade practical skills on certification exams. Finally, employers know when technical change happens before their education counterparts, so they should have the power to initiate updates. Colorado has many bright spots, but they do not comprise a system under international definitions. They cannot help all Colorado youth succeed on the labor market until they become the foundation for credentials with value and recognition.

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List of selected abbreviations

KOF EELI	KOF Swiss Economic Institute Education-Employment Linkage Index
VET	Vocational Education and Training
CTE	Career and Technical Education
CVC	Curriculum Value Chain
CDE	Colorado Department of Education
CWDC	Colorado Workforce Development Council
CCCS	Colorado Community College System
CDLE	Colorado Department of Labor and Employment

Country Abbreviations

AT	Austria
CH	Switzerland
CN	China (Shanghai)
DE	Germany
DK	Denmark
EE	Estonia
FI	Finland
HK	Hong Kong
IS	Iceland
JP	Japan
KR	Republic of Korea
LU	Luxembourg
NL	The Netherlands
NO	Norway
PL	Poland
SG	Singapore
SI	Slovakia
TW	Taiwan

1. Introduction

Colorado's young people—defined as those aged 15-24 according to international standards¹—are not fully prepared to enter the workforce, with consequences for employers and the state economy. Educational achievement gaps in Colorado are narrowing, but the Education Equality Index still ranks Denver 88th and Aurora 93rd² in the top 100 biggest cities. The “Colorado Paradox”³ is that the state has low unemployment, high rates of education and income, and a growing labor market, but students educated in Colorado may be unable to take advantage of those opportunities⁴. Young people around the United States struggle to enter the labor market (Sum et al., 2014), and Coloradans are feeling the pressure.

Conversely, firms in Colorado face substantial skill shortages. According to the Colorado Department of Labor and Employment's press release on the WORK Act Grant⁵,

“One of the most important economic issues facing Colorado—and the nation—is the **critical labor shortage of skilled craftsmen and women**. This skills gap or ‘mismatch’ between employers’ needs for skilled talent and the unavailability of those specific skills within the workforce is impacting industries that are a critical part of Colorado’s future growth” (emphasis ours).

Increased college-going is not the solution, either, as the OECD states

“In the United States, it is **estimated that one third of all vacancies by 2018 will call for some post-secondary qualification, but not necessarily the completion of a four-year degree**” (OECD, 2014, p.3; emphasis ours).

Colorado has a number of programs designed to address this twofold challenge of improving the youth labor market situation and reducing skill shortage faced by firms. Employers need skilled workers, and many have begun to engage in available training programs like registered apprenticeships and school district initiatives, or even developed in-house training programs. The need for improved school-to-work transition strategies is keenly felt throughout the state. For example, the 2016 Colorado Talent Pipeline Report (TalentFOUND, 2016) calls for increased youth apprenticeship as one of its three key recommendations.

Colorado's school districts and other local organizations have a wide variety of career-oriented programs offering career and technical education (CTE) courses or internships. The state of Colorado has multiple skills initiatives from a variety of state agencies and offices, exemplified in the Case Study section of this report. Community-based organizations like sectoral and regional employers' associations and even major philanthropies are also engaged in projects related to skills, workforce development, and youth transitions from school to work.

1.1 American CTE in the international context

Establishing clear international terminology for education comparisons is a known issue in the international context (OECD, 2014), so we will take a moment to specify a few critical terms and concepts. **Education systems** include all institutionalized, intentional, and planned activities of formal education in a given jurisdiction (UIS, 2012, p.11). Such systems are made up of multiple

¹ <http://www.un.org/esa/socdev/documents/youth/fact-sheets/youth-definition.pdf>

² <http://www.educationequalityindex.org/data/>

³ <http://www.theatlantic.com/education/archive/2016/05/a-city-that-imports-college-educated-workers-tries-to-grow-its-own-talent/484325/>

⁴ <http://opportunityindex.org/#4.00/40/-97/-/Colorado>

⁵ <https://www.colorado.gov/pacific/cdle/news/colorados-work-act-grant-addresses-skilled-worker-shortage>

programs at different levels, with international definitions for each (UIS, 2012). According to the commonly accepted ISCED classifications from UNESCO, education programs should be a “coherent set or sequence of educational activities or communication designed and organized to achieve pre-determined learning objectives or accomplish a specific set of educational tasks over a sustained period” (UIS, 2012, p. 7). Further, “A common characteristic of an education programme is that, upon fulfilment of learning objectives or educational tasks, successful completion is certified” (UIS, 2012, p. 7).

When **vocational education and training (VET)** meet specific criteria, they are considered programs and part of education systems. The OECD includes school-based and combined school- and workplace-based VET in its definition of education systems. VET programs that combine school- and workplace learning are also called **dual VET** or **apprenticeship** programs. The definition excludes any primarily work-based training over which no state education authority has oversight (UIS, OECD, & EUROSTAT, 2002). The definition further states:

“For a programme to be considered as a VET programme it should comprise at least 25% of the vocational and technical content. In comprehensive systems when students choose among general and vocational courses, VET programmes would be these ones that enable students to choose vocational courses making at least 25% of the content of the programmes” (OECD, 2004, p. 85; emphasis ours)

Despite the common perception that CTE is simply the American term for VET, **high school CTE programs in the USA do not meet the international criteria or definitions for VET programs or systems.** In the 2010 *Learning for Jobs* report, the OECD states that American “CTE in high schools contrasts with upper secondary VET in many other countries as it does not always aim to make students job ready—some students take CTE courses to explore different job fields, while others view it as preparation for the labor market” (OECD, 2010, p. 33). Another OECD report classifies American vocational education as “limited systematic career training at the upper secondary level” (OECD, 2014, p.25).

In fact, the OECD finds that none of the United States’ CTE programs fit the definition of VET programs, and reports in the 2008 Education at a Glance report that **0% of American high school students are enrolled in VET programs** (OECD, 2008). In the 2016 edition of the same report, the data are simply unavailable (OECD, 2016).

1.2 The KOF EELI

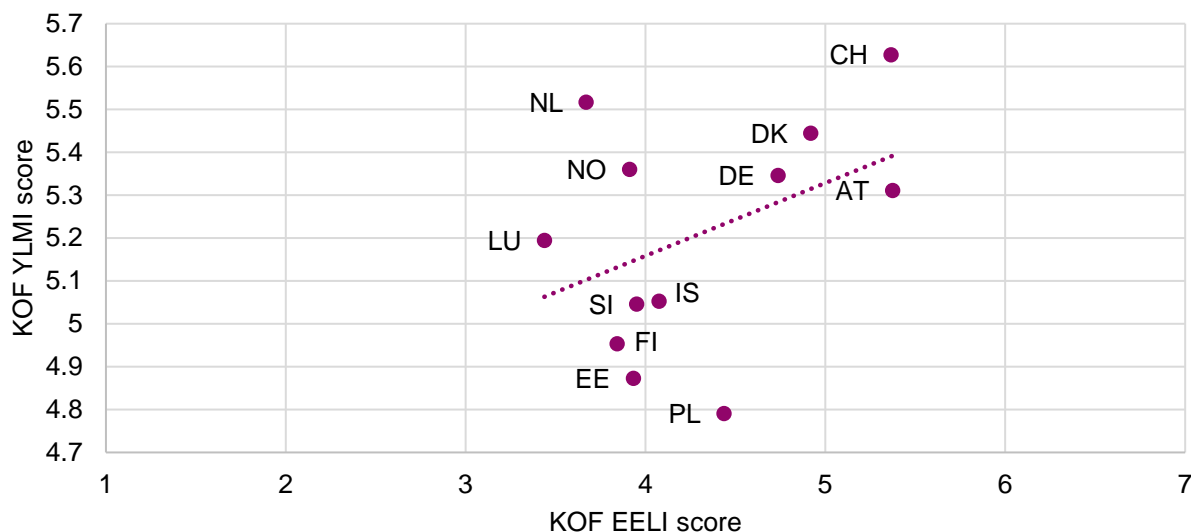
Education-employment linkage, or the level of communication and coordination between actors from the systems of employment and education, is a defining characteristic of strong VET systems (e.g. OECD, 2014). Many KOF EELI elements are well understood aspects of employer engagement in strong VET systems. These include workplace learning, industry-driven content, and well recognized qualifications (OECD, 2014). Hence, measuring that characteristic can provide a picture of a system’s strength and a preview of its areas for growth.

The **KOF Swiss Economic Institute’s Education-Employment Linkage Index (KOF EELI)** measures the extent of cooperation between education actors and employment actors for VET. This report presents the results of the KOF EELI for Colorado’s CTE. The KOF EELI was developed by the KOF Swiss Economic Institute in partnership with the Center on International Education Benchmarking, part of the National Center on Education and the Economy in Washington, DC. The development of the index and its initial application are discussed in the

report by Renold et al., (2016)⁶, which applies the KOF EELI to 18 countries with top-performing VET and general education systems. In short, **the best systems have high employer involvement in setting qualification standards, deciding when to update curricula, and designing certification exams.** In addition, **students in the best systems spend the majority of their time in the workplace.**

The KOF EELI measures employer engagement in VET and relates to outcomes on the labor market. **Countries' scores on the KOF EELI are correlated with their scores on the KOF Youth Labour Market Index⁷ (KOF YLMI),** as shown in Figure 1. The KOF YLMI measures the situation of young people in the world of work (see Renold et al., 2016 for details on the relationship of KOF EELI and labor market outcomes). The KOF YLMI assesses youth labor markets multidimensionally, using measures for the quality of working conditions, rates and relevance of education and training, and transition smoothness from school to work in addition to the usual measures of activity and employment (Renold et al., 2014). The correlation of the KOF EELI with the KOF YLMI suggests that the quality of employer engagement in VET is related to healthy youth labor markets.

Figure 1: KOF EELI scores correlated with KOF YLMI scores



In this report, we discuss our findings and present specific recommendations. The top-performing country that had a high number of responses in the initial KOF EELI study is Switzerland, so we use that system and the average from all 18 countries as benchmarks in our assessment of Colorado. The following sections briefly describe the methodology of the KOF EELI, the sample of surveyed experts, and the education system of Colorado. Results are followed by a discussion of potential explanations for Colorado's scores and concluding remarks with recommendations and limitations of the study.

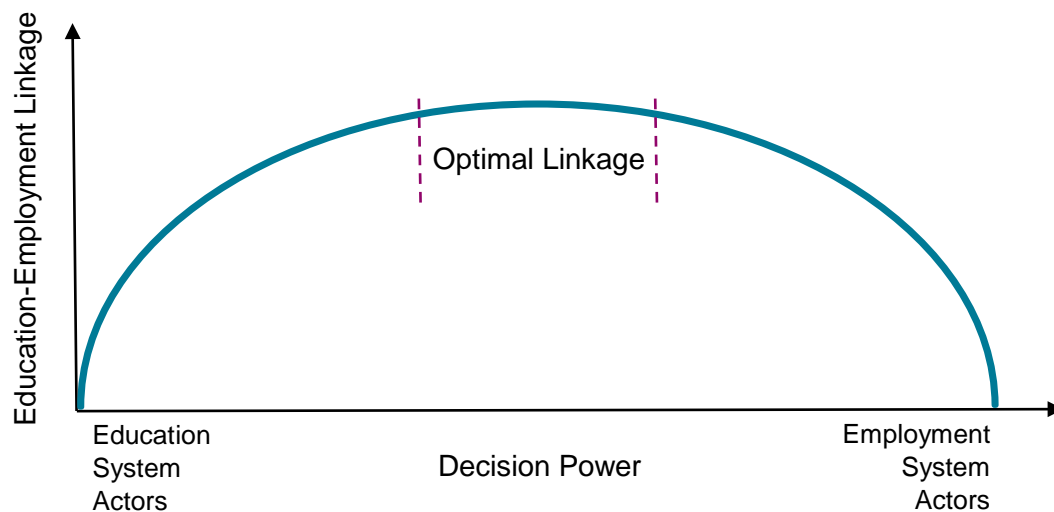
⁶ <http://e-collection.library.ethz.ch/eserv/eth:49542/eth-49542-01.pdf>

⁷ <http://viz.kof.ethz.ch/public/yunemp/>

2. Method

Education-employment linkage refers to the quality of communication and coordination between the actors of the two systems. Figure 2 illustrates the inverted U-shaped relationship between power-sharing among actors from the education and employment systems and education-employment linkage. If the education system has all power, graduates' skills will fail to meet the demands of the labor market, leading to skills mismatch. If all decision power rests with the employment system, the scales tip and training is too firm-specific. Hence, **education-employment linkage is highest when communication and coordination between the actors of the two systems is optimal**. Therefore, we hypothesize that increasing linkage improves labor market outcomes, for example reducing unemployment and increasing wages.

Figure 2: Linkage as power equilibrium



Measuring education-employment linkage requires identifying all the processes in which actors from the education and employment systems can and should interact. We use the **curriculum value chain (CVC)** as a theoretical framework. The CVC has three phases: in the **curriculum design phase**, actors define content and goals for learning. Education and training—program delivery—take place in the **curriculum application phase**. Labor market outcomes result from this phase as students graduate, then re-enter the cycle in the **curriculum updating phase**.

The CVC concept further allows us to identify the detailed processes in each of the three phases as summarized in Figure 3. The **curriculum design phase** examines the relative decision powers of education and employment actors in defining qualification standards and the form of the examination. Qualification standards are the content and level of the curriculum. The examination form is about whether employers are involved in designing and approving how material should be tested—for example practical or written exams—and where. The design phase also includes involvement quality, which has to do with how many firms are represented and whether firms participate individually or through intermediary organizations like sector or industry associations, who can aggregate information from many individual firms.

The **curriculum application phase consists of six processes**. The first two processes are about the prevalence of workplace training and how well the institutional framework ensures its quality. Workplace training is a key feature of VET, and **students in the best systems**

internationally spend 50-80% of their time in the workplace. This also makes training economically attractive to employers (Hoeckel, 2008). Three further processes capture the involvement of employment-system actors in classroom education through sharing costs, providing equipment, and providing teachers. Sharing costs is about who pays for workplace and classroom training, and equipment and teacher provision are about who supplies the occupation-specific equipment and expert teachers used for training if training is not done at the workplace. Finally, the application-phase process for examinations is not about who decides but about what actually happens: how much of the exam is practical, who is able to grade it, and where it occurs.

Figure 3: KOF EELI phases and processes

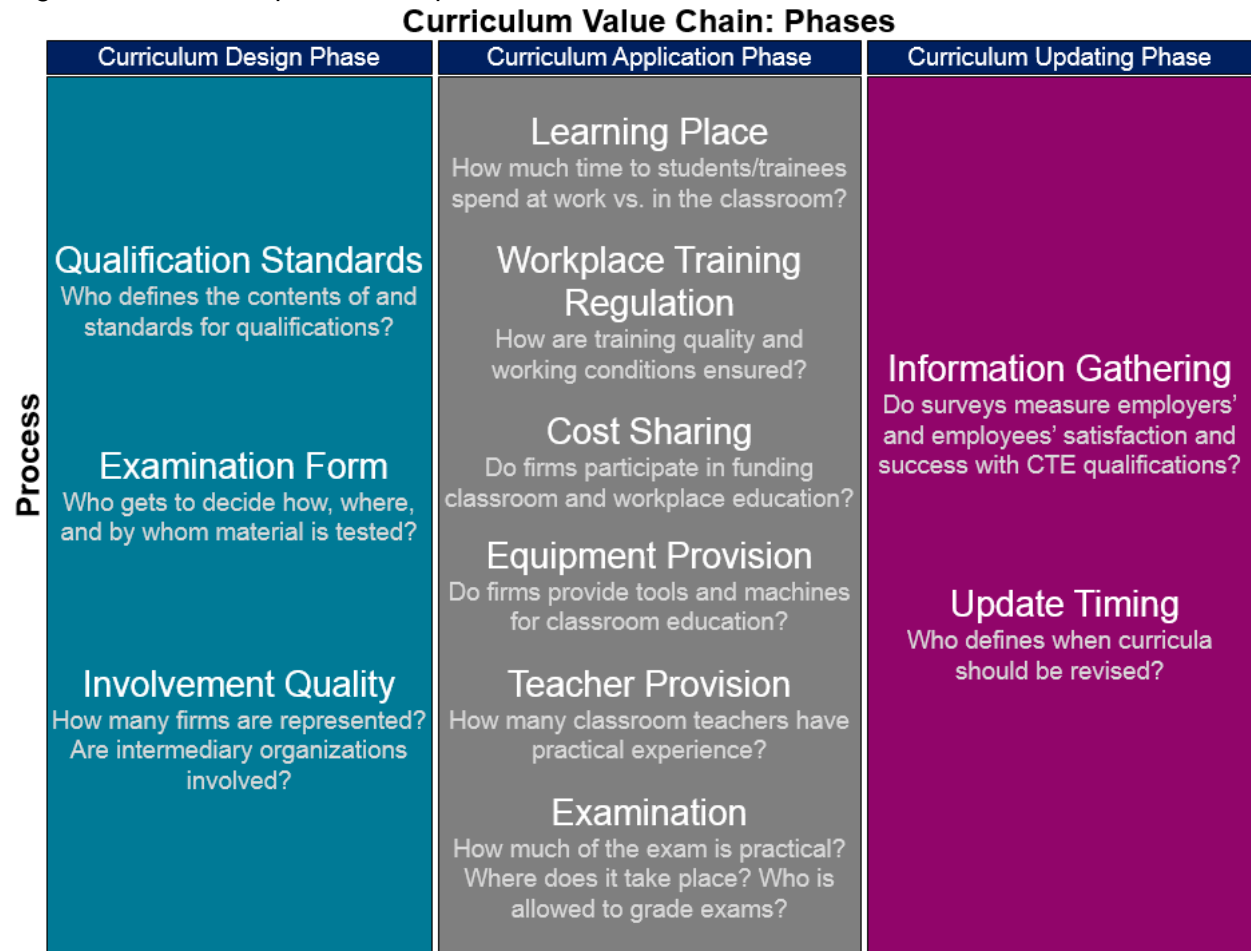


Figure adapted from Volkswirtschaft (Renold & Bolli, 2016)

Finally, the **curriculum updating phase contains two processes**. The first process evaluates whether the necessary data exists to make evidence-based revisions to the curriculum. This is usually in the form of labor force or employer surveys. The second process assesses decision power on when the curriculum is revised: whether employers are the ones to decide it is time.

In order to assess education-employment linkage, we have developed a **survey that measures the features making up each of these processes**. We use responses from experts in the field to aggregate features into processes, then phases, then the KOF EELI. The final result is on a **scale ranging from one to seven**. We need to use a weighting scheme to aggregate but weights are unknown, so we construct weights for each feature, process, and phase by comparing experts'

responses to questions about overall phase linkage compared to their feature-level responses. This enables us to exploit their expert and possibly implicit knowledge on the relative relevance of each feature. The weighting scheme is developed and fully discussed in Renold et al. (2016).

3. Sample & data

The sample for Colorado's KOF EELI is a group of CTE experts and leaders. The KOF EELI is a very detailed survey, so we use high-quality responses from experts to make up for fewer people who are able to complete the questionnaire (see Renold et al., 2016). The KOF EELI is an online survey, sent to 298 experts for 61 complete surveys. Our 20.5% response rate is strong for a detailed online survey, where response rates are typically 10-25% (Sauermann & Roach, 2013).

Respondents were selected based on the criteria that they come from leadership of Colorado CTE governance, coordination, support, and research. The main principle upon which experts are sampled is their familiarity with CTE in Colorado, and the main criteria are:

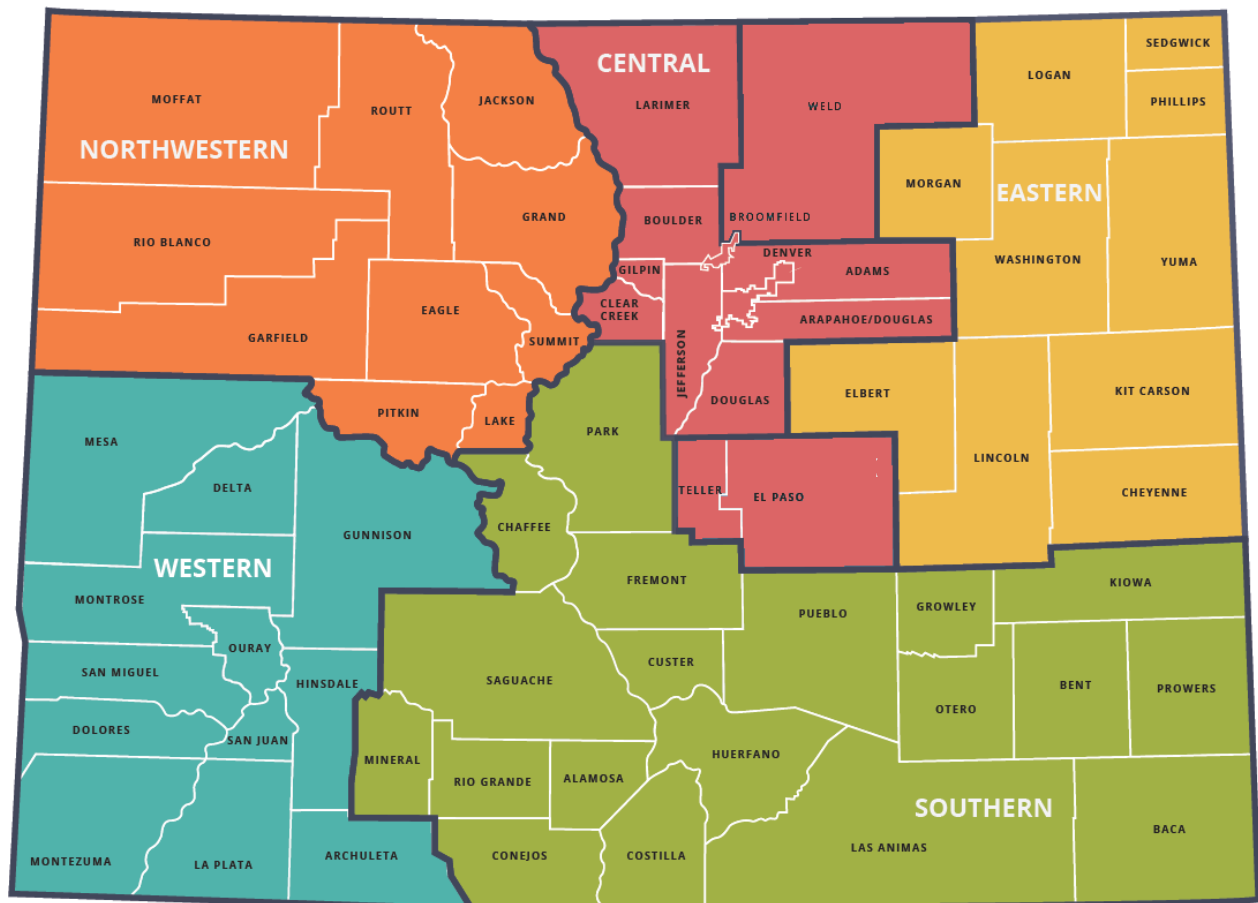
- **State-level & government CTE leaders** from departments of education, labor, workforce development, etc. and the Colorado Community College System.
- **CTE leaders at the district level**, like district CTE coordinators, possibly community colleges in cases with dual enrollment, etc.
- **Intermediaries** like industry and sector associations
- CTE leaders within **support and philanthropic organizations** that help current CTE programs continue to run
- **Researchers** on CTE, workforce development, and the talent pipeline

We do not sample individual CTE teachers or the parents and students involved in those programs. This survey addresses the communication and coordination across education and employment systems, not the functioning of either. Therefore, our focus is on the highest-possible leaders that work specifically on CTE.

For subsample analyses but not the index as a whole, we differentiate among responses on two dimensions: education and employment, and regions in Colorado. The education group are experts in the departments of education, labor, and workforce development. The latter two are included in this group because their primary roles in CTE is part of education governance. Experts from community-based organizations that work on CTE are also in this group. The employment group are experts from industry intermediaries like sector associations, and business-based CTE organizations. Regional groups are based on the Colorado Workforce Development Committee's (CWDC) planning regions, with Weld and Pike's Peak merged with Central to increase sample sizes (see Figure 4). We used data on the location of respondents' organizations to manually allocate responses to regions, and allocated experts operating statewide to a "state-level" region.

Most of the survey recipients were from the education group since that group is much larger in Colorado's CTE programs, and the responses reflect that: 50 responses come from education actors and 11 come from employment actors. The six regions we study are the central (23 respondents), eastern (six respondents), northwestern (two respondents), southern (six respondents), and western (six respondents), plus a group who responds for Colorado as a whole due to the statewide nature of their work and expertise (18 respondents). The number of respondents from each group is similar to our sampling ratios and the populations of those regions.

Figure 4: Colorado regions (lightly modified from CWDC planning regions⁸)



4. Colorado case study

This subchapter describes the education system of the State of Colorado, USA, and in particular the CTE programs at the upper secondary education or high school level. Colorado is a local control state, so its education system consists of 178 autonomous school districts (CASB, 2015; CDE, 2015). These districts have a total of 1,824 schools, 5,092 administrators, 56,947 teachers (CDE, 2015), and nearly 900,000 students (CASB, 2015; CDE, 2015). Together, these districts' budgets exceed \$5.2 billion from local as well as state and federal sources (CASB, 2015).

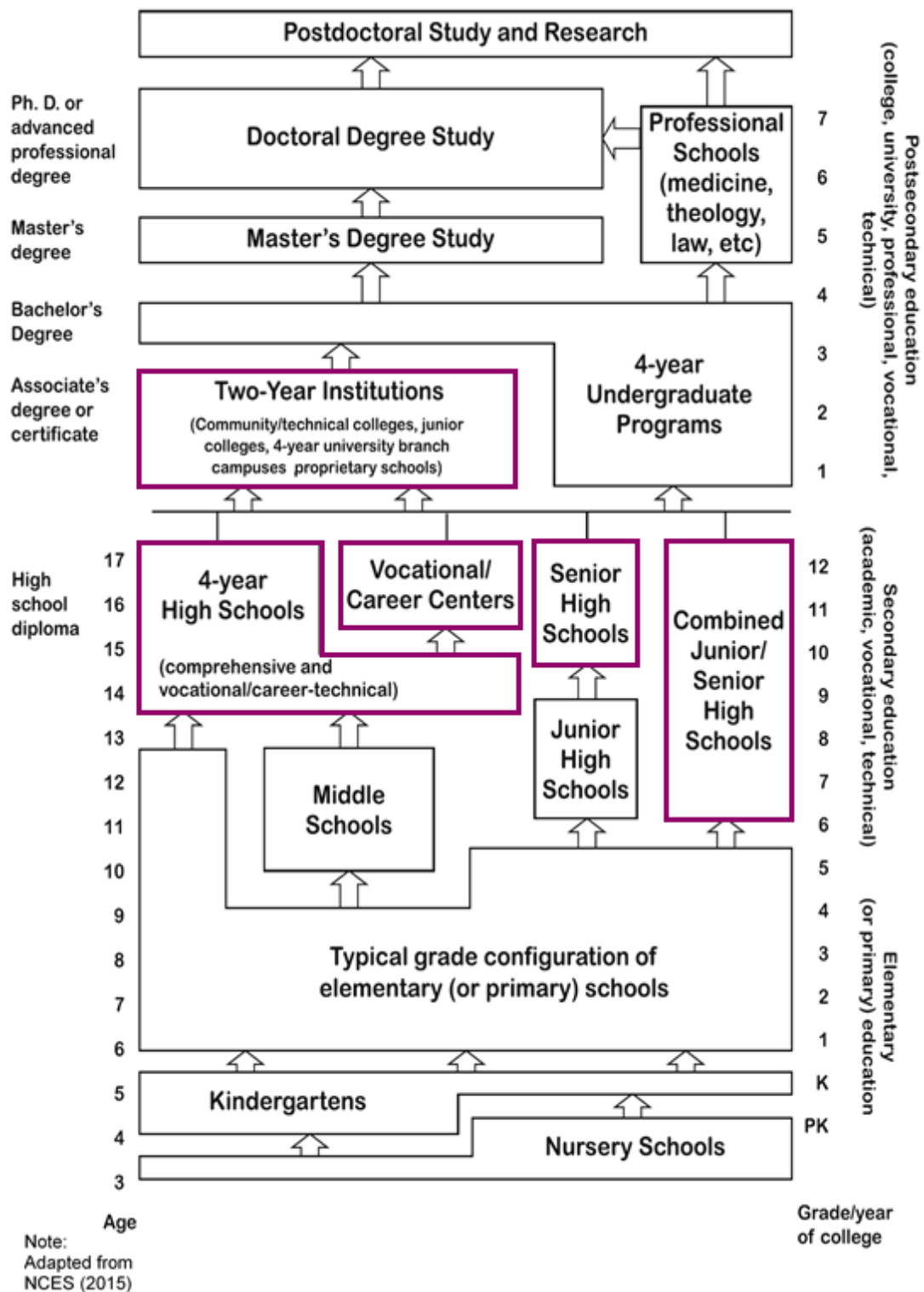
4.1 The Colorado education system

Like the rest of the USA, Colorado's education system consists of three main levels: elementary school or primary, high school or secondary, and postsecondary education including the tertiary level. There are a variety of different configurations in the primary and secondary grade levels, easily visible in Figure 5, which is a diagram of Colorado's school system. Compulsory schooling in Colorado starts at age six or seven in first grade, and ends at age 17.⁹ Before starting elementary school, children can voluntarily attend kindergarten and/or nursery school.

⁸ <https://www.colorado.gov/pacific/sites/default/files/CWDC-PlanningRegions-2016-01-05.pdf>

⁹ Colorado Revised Statutes, Title 22, Article 33 on Education, Section 104 (School Attendance Law of 1963).

Figure 5: Overview of the Colorado education system



The two most common models in Colorado are grades K-5 in elementary followed by 6-8 in middle school and 9-12 in high school, or grades K-6 in elementary followed by 7-9 in junior high and 10-12 in senior high school. There are also six-year combined junior and senior high models or K-8 schools followed by four-year high schools. Four-year and senior high schools represent the upper secondary level. Regardless of configuration, basic education is always 12 grades.

High schools offer general education programs that teach academic content, and many also offer CTE programs and other programs. However, as discussed in section 1.1, none of these programs meet the international definitions for VET. High schools usually deliver multiple programs, but there are also a few specialized schools and institutions that teach only CTE programs (CCCS, 2016a). In the 2014-15 school year, 38.1% of Colorado's high school students were enrolled in CTE programs and courses, while 61.9% of students were taking only general courses (CCCS, 2016a). All students receive a high school diploma upon completion of (senior) high school, which usually affords access to postsecondary education (Raughton, 1997; CASB, 2015).

Table 1: Upper secondary enrollment, 2014-15

Level & Type	Enrollment
High school, general education	61.9%
High school, CTE	38.1%

Source: own calculations based on CDE (2015b) and CCCS (2016a).

High schools in Colorado—and the United States in general (Snyder et al., 2016)—have dropout rates that are not negligible. In Colorado, only 77% of students graduate high school on time. In each cohort, 44% immediately enroll in postsecondary education (CWDC, 2015a).

Postsecondary education in Colorado is provided by various types of institutions. Public two-year institutions include community colleges, junior colleges and technical or area colleges that mainly confer associate's degrees or certificates. Public and private four-year colleges and universities mainly award bachelor's degrees (CDHE, 2016). Entry requirements and the financial burden of attending these institutions can be prohibitive even for students who have the cognitive ability to pursue higher education. Students can transfer from two- to four-year institutions if they meet entrance requirements and their credits are transferrable. Nearly all four-year colleges and universities offer graduate programs leading to master's degrees, and some also offer doctoral studies. A limited number of public two-year colleges also offer specialized master's programs (CDHE, 2016).

For those who desire education and training after high school but not higher education, there is also the option of attending one of the many Private Occupational Schools, approved by the Division of Private Occupational Schools of the Colorado Department of Higher Education¹⁰, which confer diplomas and certificates. Some of the programs offered by these institutions can be significantly shorter than 2 years (DPOS, 2016). The Private Occupational Education Act¹¹ of 1981

¹⁰ Colorado Revised Statutes, Title 12, Article 59 on Private Occupational Schools (Private Occupational Education Act of 1981).

¹¹ Colorado Revised Statutes, Title 12, Article 59 on Private Occupational Schools (Private Occupational Education Act of 1981).

defines the purpose of such institutions as preparing individuals for employment in semiskilled or skilled positions, or as technicians in occupations specified by the Act.

4.2 Focus program: High school Career and Technical Education (CTE)

This section discusses high school CTE in Colorado in more depth. Close to 40% of Colorado high school students enroll in CTE programs and courses (CCCS, 2016a). This is below the OECD average of 46% among upper-secondary students in VET programs (OECD, 2015). High school CTE in the United States is typically school-based vocationally oriented education, though it does not meet the OECD definition of a VET program (see Section 1.1 of this report; OECD, 2004). However, Colorado has been making changes to add more practical content and work-based learning experiences into CTE.

There is also a countervailing tide of reforms aimed at increasing requirements and standards in general education. In 2008, the State Legislature enacted Colorado's "Achievement Plan for Kids,"¹² which mandated revised preschool through high school standards (CDE, 2016). The subsequent Education Accountability Act¹³ requires assessments aligned to academic standards (CDE, 2015c), and the Great Teachers and Great Leaders Act¹⁴ introduced a new system of teacher and principal evaluation (CDE, 2014b). These reform steps attempt ensure students leave high school ready for both postsecondary education and the workforce (CDE, 2014a).

Colorado's Career and Technical Act determines what CTE programs are offered by the state and has narrowed its programs down into six industry-specific career clusters: 1) Agriculture, Natural Resources & Energy; 2) STEM, Arts, Design & Information Technology; 3) Skilled Trades & Technical Sciences; 4) Health Science, Criminal Justice & Public Safety; 5) Hospitality, Human Services & Education; 6) Business, Marketing & Public Administration¹⁵. Students are also encouraged to join Colorado Career and Technical Student Organizations.

Statewide, the guiding principle of Colorado's CTE programs is "postsecondary and workforce readiness," Formally introduced in 2009 by the Colorado State Board of Education and the Colorado Commission of Higher Education (CDE & CDHE, 2016), it is an education policy instrument, revised every six years, that defines readiness and guides all efforts of Colorado's compulsory education system. A work group composed of business and industry representatives, education and higher education actors, non-profit organizations, and representatives from different government sectors identify relevant skills, and the Colorado Department of Higher Education, Colorado Department of Education and the Colorado Workforce Development Council approve it. The current definition of readiness is as follows: "Colorado high school graduates demonstrate the knowledge and skills (competencies) needed to succeed in postsecondary settings and to advance in career pathways as lifelong learners and contributing citizens" (CDE & CDHE, 2016, p. 1).

Colorado CTE programs are clearly defined and have specific approval requirements. Programs seeking funding under the Colorado Technical Education Act must go through the Colorado Community College System CTE Program Approval Process and work with a Technical Advisory Committee to plan their program and curricula. Program lengths vary but must be at minimum

¹² Colorado Senate Bill 08-212 (2008).

¹³ Colorado Senate Bill 09-163 (2009).

¹⁴ Colorado Senate Bill 10-191 (2010).

¹⁵ http://www.coloradostateplan.com/wp-content/uploads/2016/03/CTE_2016_FACT_SHEET.pdf

equivalent to one academic year of 120-180 hours, and must provide work-based experience, though the amount is not specified and is often very small. An approval process should ensure that programs and training facilities are safe and appropriate, anti-discriminatory, and include certain core academic standards. Instructors are required to have specific CTE credentials. Programs are evaluated on criteria designed to provide a framework of continuous improvement¹⁶.

Key CTE actors: Colorado, USA

The state-level CTE landscape in Colorado is characterized by multiple agencies fulfilling often-overlapping roles. The primary body responsible for CTE is the Colorado Community College System, with the Colorado Department of Education also critical for its role in overseeing the high schools where CTE takes place. Education and governance actors are the main players, with industry-side and employment actors in advisory roles. Individual school districts bear ultimate authority for much of what students actually experience, though they are not represented here as they are not statewide actors.

Colorado Community College System (CCCS) and State Board for Community Colleges and Occupational Education (SBCCOE)

The SBCCOE governs the CCCS and supports CTE by coordinating public secondary and postsecondary institutions for quality programming, efficient delivery, statewide policy optimization, and funding regulation and administration. Its Rules and Regulations govern the distribution of funding through the Career and Technical Act, and it approves districts' CTE programs. Its nine members are appointed by the Governor with approval from the Colorado Senate.

The CCCS president and state CTE director within the CCCS are responsible for administering SBCCOE policies. It does this by working with the relevant state and local agencies (CCCS, 2016b).

Colorado Department of Education (CDE) and State Board of Education

The State Board of Education exists to provide guidance on all types of education issues to Colorado's locally controlled districts. It directs the CDE, which is its administrative arm (CDE, 2015a).

The CDE is responsible for all students including CTE students, with the mission to "ensure that all students are prepared for success in society, work, and life by providing excellent leadership, service, and support to schools, districts, and communities across the state" (CDE, 2015a, p. 3). The CDE is a service agency that supports local entities with "leadership, resources, support, and accountability" (CDE, 2015a, p.4) by managing licensing, accreditation, and state-level leadership issues.

Technical Advisory Committees

Every approved CTE program has its own technical advisory committee to assist with curriculum design, application, and updating. Committees are made up of people with experience or expertise in the program's field and their role is to advise educators (CCCS, 2016b, p. 22).

Colorado Workforce Development Council (CWDC)

The CWDC was first founded under the federal Workforce Investment Act of 1998. The CWDC is responsible for working with the governor and legislating bodies to identify workforce investment opportunities, possible partnerships for job creation and align the skills and training of the Colorado workforce with job opportunities. The CWDC presents the Talent Pipeline Reports to the Colorado State Legislature, which describe the occupations and skills in highest demand and training strategies with

¹⁶ <http://coloradostateplan.com/administrator/administrators-handbook/>

positive outlooks for the future of workers in Colorado. In short, it assesses how education and job training in Colorado is keeping with the economic situation and in-demand jobs and industries. So far, Talent Pipeline Reports have been released for 2014, 2015 and 2016.

Colorado Department of Higher Education (CDHE)

The CDHE oversees policy and state resources for public and private higher education institutions and loan programs. For CTE, the CDHE has policies and resources for the CCCS and CTE programs that include dual enrollment leading to associate's degrees (CCCS, 2016b).

Colorado Department of Labor and Employment (CDLE)

The CDLE is primarily focused on supporting Colorado's adult workforce through development, employment, and training centers including workforce development centers. The most important function of the CDLE for CTE is producing Labor Market Information¹⁷.

Office of Economic Development and International Trade (OEDIT)

OEDIT is involved in promoting innovation and ensuring Colorado's highly skilled talent pipeline. Its most relevant roles for CTE are administering training grants and identifying workforce needs¹⁷.

Board Designated Oversight Committee for Credentialing (BDOC)

The BDOC supports CTE by providing qualified instructors. It does this by determining, enacting, and updating credentialing standards for CTE teachers and instructors (CCCS, 2016b).

Industry & Professional Associations

Various associations are involved in CTE through Technical Advisory Committees and other advisory roles. CTE instructors are also encouraged to be involved in the relevant association for their field, which includes the Colorado Association of Career and Technical Education (CCCS, 2016b).

Colorado Department of Human Services (CDHE)

The CDHE is responsible for programs that help low-income adults, disabled adults, and seniors attain skills for work. Some of the CDHE's programs overlap with CTE, and all are part of the talent pipeline¹⁷.

Colorado Department of Corrections (CDOC)

The CDOC provides education and training to incarcerated youth and adults. Its programs overlap with CTE and are part of the talent pipeline¹⁷.

4.3 Financing CTE

The main sources of funding for CTE in Colorado are federal, state, and local governments. The Carl D. Perkins Career and Technical Act provides federal funding to CTE programs that meet its criteria, and all of Colorado's local education agencies are eligible (CCCS, 2016b). The state funds CTE through the Colorado Technical Act (CCCS, 2016b). However, the proportion of CTE funding covered through that law has decreased over time to just over a quarter of total CTE spending, or \$24 million in 2015 against total reported expenses of \$97 million¹⁸.

¹⁷ <https://www.colorado.gov/pacific/atom/4126>

¹⁸ <http://coloradostateplan.com/>

4.4 Colorado's CTE programs through the CVC

CTE in Colorado is designed, enacted, and updated almost exclusively by education-system actors. Employment-system actors are frequently included in CTE as advisors, donors, or hosts for workplace visits, but do not have power or the capacity to make and enact decisions. We briefly describe the statewide process in each phase.

4.4.1 Curriculum design

Colorado's career clusters and pathways are each defined based on Colorado Technical Content Standards. The standards are "developed through efforts of secondary and postsecondary instructors and validated by business and industry representative[s]" (CCCS, 2016b; Sec. 3.06 (a)). Industry validation takes place through volunteer advisory committees or councils. However inclusive the intentions, respondents to the survey overwhelmingly indicate that this type of validation is a *post hoc* formality, and more about a sign-off than actual decision power or participation in the standards' development process.

Alignment to academic standards is a priority in Colorado because of district standards and Perkins funding requirements that content be aligned. All CTE pathways must meet Colorado Academic Standards in addition to any CTE goals. Specific CTE courses are designed at the local level with career pathway standards, and students can take one or more courses in a given pathway. Local courses and pathways are approved by the CTE team at the Colorado Community College System¹⁴. This entire process takes place within the education system. Education-system actors are right to pursue general content, but in VET programs employment-system actors should be able to counterbalance that by pushing for occupation-specific skills. Without employment-system actors having a strong and systematic voice—as survey respondents indicate they generally do not—there is great risk for an overabundance of general content taking away from occupational skills.

4.4.2 Curriculum application

Colorado's high school CTE programs are taught in local schools and are primarily school-based. Funding incentives and program requirements specify that students should have at least some workplace learning experience if they pursue a CTE pathway, but these experiences vary greatly among localities. The most common forms of workplace learning are internships and job shadowing. Typically these are all very short—no more than a few months over summer vacation—and not paid or carried out according to specific learning objectives.

Colorado is home to 1,306 separate CTE programs in 147 public school districts and a number of specialized institutions¹⁴, so the level of workplace learning is widely diverse across the state. Again **all processes in this phase take place within the education system with only token involvement from employment**, preventing Colorado's CTE from being a system that can serve its students, workforce, employers, and state economy.

4.4.3 Curriculum updating

Colorado's CTE curriculum development process does not include explicit requirements for updating. Information is gathered and distributed through instruments like the Colorado Workforce Development Council's Talent Pipeline Report (TalentFOUND, 2016). However, there is not a clear architecture for out-of-date curricula to be updated or for employers to express their wish for changes to CTE curricula as technology and labor demand changes. **Without an employer role**

in this phase, even the best curricula will quickly be out of date and mismatched to labor market skills needs on the part of future employees and employers.

There are many bright spots at the local and regional levels in Colorado's CTE programs that hint at some areas with higher education-employment linkage than the statewide average. However, it is nearly impossible to enumerate all of the programs, efforts, and relationships involved in this non-systematic approach. In the end, students are offered enhanced CTE experiences but not a CTE certification that can act as a strong signal on the labor market. In the next section, we describe the results of the KOF EELI for Colorado.

Bright spots: Examples of efforts to improve CTE in Colorado

Colorado has weak education-employment linkage overall, and CTE stakeholders in the state understand that there is a problem. There are a large number of local, bottom-up, relationship-based, or single-population efforts throughout the state. However, they are not enough to make Colorado's CTE a system that can offer young people permeable, interconnected programs recognized by businesses and education authorities statewide with no dead ends. That does not invalidate the effort and energy put into these bright spots, instead highlighting the importance of taking a system-level perspective as we do here. By understanding the statewide goals and challenges, Colorado can take advantage of and build upon these existing bright spots.

The following are examples of the efforts already underway in Colorado:

Schools, districts, and workforce development

Colorado's **Workforce Development centers** are working with the **Colorado Department of Education** on shared positions and targeted planning for supporting greater youth engagement and improving outcomes. Workforce is part of a dual credit approach for education and work-based training experiences during summers (Elise Lowe-Vaughn, CDLE-Workforce Development).

In **Mesa County Schools**, the district awards 400 ACT NCRC work-ready certificates annually. Students have access to vocational training through the Career Center and KICCC. At KICCC, students can work towards a certification that can create future job opportunities while they are earning college and high school credit (Andrea Bolton & Matthew Diers, Mesa County Valley School District 51).

The school-workforce-employer partnership in Mesa County is firmly established through the **ACT Work-Ready Community Initiative**. There is an active partnership between the workforce development board, school board, and employers because of WRC (John Flanagan, Mesa County Workforce Center).

Denver Public Schools has a number of programs to support CTE and include employers. The **CareerSpark** program starts STEM exploration in middle school. Work-based learning is promoted through **CareerX** in 9th grade. In 10th grade, the **CareerCoach** program has connected 95 students with mentors. In the 11th and 12th grades, **CareerLaunch** has 212 students in internships (Sam Haviland, DPS).

Intermediaries, philanthropy, and non-profits

Skillful is supporting companies in creating better pathways for skilled adults. Employers are taking the training from Skillful, making it their own, and turning it into action in their own companies, especially in manufacturing (Andi Rugg, Skillful).

As part of a partnership between the community, K-12, higher education, the **Vail Youth Foundation**, **Eagle County Schools**, and **Colorado Mountain College**, increased career exploration is being funded through the Vail Youth Foundation in coordination with 20 businesses and Eagle County. The goals are observation and future internships, with Colorado Mountain College offering dual credit for internships.

Colorado's **healthcare sector partnership in the Central region** is now partnering with youth organizations to include non-profits. Education and workforce are beginning the conversations around apprenticeships and pre-apprenticeships for youth aged 16-24 (Kelly Folks, State Youth Council).

In the **Southeast** region, there are two active sector partnerships—one in Advanced Manufacturing and one in Health Care. Both partnerships are well represented by employers and led by business. In the **South Central** region, workforce has developed good relationships with area schools, we provide job skills, job readiness classes, mock interviews, and career exploration workshops (Betty Velasquez, CDLE).

Employers, unions, and chambers of commerce

In **Southeast Colorado**, Manufacturing representatives in the La Junta area already meet monthly and have engaged with CareerWise. Healthcare stakeholders are also meeting monthly and inviting school district representatives to those meetings (Jody Sniff, Las Animas School District).

The **bank in Las Animas** recruits apprentices each year from the high school and helps pay for college classes. They also come talk to our 5th/6th grade and give them a tour of the bank. Also in that area, a **local nursing home** pays for CNA classes for high school student (Jody Sniff, Las Animas School District).

Colorado's **healthcare sector partnership in the Central region** is now partnering with youth organizations to include non-profits. Education and workforce are beginning the conversations around apprenticeships and pre-apprenticeships for youth aged 16-24 (Kelly Folks, State Youth Council).

AFL-CIO Training Directors are meeting with teachers and counselors in various school districts to spread the word on an alternative career path through the apprenticeship programs. Pre-apprenticeship programs are already in place.

The **bank in Las Animas** recruits apprentices each year from the high school and helps pay for college classes. They also come talk to our 5th/6th grade and give them a tour of the bank. Also in that area, a **local nursing home** pays for CNA classes for high school student (Jody Sniff, Las Animas School District).

The **Grand Junction Chamber of Commerce** is meeting with businesses in Mesa County to convince them to be apprenticeship locations (Dennis Bailey-Forgnier, Western Colorado Community College).

5. Results

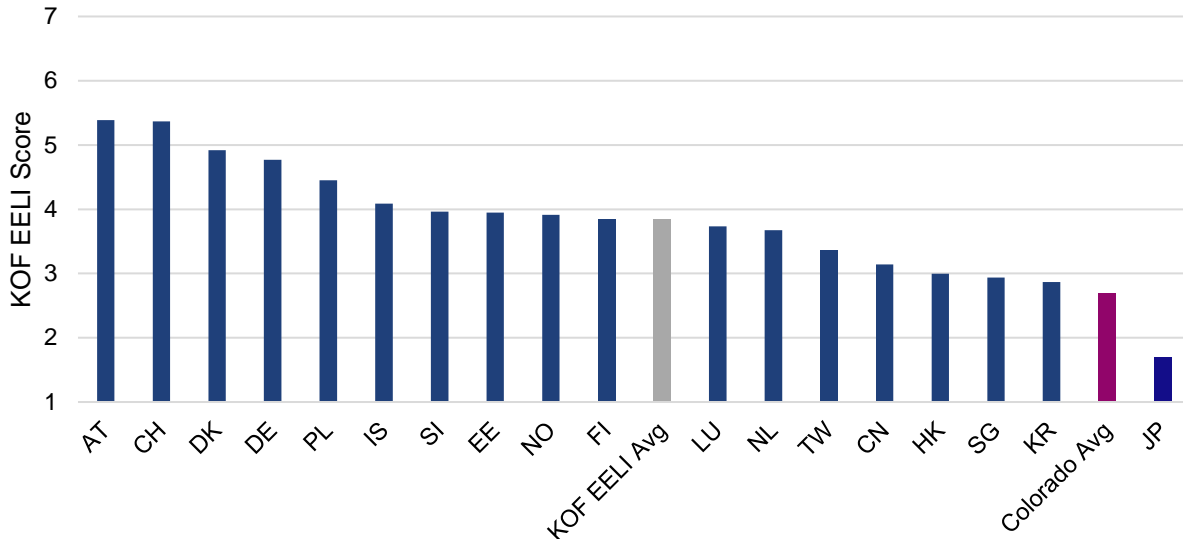
Colorado's actors from education and employment are not strongly linked. While there are many instances of schools and employers interacting and even cooperating, none of these relationships constitutes a system or VET. The most notable statewide cooperation for policymaking is the multi-stakeholder group that meets to define postsecondary and workforce readiness, but even that is ultimately up to actors primarily from the education system. That and the many small connections between education and employment at the local level demonstrates willingness on the part of Colorado's employers and educators to engage in linkage, but the current situation lacks systematic education-employment linkage.

Colorado's total KOF EELI score is 2.69 in a one- to seven-point range, meaning that education and employment are very poorly linked. In the initial 18-country run of the KOF EELI, the average score among national VET programs is 3.78. Figure 6 shows Colorado's position in the original 18 KOF EELI countries. Colorado is far below average. Like Colorado, the VET systems at the bottom of the distribution are isolated from the demands and contributions of industry. The lack of linkage between Colorado's education and employment systems for CTE is well understood; when surveyed experts were asked to rate overall linkage subjectively instead of through the index, they scored Colorado even lower at 2.60.

The highest-scoring countries are Austria and Switzerland at 5.37. We will use **Switzerland as the top-performer benchmark** in this report since it is the highest scoring country with sufficient depth of data (see Renold et al., 2016 for more information). Note that the countries in the original KOF EELI sample were selected as global top performers for VET or general education. Half have

strong performance on PISA tests¹⁹, and the other half have strong youth labor market outcomes according to the KOF YLMI (Renold et al., 2015). The KOF YLMI includes young people’s working conditions, education levels and appropriateness, and the smoothness of their transitions from school to work as well as the traditional measures of their activity in the market.

Figure 6: Colorado in the context of international KOF EELI scores



As mentioned earlier, the KOF EELI is correlated with the KOF YLMI, suggesting that better education-employment linkage is related to better youth labor market outcomes. We find the countries selected for their KOF YLMI scores near the top of the KOF EELI distribution and those selected for their PISA scores closer to the bottom. Colorado youth struggle somewhat on the labor market²⁰, but we cannot estimate its KOF YLMI score as the data is not currently available at an internationally comparable level. Based on international evidence, Colorado’s weak linkage between education and employment for high school CTE is not helping its youth labor market.

5.1 Descriptive results

Colorado’s three phase scores are all close together, much like the KOF EELI average and the top performer benchmark country, Switzerland. We present Colorado’s KOF EELI scores and include examples of bright spots—places and programs where employers are engaged in CTE at local and single-institution levels—from a panel of diverse stakeholders across Colorado.

Table 2: KOF EELI phase scores for Colorado, KOF EELI average, and Switzerland

	Colorado Average	KOF EELI Average	Switzerland
Curriculum Design Phase	2.78	3.94	5.32
Curriculum Application Phase	2.65	3.52	5.49
Curriculum Updating Phase	2.68	3.87	5.25

¹⁹ <https://www.oecd.org/pisa/> The PISA-selected countries are CN, SG, HK, KR, JP, TW, FI, EE, PL

²⁰ <http://opportunityindex.org/#4.00/40/-97/-/Colorado>

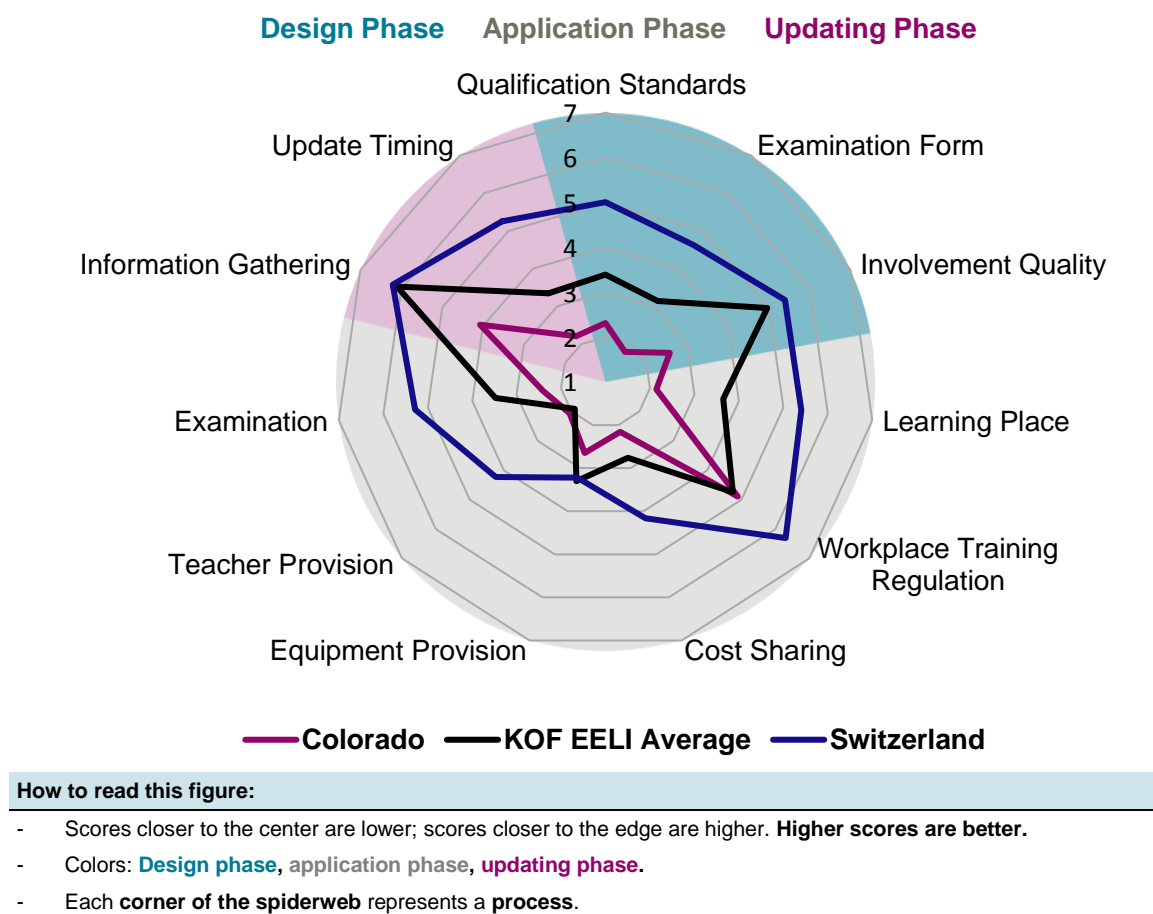
The weakest phase-level score is the application phase at 2.65, with the updating phase close behind at 2.68 and the design phase very slightly better at 2.78. The average scores roughly a point higher in all three phases, and Switzerland is 2.5 to three points higher in all three phases. These are large differences.

The KOF EELI also captures the specific processes involved in each phase, and the features of those processes. Figure 7 shows Colorado's process scores, and compares them to the KOF EELI Average and Switzerland benchmark. All process and feature scores are shown in Table A1 in the appendix.

5.1.1 Design phase

There are three processes in the curriculum design phase: setting qualification standards, deciding on the form of examinations, and one process measuring the quality of employers' involvement. **Colorado's score in the design of qualification standards is low at 2.31**, below the average score of 3.39. Notably, Switzerland is far away in this process at 5.00, which suggests it is a feature of the best VET systems if not the average system. Employer power and voice in designing and finalizing qualification standards ensures that students learn labor market-relevant skills and balances the influence of the general-skills-focused education system actors. Colorado employers are not strongly involved in creating curriculum content and equally unlikely to have a vote in the final decision to enact a particular curriculum.

Figure 7: Colorado's process scores compared to the KOF EELI Average and Switzerland



Colorado's lowest process score in the design phase is 1.80 for the design of the examination form, a process which describes how and where final certification exams should be. Colorado is far below the KOF EELI average's 3.15 and again far below the top-performing benchmark at 4.63. An employer voice in the examination form ensures that it measures skills in a manner that employers can accept when using the final qualification as a signal to hire graduates. Determining how students should be tested on their mastery of practical and theoretical knowledge and skills is even more strictly reserved for education actors than deciding on the curriculum. The very low scores for employers' involvement in designing qualification standards or examinations is evidence that employers do not have a strong formal role in Colorado's CTE programs.

Colorado's score for involvement quality is slightly higher at 2.57, but the average is also high at 4.96 and Switzerland reaches 5.39. The lowest- and highest-scoring features in the design phase are both in this process: the lowest feature score is about the purpose of CTE and the highest is about the opportunities that firms have to engage with education. Instead of preparing students to enter the labor market in an occupation, Colorado's programs are more likely to focus on single-firm jobs or on college and career readiness together. A jobs focus limits graduates' labor market mobility and a failure to focus undermines quality. In contrast, Colorado's employers are welcomed into CTE cooperation however they choose—individually or through employer associations. This openness is a strength that is undermined by Colorado's ambivalence toward occupational preparation. **Interest and access is there for both students and firms, but the content and quality of CTE is limited by a misunderstanding of its purpose and value.**

5.1.2 Application phase

The application phase has six processes. **Colorado has very little workplace learning, reflected by its learning place score of 2.14.** The average is 3.65 and Switzerland's very strong 5.40. Workplace learning not only matches trainees' skills efficiently to the needs of industry, it also enables employers to earn back some or all of their investments through the productivity of trainees and saved recruiting costs. Colorado's firms are given few opportunities to recoup any costs they might incur in supporting CTE—shown in its low score for the learning place process—so employers have very little incentive to invest. There is no legal definition of how much workplace training students should do, and no system for site visits to firms when students do not have the opportunity to train in the workplace.

Colorado's highest score out of all processes is 4.90 for workplace training regulations. This is slightly above the 4.75 average and much closer than usual to Switzerland's 6.31. Regulations balance the power of employers, preventing exploitation of trainees as cheap labor. The features of workplace regulations are legal requirements for and about trainers and curricula in the workplace. Students are given contracts and there is a curriculum that is implemented when they train in the workplace. Workplace trainers are not always required, but when they are they must continually update their skills and have some kind of certification. These regulations are a strength for Colorado, and can enhance the quality of CTE as it begins to improve and move towards a systematic approach.

Colorado's cost-sharing score is typically low at 2.16, not far from the average at 2.76 and below Switzerland's 4.16. Cost sharing is employers' contributions to bearing the costs of training either in classrooms or the workplace. When systems do not include workplace training, then employers should bear some of the classroom training costs of practical and occupation-specific skills so

they maintain the right to demand those skills be taught. Workplace training eliminates the need for direct investments on the part of employers since they will be bearing workplace training costs automatically. Colorado scores low on both features, meaning **employers are contributing neither to classroom nor workplace training costs on a systemic and sustainable level**. Given that employers have very little power to advocate for practical and occupation-specific skills during the design phase, it makes sense that the education system should bear most of the costs. If either party wants to move towards VET, both content and investments will need to change.

For equipment and teacher provision, Colorado scores 2.65 and 2.06. Switzerland is also relatively low with scores of 3.22 and 4.24 in those processes, as is the KOF EELI average scores 1.91 and 3.48. This result hides some subtlety that is worth exploring: teacher and equipment provision are not necessarily requirements in systems with a lot of workplace learning because employers invest directly by paying the salaries of their apprentices and their trainers and sponsoring use of equipment and materials. However, they are important opportunities for linkage in systems where employers do not host trainees—they can act as substitutes for workplace learning to a certain extent. **Providing industry-standard equipment and expert classroom teachers are opportunities for employers to participate in CTE without entering into a dual VET model, but in Colorado neither alternative is the case.**

Finally, the role of employers in examining students—by providing expert examiners, space, or materials—is the last process of the application phase and the last opportunity for education to offer up some of its power in exchange for a higher-quality system that matches the needs of the local labor market. In Colorado, this opportunity is again not taken and Colorado scores 2.41, below the average score of 3.48 and far below the benchmark of 5.29. Colorado is closest to the KOF EELI average in the application phase, but furthest from Switzerland. This implies that Colorado's challenges are not unique but they do separate CTE in Colorado from the best VET programs internationally.

5.1.3 Updating phase

The final phase is curriculum updating, which entails processes for information gathering and the timing of an update. **Colorado, like the KOF EELI average, is especially strong at information gathering with a score of 4.07**. Many governments feel comfortable collecting information on employer and labor force surveys to understand labor demand, trends, and needs. Colorado does well, but could do slightly better as it still trails below the KOF EELI average of 6.11 and the Swiss score of 6.21 in this process. This is an opportunity for Colorado to grow on a strength instead of addressing a weakness.

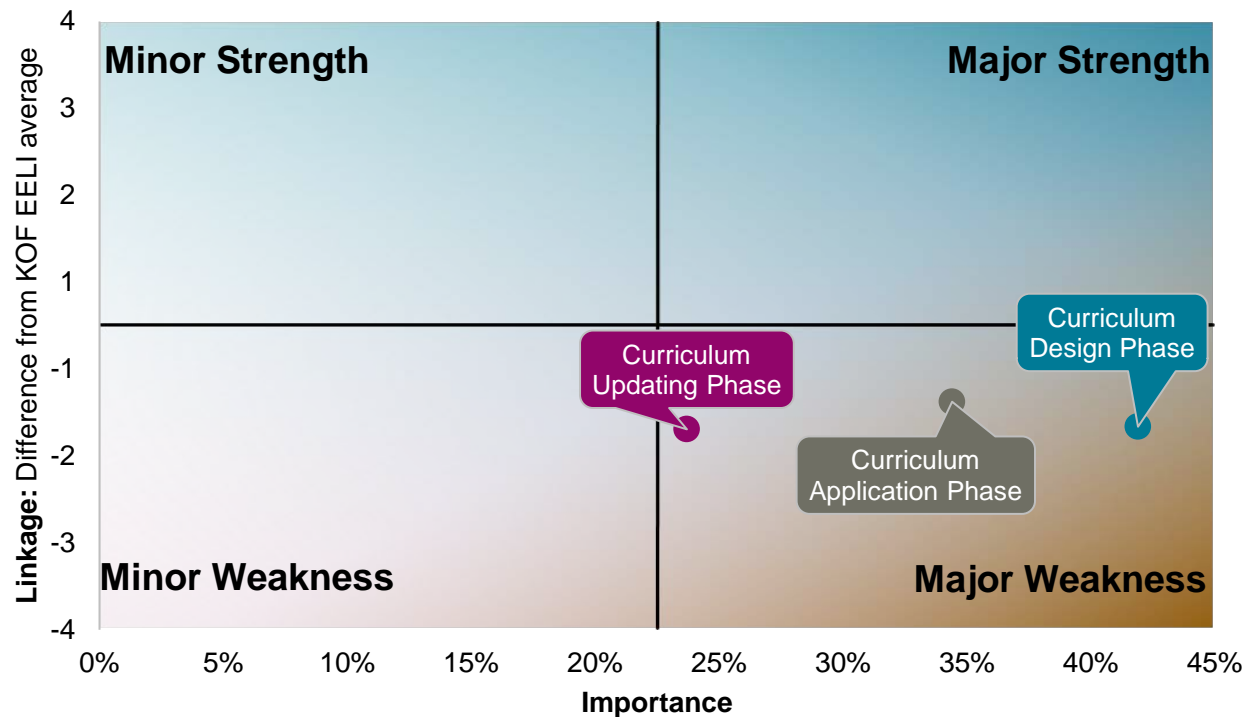
Update timing is the employers' ability to decide when an update should take place and initiate the updating process. This role is especially important for linkage because it helps address the information asymmetry between education and employment. Employers know far before educators when the skills in a given VET or CTE curriculum are no longer sufficient on the labor market. Unless they have power in the process, updates will always come too late. Unfortunately, Colorado scores very low for linkage in this process at 2.21, which is below the KOF EELI average at 3.34 and far below the top performers represented by Switzerland's 5.25. Overall, the updating phase tells two clear stories: **employers are asked to provide information on their needs and the current status of the labor force, but not given any power to update curricula when necessary.**

5.2 Priorities and critical scores

The KOF EELI includes weights for each phase, process, and feature, derived endogenously from the initial 18-country application of the index by using regression analyses of respondents' overall weighting of each CVC phase and specific scores (see Renold et al., 2016). The weights describe which parts of linkage are the most important, enabling us to prioritize the many scores and findings generated by the survey. In this section, we look at the **phases, processes, and features that Colorado should prioritize as it moves forward**; the aspects of VET systems that have the heaviest weights and lowest scores simultaneously. All scores and weights are available in Table A1 in the appendix.

The figures in this section show Colorado's KOF EELI scores in the contexts of how important the phase, process, or feature is and how far above or below the 18-country average Colorado's score is. This shows where the most important strengths and weaknesses are for Colorado, taking into account that strong international VET systems do not have perfect scores throughout the KOF EELI. The purpose of this section is to explore priorities for improving CTE in Colorado.

Figure 8: Critical KOF EELI phases for Colorado



How to read this figure:

- Scores closer to the bottom are lower relative to the international average, so **higher points are strong points** for Colorado. They are also the points where Colorado is outperforming the 18-country KOF EELI average.
- Weights to the right are heavier, so **points on the right are more important**.
- The most relevant quadrants are the **top right** (Major Strengths) and the **bottom right** (Major Weaknesses)
- The less relevant quadrants are the **top left** (Minor Strengths) and the **bottom left** (Minor Weaknesses)
- Colors: **Design phase**, **application phase**, **updating phase**.

When scores are in the bottom right quadrant, they are major weaknesses, making them plausible high-priority phases. The top right quadrant is for major strengths that Colorado can build upon as it improves. The left side of the graph is minor strengths and weaknesses, where successes and struggles are less important and unlikely to be priorities in the first phases of improvement. Each graph is scaled to improve readability; the highest weight shown on the x axis is close to the highest weight of any KOF EELI element at the given level.

5.2.1 Critical phases

In Colorado, **all three KOF EELI phases fall into the “major weakness” quadrant.** Given that the overall KOF EELI score for Colorado is also quite low, this is not surprising. It should also not be discouraging—the current state of the system is well known to Colorado’s policymakers, employers, parents, and educators. This survey has been undertaken to provide more information on exactly where the weak spots are, so the great effort and multiple projects aimed at improving CTE in Colorado can be effective at improving linkage and success for young people. We next look into the processes and features to learn more about where to start and focus effort.

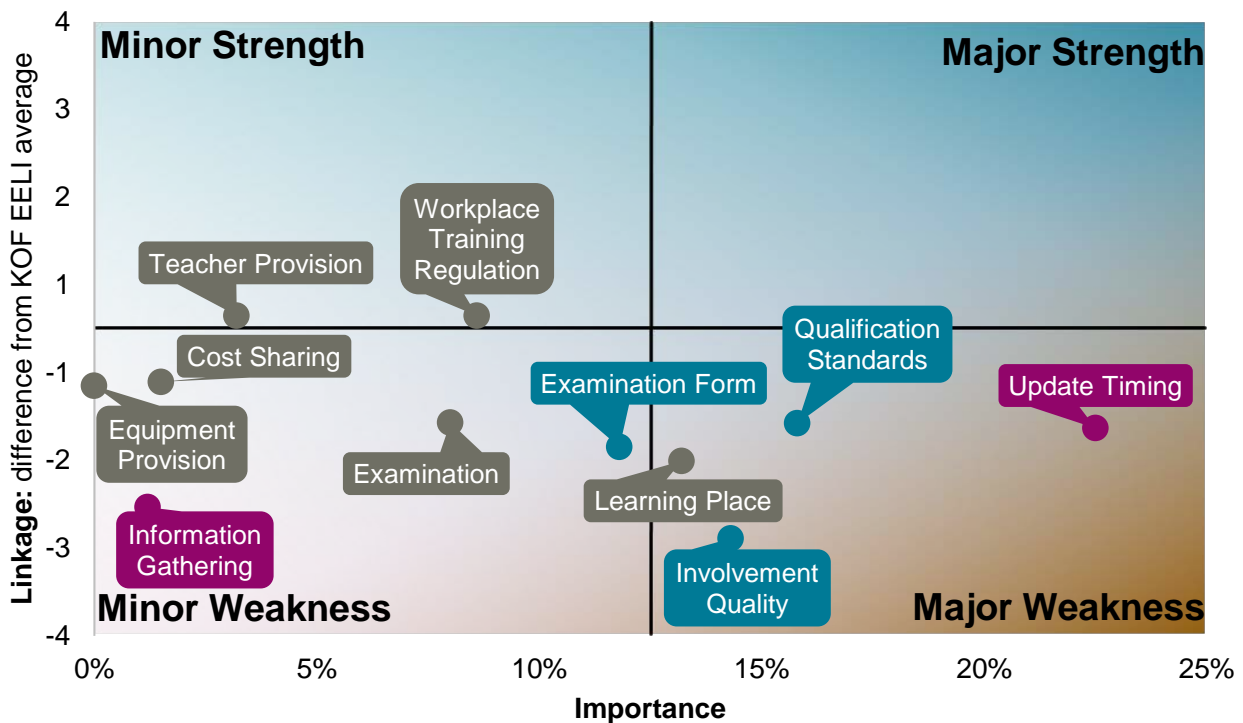
5.2.2 Critical processes

Processes are large enough to be clearly understood but small enough to be actionable. Figure 9 plots the weights of each process against Colorado’s KOF EELI scores’ differences from the 18-country average. There is more diversity in points’ locations on the graph for processes than phases. Most are still in the low-scoring bottom half, but the processes of teacher provision and workplace training regulation in the application phase are very close to the KOF EELI average. These are strengths of the current system and should be reinforced as changes are made. Also in the application phase, cost sharing and equipment provision on the part of employers are both close to the KOF EELI average, though neither is very important.

There are a number of very low-scoring processes in the bottom left of the graph, but these have very low importance and are therefore not the first points of intervention. Though information gathering in the updating phase and employers’ participation in examinations during the application phase, look dire, they are not important enough to justify immediate action. Employers’ design-phase voice in deciding on the form of qualification examinations is also in this quadrant, but is close enough to the purely illustrative cutoff that it is worthwhile to include a larger role for employers in this process in upcoming changes.

The most important processes for immediate intervention are those in the bottom right “major weakness” quadrant: processes that are very important but currently score below the average. We will discuss these in ascending importance. Learning place is the most important application phase process, and its score is low because there is very little workplace learning in Colorado. Adjusting this feature alone would be enough to qualify Colorado’s CTE as a VET program according to the international standard (OECD, 2004). The next two processes are in the design phase: the quality of employers’ involvement and employer engagement in designing qualification standards. Again, these are clearly upheld by the recommendations of international research bodies and clearly important for strong VET systems. Finally, employer power in deciding on the timing of curriculum updates is the most highly-weighted process and has a low score in Colorado. The best CTE program in the world will quickly be out of date if it does not include processes for updating led by the demand of employers.

Figure 9: Critical KOF EELI processes for Colorado



All of the scores for these “major weakness” processes are quite low and their critical status—accounting for approximately 13-22% of the total KOF EELI score each—makes them necessary changes if Colorado is to improve its education-employment linkage and thus its CTE. All of these critical processes are areas where **employers will need to be given formal roles, responsibilities, and power as partners in CTE.**

5.2.3 Critical features

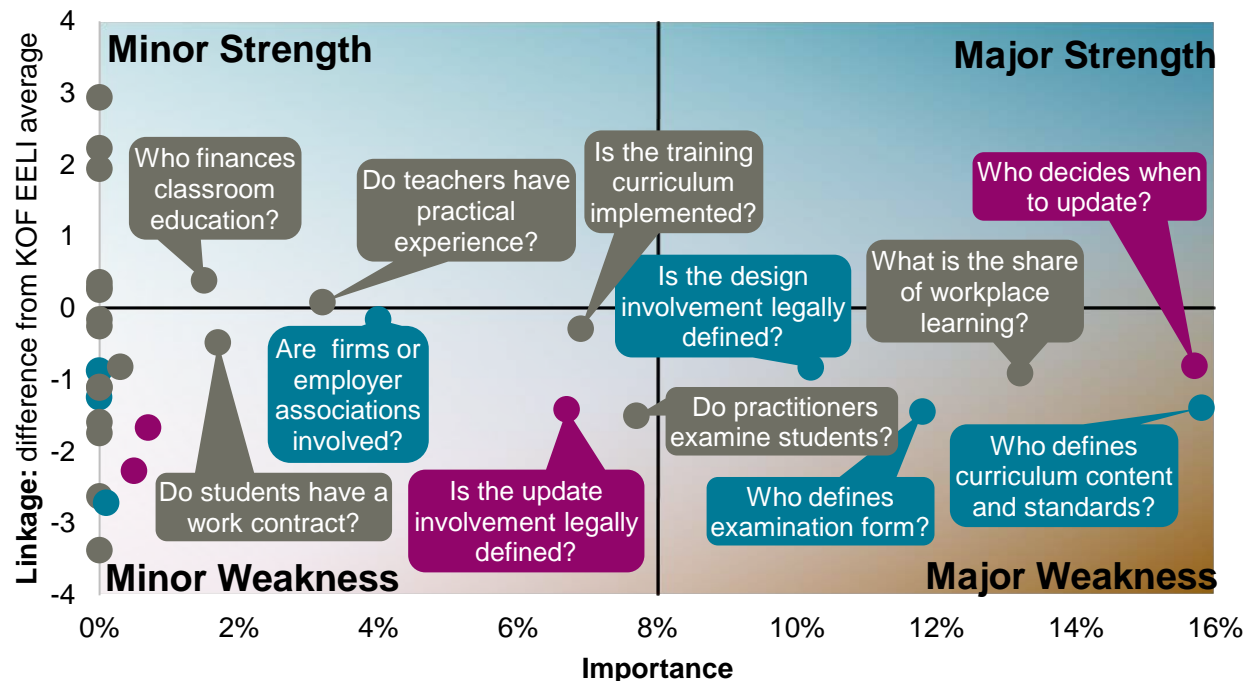
Finally, we will briefly discuss a few critical features. These can be very granular, but looking at the highly-weighted features lets us focus on the most important ones. Figure 10 shows the relationship between scores and feature weights, and there is a **clear pattern of more important features having lower scores**. There are no features at all in the top right “major strength” quadrant and many on the left side for irrelevant features. There are a number in the bottom right “major weakness” quadrant.

The features in the top half and middle of the chart are areas where Colorado is doing well or similar to the KOF EELI average. For application-phase features about classroom education financing, work contracts for workplace learning, practical experience among teachers, and implementation of the training curriculum when it exists, Colorado is similar to the average. This is also true for the design-phase feature that employers can enter the design process as individual firms or through employer associations. The rest of Colorado’s highest and lowest scores on the left side of the graph—scores available in Appendix table A1—are not important.

Important features that need improvement are those in the bottom half and right side of the chart. Two features fall outside the “major weakness” quadrant but are still important enough to merit discussion. In the updating phase’s process about deciding when to update, the feature about

firms' legally defined role in the decision to update is below the KOF EELI average and important enough to be a priority. Employers should have a clear and specific role in initiating updates. In the application phase process on employers' role in examinations, the feature on whether practitioners from employers is similarly important and low scoring. When practical examinations exist, experts currently working in the field should be included in the grading process.

Figure 10: Critical KOF EELI features for Colorado



The features in the bottom right are, in order of ascending importance, the legal definition of firms' involvement in curriculum content design, firms' involvement in designing the examination form, how much time students spend training in the workplace, the extent to which employers are involved in deciding when an update should happen, and firms' involvement in designing the content of the curriculum. These are all highly important features of strong VET systems and areas where Colorado's KOF EELI scores are very low. **All of these critical features are, again, instances when real power would have to be transferred to firms in order to improve the quality of the system.** These are the places where improvement should start.

At the feature level, each score is a specific issue that can be solved. In the design phase, firms should have a legally defined role in the process of designing curriculum content and standards. They should also be part of the group determining how to examine students' mastery of the curriculum, and most importantly they should have a loud voice in defining the content and standards of all CTE program curricula. In the application phase, students must spend much more of their time in the workplace to match up to international standards for dual VET programs. At least 25% to meet the basic definition and 50-80% to match the best systems (Hoeckel, 2008). In the updating phase, firms need to be the ones deciding when updates need to happen.

5.3 Regional differences

Colorado is a local control state, so education is largely designed and implemented at the district level. The Colorado KOF EELI study asked respondents from all over the state to assess their own systems in addition to collecting information on Colorado as a whole from respondents who operate at the state level. All of the responses are combined into the scores discussed above, but we separate them out to see regional differences in this section. All scores are available in Table A2 in the appendix and the geography of regional samples is described in section 3 of this report.

It is important to note that the number of observations differ substantially across regions. We collected 23 responses for Central Colorado, six for the Eastern part of the state, two for its Northwest, six for Southern Colorado, six for Western Colorado and 18 for the state-level respondents who are experts on CTE statewide. These results need to be considered with caution for regions where we have a few observations.

Further note that the share of students differs substantially across regions.²¹ Central is by far the most populated region, with 82% of Colorado's total students in grades nine to twelve. Western and Southern Colorado represent 6% each. Four percent and 2% of students come from Northwestern and Eastern Colorado, respectively. Hence, the sample of experts roughly represents the size of the regions in terms of student numbers, though the smaller regions are somewhat overrepresented.

Figure 11: KOF EELI scores in Colorado by region

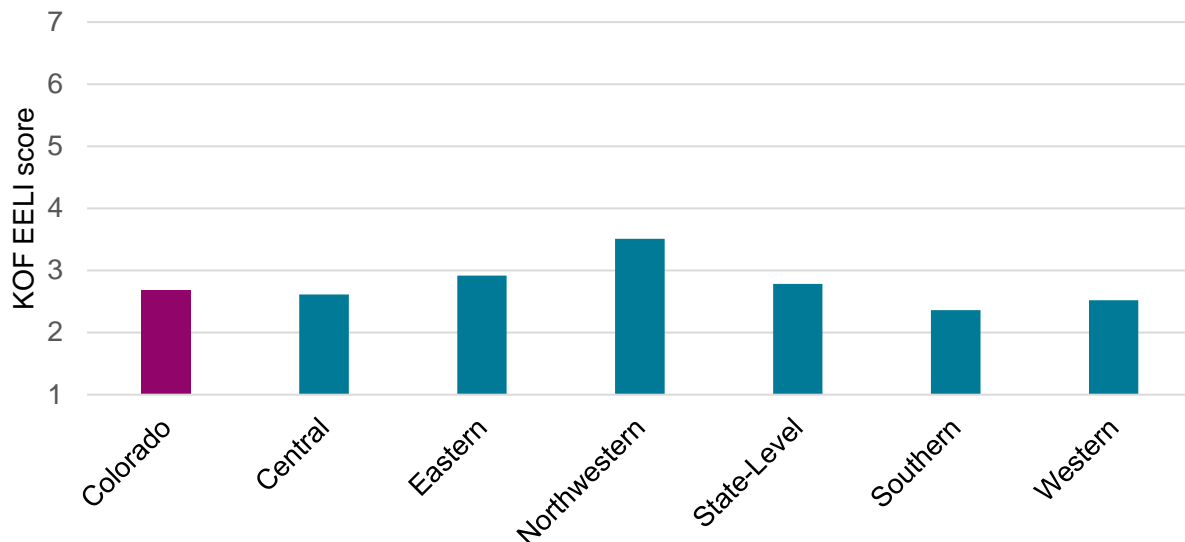


Figure 11 shows the KOF EELI scores for the state of Colorado and the regions we examine here: Central, Eastern, Northwestern, State-level, Southern, and Western Colorado. Central, State-level, and Western Colorado. **All of the regions are similar to the state average**, with the Eastern and Northwestern parts of the state slightly outperforming that average. Southern Colorado is below the average. We turn to the phases and processes to understand this pattern.

At the deeper levels of KOF EELI processes and features, Colorado's regions are generally very similar. No region has CTE students systematically spending a large proportion of their time

²¹ <http://www.cde.state.co.us/cdereval/2015-16-pupilmembership-bycountydistrictgrade-excel>

in the workplace, but training regulations are more varied—Eastern Colorado has much stronger regulations and the Southern state has less strong regulations. Employer contributions to costs, equipment, and teachers are generally low, though Eastern Colorado is slightly above the rest of the state. Western Colorado gathers the most information on updating, but employers in all regions have no opportunity to determine when updates should happen. This is especially true in Southern Colorado.

Scores are somewhat limited in their interpretability by the relatively lower number of respondents for each region compared to the entire survey sample. In addition, there are a number of potential interactions and substitutions among processes—such as the relationship between workplace training and the regulation of workplace training—that can make directly interpreting scores difficult. However, when we compare the scores for different regions in Colorado we can clearly see that, **though the state generally moves together, individual regions may have their own challenges and strengths.** The Eastern and Northwestern parts of Colorado appear to be doing more to enhance education-employment linkage in the application phase especially, and Southern Colorado will need more support to connect education to employment for CTE.

5.4 Respondent group differences: Education and employment

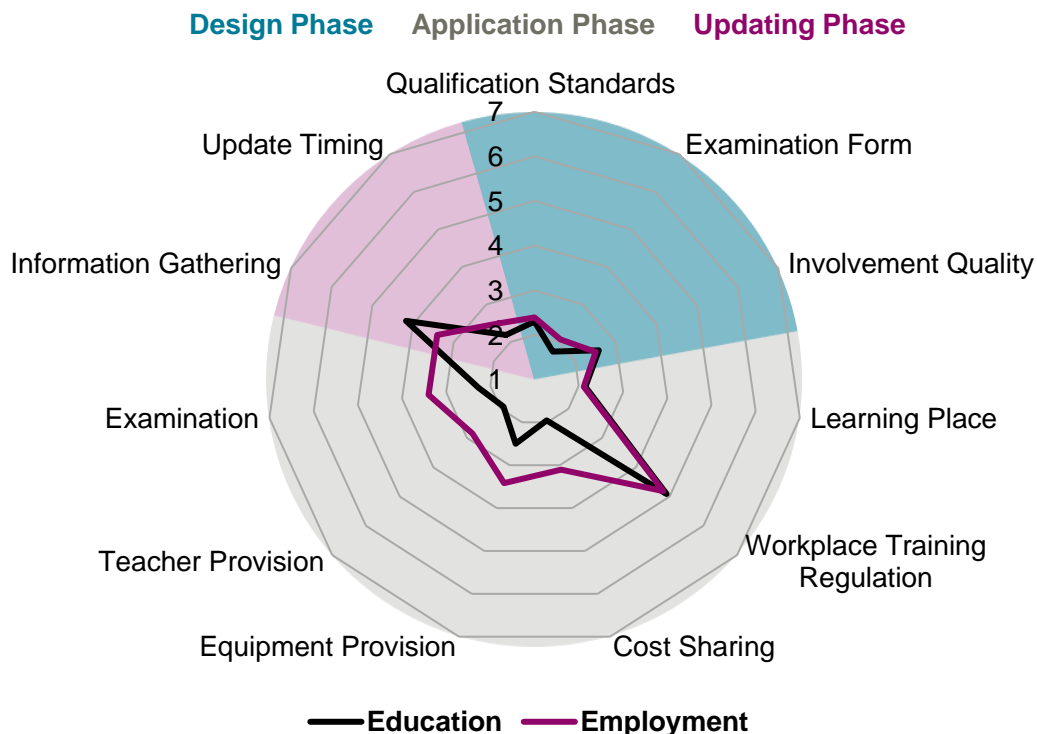
The other dimension of comparability within the Colorado KOF EELI sample is respondents who come from education and those who come from employment. We examine the two subgroups in this section to determine whether there are differences of perception in how the two groups see their participation in CTE and the linkage between themselves. The “education” group in this case is made up of Colorado state- and district-level education leaders, community-based organizations, and education-related nonprofits. The “employment” group is employers’ associations and employers. Scores are shown at the process level in Figure 12.

Although the total KOF EELI scores from both groups are similar (2.73 for education, 2.49 for employment), it is interesting how those scores arise. **On the overall index level, employers report lower linkage than education-system actors. However, at the process level, experts from employment consider education-employment linkage to be higher than experts from education.** This is for two reasons: first, differences in perception can cancel out upon aggregation if they are in different directions on different features or processes. Second, the weighting scheme that applies as we aggregate the index prioritizes important elements, so even though employers generally report more linkage up to the process level, their highest processes may not be important. The response differences demonstrate divergences in perception between education actors and employment actors about how much both sides are contributing and cooperating. We will explore the data from the feature level upwards. All data is shown in Table A3 in the appendix.

Throughout the curriculum design phase, the education and employment groups are in general agreement. Divergences are small on the feature level and there is no strong pattern, though the values are slightly higher for experts from employment than for experts from education. The same is mostly true in the updating phase, where both sides generally agree except that employers report a much lower level of input on curriculum update timing. This could indicate that the perception of effort from creating, sending out, collecting, and analyzing surveys is higher than the level of response among employers; alternatively it could mean employers feel their voices are not being heard. Overall, employers and education both know that there is very little linkage between them in the design and updating of CTE curricula.

Differences emerge in the application phase, when students are actually engaged in training and learning. The pattern that seems to emerge is that **employers believe they are doing and contributing much more than education believes they are**. For example, employers report that they are sharing the costs of classroom education and workplace training at rates fully 1.15 points higher than those of education, which is a great deal more. Similarly, employers report training and providing classroom teachers at much higher rates than educators report them doing. Finally, employers argue that they provide experts for practical examinations (4.00) while education reports that they do not (2.30).

Figure 12: KOF EELI scores for Colorado by respondent group



These differences could impede the progress of improvement. While all parties seem to understand that employers are not linked to the design and updating of the curricula for CTE, employers believe they are already contributing to CTE application much more than education is ready to concede. **Clarity, transparency, and a set of clearly defined roles and responsibilities for all parties are necessary to prevent resentment and a sense of ill use from both sides.**

6. Discussion: Why is linkage so low?

Colorado's employers and education actors are not equal partners in the career and technical education of young people—yet.

Colorado's employers and education actors are not equal partners in the career and technical education of young people—yet. Education-employment linkage is low overall and low in the most heavily weighted features. The failure to link education and employment for CTE raises questions: are employers willing but pushed out of by education actors? Are

they welcome but resisting responsibility? Are both education and employment actors facing mixed incentives? We discuss the reasons that could explain why linkage in Colorado is so low and how various parties' conflicting or problematic incentives can be resolved or addressed.

There is, of course, a difference between resistance and failure to initiate—actively preventing linkage is not the same as simply not starting cooperation. There are bright spots in Colorado, suggesting that at least some employers are willing to participate in CTE and at least some education actors are willing to accept their contributions. However, **something is preventing a statewide systematic cooperative partnership for CTE**. Making changes to the way actors in two systems operate and cooperate is an intimidating task. Instead of resistance from either side, the problem might simply be the **absence of change agents** taking initiative until now. We explore both systems' reasons to stay or go in CTE cooperation, then conclude with recommendations that can help reduce the starting costs of change.

Employers resist participating in CTE when it would be a net cost. Employers need a system where the content meets their needs and trainees are in the workplace long enough to help make up for the cost of their training.

Employers rationally resist participating in CTE when doing so would be a net cost for them. If they contribute curriculum ideas but have no power to ensure the final curriculum meets their needs, they risk losing the time and personnel invested in advising. If employers provide workplace training but the training is too short, too low-skilled, or too far from their own business needs to contribute productively, they lose again. Even if their need for skilled workers is so strong that they are willing to invest in

participation just to save hiring and recruiting costs, another non-contributing employer who poaches some of those workers away creates a risk. To participate sustainably in CTE, employers need a system in which the content at least meets—if not matches—their needs and trainees are in the workplace doing the right work long enough to help make up for the costs employers incur.

When employers earn back their investments during the training period, most of their barriers to participation are resolved. When training is an investment that breaks even or earns a return by the time trainees graduate, then poaching and competition among employers are less risky. In fact, the poaching problem can be framed as a prisoner's dilemma: when employers only advise curriculum design, they risk losing that investment if another employer chooses to freeride so they give up the possibility of a gain to maintain the status quo. In contrast, employers who can earn back their investment during training risk breaking even at worst, and so are willing to participate in CTE (Muehleman & Wolter, 2014). **When training is cost-neutral, poaching is less of an issue and employers have much less to lose.**

Education actors' incentives to protect their own self-interest can cause them to block employer participation in CTE even though cooperation would benefit students. American **education can feel like a competitive zero-sum fight for resources, in which giving up power seems like an irresponsible risk**. If employers are full partners in CTE, students spend half or more of their time in the workplace instead of the classroom. This lowers demand for teachers and classrooms, making teachers and school administrators react protectively. Even though workplaces have a competitive advantage over the classroom for learning practical skills and soft skills (Bolli & Renold 2015), and providing the resources and experts necessary for learning to work, education actors

will resist because they face potential loss of power and resources. **All this creates an environment characterized by silos and a fear of change.**

Employers can offer cutting-edge equipment, experienced trainers, and even funding for trainees' salaries. **It is much more cost-effective for a firm** to dedicate ten minutes of existing machine time to training an apprentice than it is for a school to buy and maintain the same piece of equipment for training purposes. **This is particularly true when technology changes quickly or equipment is very expensive**—common situations today. Similarly, employers can dedicate small amounts of experienced workers' time to training instead of the school having to hire the same workers full time. Lost productivity is part of the employer's contribution to training, and the apprentice makes up for that loss through productive work. The employer even pays the apprentice's salary, which is lower than that of their skilled workers to share the training costs but still a great deal for a teenager living at home. Such a system is actually cheaper for education actors and the government than academic education (Muehlemann, 2016).

It is easy to think of employment as a competitive, cutthroat system that exists only to further its own ends and profits, and of education as a benevolent and purely altruistic system that exists only to benefit young people. This argument is commonly articulated, so it is important to point out that education actors have their own self-interested goals and employment actors can be well suited to benefit young people. There are vicious and virtuous cycles: employers who are treated with mistrust are encouraged to prioritize their own self-interest and reinforce the lack of faith, while employers who are given responsibilities—especially binding responsibilities—must make the best of their obligation by making their trainees as highly skilled and productive as possible.

In an environment where they have no role to play but extracting resources from education and students, employers will do so. Conversely, in an environment of inclusive institutions where they are empowered to benefit themselves and their students simultaneously, employers will do so.

In an environment where they have no role to play but extracting resources from education and students, employers will do so. In an environment of inclusive institutions where they are empowered to benefit themselves and their students simultaneously, employers will do so. The system of checks and balances—institutional barriers to the rational self-interest of both systems' actors—is already underway in the countries that score well on the KOF EELI, and their youth labor market outcomes demonstrate that their systems work. **The change is not attitudes or closely-held beliefs, but institutions and systems.**

Shared power between education and employment actors is the crux of strong education-employment linkage, and of systems that can sustainably engage both sides to best serve students. If education were to have all the power, linkage would necessarily be low and students would not be prepared for the workforce; this is the current situation in Colorado. If employers were to have all the power, they could train students so firm-specifically that mobility would be zero; that is also the case with much of Colorado's on-the-job training after high school and its linkage is no higher.

For students to be successfully, efficiently, and sustainably prepared to enter the world of work, they must spend time at work, employment actors must have a part of the power to decide upon curriculum content creation and updating, and employer experts need some of the right to grade

and examine students' mastery of practical skills. On the flip side, Colorado's employers need to step into the leadership and partnership roles they currently do not occupy because of their own hesitations or the pushback from education actors. That means that to claim power, they need to accept responsibility.

7. Conclusions & recommendations

Based on the results of the KOF EELI, Colorado should **focus on increasing workplace training as a proportion of students' time and include employers as equal partners in designing standards and examinations, grading and examining students, and initiating updates** to CTE curricula when necessary.

Students need to spend time in the firm: workplace training is critical and must be a significant proportion of students' time: at least 25% to qualify as a dual VET or apprenticeship-style model (OECD, 2010). The workplace training proportion is 50-80% in the best systems, as mentioned earlier. Training should last three to four years so employers can afford to offer high-quality training. Giving up students' time to workplace training and occupational curriculum goals is necessary if Colorado wants high-quality CTE. General and transferrable skills will still be included to enable mobility and pathways to further education, but Colorado's current system takes this to such an extreme that quality occupational training and sustainable employer engagement are impossible.

Specific recommendations:

Increase & improve **workplace learning**:

- Students spend **more time in the workplace**
- Continue improving **curricula** for workplace training

Increase & legally define **employer partnership** on:

- Designing **qualification standards**
- Designing **certification examinations**
- **Hosting and grading** certification exams
- **Initiating** curriculum updates

Employers need to be partners in CTE, meaning they need to have specific roles, power, and responsibilities. Employers should have equal input on what students will learn as part of their occupational qualification. Employers should be partners who have power in the design of qualification standards and how they are tested. Finally, employers need to be part of the testing and certification process so they know their own

and other firms' trainees are meeting the standards set out for them. Allowing employers to grade the practical part of examinations uses the evaluation techniques they already possess for determining salaries, raises, and bonuses, while ensuring that students' grades reflect the feedback they will get when they enter the workforce.

Colorado's education actors are fulfilling their role of promoting general and transferrable skills, and contributing in the areas where they have the comparative advantage; their challenge is stepping back enough to allow employers a real seat at the table as partners and not adjunct advisors. They protect students from exploitation by enforcing workplace training curricula and regulations to make sure training leads to mastery. **Education actors make sure graduates are mobile on the labor market by ensuring that the overall curricula include general and**

transferrable skills like mathematics and languages, and the workplace learning curriculum includes the soft skills employers want to find on the labor market (Bolli & Renold, 2015).

Employer associations can support them in this role by ensuring that training meets the needs of an entire industry and not only one firm. Education actors are experts at curriculum design and classroom instruction, which are both part of strong systems and areas where education has the comparative advantage and skills employers do not possess.

In contrast, it is employment actors who are experts in the skills demanded on the labor market, the training of industry-specific skills, and the pace of technological change. They have the resources to dedicate some workers' time to acting as cutting-edge trainers, they already buy industry-standard equipment, and they update both as the need arises. Workplaces are the best places to learn soft skills and occupational skills, and trainers are better than teachers for practical skills in their own vocations. **Education actors can step back to allow employers space to contribute and give every actor the opportunity to make their most impactful contributions.** That means employers are partners in designing qualification standards and examinations, hosting and grading practical examinations, and deciding when updates need to happen so graduates' skills are always valuable on the labor market.

Colorado has strengths in its CTE programs that can be built upon. Employers' access to the curriculum design process is relatively open: they can enter individually or through employers' associations. This strengthens the power of engaged individual employers, while improving efficiency, trust, and representation of small employers. **Workplace training requires checks and balances between education and employment** so neither side can push content to be too general or too specific. The employment side is already checked through rules for workplace training, but education needs to be balanced by putting students in workplaces and allowing them to do productive work during training. Finally, finding CTE teachers who have practical experience with their subjects is a minor feature but a strong point for Colorado. **These strengths should all be emphasized and expanded upon as Colorado moves forward with improving CTE.**

7.1 Limitations

The KOF EELI measures education-employment linkage, which is a critical feature of strong VET systems. However, it is not the only characteristic of such systems. One issue that is not specifically measured by the KOF EELI is permeability: students' ability to follow clear pathways and crosswalks up through further training or across to colleges and universities if they wish. This is not an issue of education-employment linkage, but is a characteristic of the best VET systems in the world and must be part of Colorado's in order to maintain equity.

In a permeable system, students can move freely between VET and academic education. This permeability means that students never risk losing the opportunity to pursue either type of education, lowering the stakes on the initial decision to pursue VET. Permeability is facilitated by the availability of higher occupational training and clear pathways across education types. For example, VET students should have a clear route to tertiary education—often a few extra courses to make up additional requirements. Permeability preserves equity without compromising on quality.

An important limitation of the study concerns heterogeneity in the education-employment linkage within the education system. The region-specific analysis suggests that heterogeneity across regions exists, but these results need to be treated with caution due to the low number of

observations in some regions. Furthermore, the analysis refers to the average situation within regions and might mask substantial heterogeneity across schools. Similarly, we evaluate average education-employment linkage across the six industry-specific career clusters and fail to capture differences between these clusters. Furthermore, the analysis focuses on upper secondary education and hence provides no information regarding education-employment linkage in post-secondary education.

The policy recommendations in this report are drawn from the KOF EELI survey undertaken in September and October of 2016. They reflect the state of CTE in Colorado at that time, and according to the sample of experts assessed in this study. The content of the KOF EELI and its weighting scheme have been tested in 18 countries before this study on Colorado, but we continue to develop and refine the index.

This report analyzes the current state of CTE in Colorado, so it only includes programs where students are currently involved and does not measure the future. Colorado is on the precipice of a major change led by CareerWise Colorado that aims to develop a system that can improve conditions for the young people, employers, and state economy of Colorado. This report has been created with funding from CareerWise Colorado to help inform that effort.

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9. Appendix I

The tables in this section are color-coded to simplify reading. Phases are colored as they have been throughout the report: teal for design, grey for application, and pink for updating. Processes and features of the KOF EELI are light teal and white, respectively. Scores for each element are colored so that better scores approaching the maximum score of 7.00 are greener, poorer scores approaching the minimum score of 1.00 are redder, and midrange scores near the midpoint of 4.00 are yellower. The greener a score is, the better it is. In addition, the total Colorado KOF EELI score is included in every table as “CO” in bold and with the column differentiated.

Table A1: Colorado KOF EELI scores compared to KOF EELI average, Swiss benchmark

	Weights			KOF EELI scores		
	Phase	Process	Feature	CO	EELI Avg	CH
Overall				2.69	3.78	5.37
Design	41.9			2.78	3.94	5.32
Qualification Standards		15.8		2.31	3.39	5.00
Standards: Involvement			15.8	2.31	3.70	5.29
Standards: Decision Power			0	2.30	3.18	4.72
Examination Form		11.8		1.80	3.15	4.63
Examination: Involvement			11.8	1.88	3.32	4.81
Examination: Decision Power			0	1.73	2.98	4.45
Involvement Quality		14.3		2.57	4.96	5.39
Career vs Occupation vs Job			0	1.10	5.75	4.89
Firms vs Employer Associations			4	4.83	4.98	5.68
Represented Firm Share			0.1	2.40	5.11	5.25
Legal Def. of Involvement			10.2	3.85	4.68	5.66
Application	34.4			2.65	3.52	5.49
Learning Place		13.2		2.14	3.65	5.40
Classroom vs Workplace Share			13.2	2.33	3.23	5.47
Legal Def. of Share			0	1.63	4.25	5.33
Site Visits				1.50	1.75	
Counselling				1.94	1.69	
Workplace Training Regulation		8.6		4.90	4.75	6.31
Work Contract			1.7	5.15	5.63	6.78
Curriculum: Existence			0	6.49	6.19	6.89
Curriculum: Implementation			6.9	5.00	5.29	6.19
Trainer: Existence			0	1.82	5.19	6.79
Trainer: Number			0	4.00	3.64	6.27
Trainer: Training			0	4.00	5.10	7.00
Trainer: Continuous Training			0	5.00	3.06	4.13
Cost Sharing		1.5		2.16	2.76	4.16
Classroom Education Costs			1.5	1.69	1.31	2.02
Workplace Training Costs			0	2.85	4.43	6.30
Equipment Provision		0		2.65	3.30	3.22
Equipment Provision			0	2.23	2.38	2.42
Equipment Quality			0	4.22	5.96	6.23
Teacher Provision		3.2		2.06	1.91	4.24
Teacher Provision			3.2	1.72	1.64	2.87
Teacher Training			0	6.40	3.46	6.85
Continuous Training			0	5.36	3.13	5.33
Examination		8		2.41	3.48	5.29
Practical Share of Examination			0	3.01	4.12	4.75
Examination: Location			0.3	1.68	2.50	5.06
Examination: External Supervision			0		5.74	6.68
Examination: Employer Expert			7.7	2.44	3.93	5.90
Updating	23.7			2.68	3.87	5.25
Information Gathering		1.2		4.07	6.11	6.21
Employer Surveys			0.7	4.17	5.83	6.09
Labor Force Surveys			0.5	4.00	6.27	6.19
Update Timing		22.5		2.21	3.34	5.25
Update Involvement			15.7	2.23	3.04	4.90
Legal Def. Update Involvement			6.7	2.06	3.48	5.64

Table A2: Colorado KOF EELI scores by region

Weights				KOF EELI scores						
	Phase	Process	Feature	CO	Central	E	NW	State	S	W
Overall				2.69	2.61	2.92	3.51	2.79	2.36	2.52
Design	41.9			2.78	2.66	2.83	2.93	3.13	2.20	2.43
Qualification Standards		15.8		2.31	2.38	2.31	2.50	2.31	2.13	2.20
Standards: Involvement			15.8	2.31	2.33	2.50	2.50	2.31	2.13	2.20
Standards: Decision Power			0	2.30	2.42	2.13	2.50	2.31	2.13	2.00
Examination Form		11.8		1.80	1.63	2.13	2.50	2.03	1.56	1.38
Examination: Involvement			11.8	1.88	1.75	2.13	2.50	2.20	1.38	1.38
Examination: Decision Power			0	1.73	1.50	2.13	2.50	1.94	1.75	1.00
Involvement Quality		14.3		2.57	2.58	2.60	2.13	2.92	1.88	2.29
Career vs Occupation vs Job			0	1.10	1.00	1.00	1.00	1.33	1.00	1.00
Firms vs Employer Associations			4	4.83	4.53	6.00	7.00	4.43	5.50	6.00
Represented Firm Share			0.1	2.40	2.50	2.50	2.50	2.50	1.50	2.20
Legal Def. of Involvement			10.2	3.85	4.20	3.50	2.50	4.10	2.50	3.00
Application	34.4			2.65	2.67	3.26	2.74	2.51	2.24	2.72
Learning Place		13.2		2.14	2.20	2.89	1.75	1.80	2.08	2.40
Classroom vs Workplace Share			13.2	2.33	2.50	2.25	2.50	2.08	2.25	2.50
Legal Def. of Share			0	1.63	1.46	6.00	1.00	1.18	1.00	1.67
Site Visits				1.50	1.71	1.00		1.63	1.00	1.50
Counselling				1.94	2.19	2.00		2.00	1.50	1.50
Workplace Training Regulation		8.6		4.90	4.38	6.50	6.00	4.99	3.25	5.07
Work Contract			1.7	5.15	4.82	7.00	7.00	5.29	1.00	5.00
Curriculum: Existence			0	6.49	6.14	7.00	7.00	6.40	7.00	7.00
Curriculum: Implementation			6.9	5.00	5.09	5.88	4.00	5.20	4.00	4.38
Trainer: Existence			0	1.82	1.55			1.75		3.00
Trainer: Number			0	4.00	1.00			7.00		
Trainer: Training			0	4.00	1.00			7.00		
Trainer: Continuous Training			0	5.00	1.00			7.00		7.00
Cost Sharing		1.5		2.16	1.86	4.15	2.50	2.37	1.38	1.38
Classroom Education Costs			1.5	1.69	1.43	3.70	1.00	1.75	1.38	1.25
Workplace Training Costs			0	2.85	2.70	4.38	4.00	3.00	1.75	1.38
Equipment Provision		0		2.65	2.43	3.63	4.00	2.66	1.90	2.63
Equipment Provision			0	2.23	2.02	3.25	2.50	2.39	1.60	2.00
Equipment Quality			0	4.22	4.12	4.60	5.50	3.81	4.00	4.38
Teacher Provision		3.2		2.06	1.36	3.38	1.00	2.66	2.17	2.05
Teacher Provision			3.2	1.72	1.21	2.50	1.00	2.18	2.00	1.60
Teacher Training			0	6.40	7.00	7.00		5.80	7.00	7.00
Continuous Training			0	5.36	7.00	7.00		4.00	7.00	
Examination		8		2.41	2.38	2.08	1.50	2.38	2.88	2.75
Practical Share of Examination			0	3.01	2.73	2.50	2.50	4.00	3.25	3.10
Examination: Location			0.3	1.68	1.43	2.00	1.00	1.43	4.00	2.00
Examination: External Supervision			0							
Examination: Employer Expert			7.7	2.44	2.83	2.50	1.00	2.50	1.00	2.50
Updating	23.7			2.68	2.54	2.75	4.00	2.47	3.00	2.94
Information Gathering		1.2		4.07	3.67	4.00	4.00	4.60	3.00	5.50
Employer Surveys			0.7	4.17	3.63	5.00	4.00	5.00	1.00	5.50
Labor Force Surveys			0.5	4.00	3.40	4.00	4.00	4.75	3.00	5.50
Update Timing		22.5		2.21	2.06	2.80		2.13	1.00	2.80
Update Involvement			15.7	2.23	2.06	2.50		2.35	1.00	2.80
Legal Def. Update Involvement			6.7	2.06	2.03	5.50		1.90	1.00	2.50

Table A3: Colorado KOF EELI scores by respondent type

	Weights			KOF EELI scores		
	Phase	Process	Feature	CO	Education	Employment
Overall				2.69	2.73	2.49
Design	41.9			2.78	2.75	2.95
Qualification Standards		15.8		2.31	2.30	2.39
Standards: Involvement			15.8	2.31	2.28	2.50
Standards: Decision Power			0	2.30	2.31	2.29
Examination Form		11.8		1.80	1.75	2.07
Examination: Involvement			11.8	1.88	1.81	2.29
Examination: Decision Power			0	1.73	1.71	1.86
Involvement Quality		14.3		2.57	2.58	2.50
Career vs Occupation vs Job			0	1.10	1.00	1.55
Firms vs Employer Associations			4	4.83	4.79	5.00
Represented Firm Share			0.1	2.40	2.30	2.93
Legal Def. of Involvement			10.2	3.85	3.87	3.70
Application	34.4			2.65	2.68	2.52
Learning Place		13.2		2.14	2.15	2.11
Classroom vs Workplace Share			13.2	2.33	2.38	2.09
Legal Def. of Share			0	1.63	1.59	1.80
Site Visits				1.50	1.38	1.80
Counselling				1.94	1.81	2.30
Workplace Training Regulation		8.6		4.90	4.91	4.81
Work Contract			1.7	5.15	5.17	5.00
Curriculum: Existence			0	6.49	6.60	5.80
Curriculum: Implementation			6.9	5.00	5.02	4.75
Trainer: Existence			0	1.82	1.95	1.00
Trainer: Number			0	4.00	4.00	
Trainer: Training			0	4.00	4.00	
Trainer: Continuous Training			0	5.00	5.00	
Cost Sharing		1.5		2.16	1.95	3.10
Classroom Education Costs			1.5	1.69	1.50	2.67
Workplace Training Costs			0	2.85	2.73	3.50
Equipment Provision		0		2.65	2.50	3.42
Equipment Provision			0	2.23	2.11	2.83
Equipment Quality			0	4.22	4.17	4.43
Teacher Provision		3.2		2.06	1.92	2.84
Teacher Provision			3.2	1.72	1.62	2.31
Teacher Training			0	6.40	6.14	7.00
Continuous Training			0	5.36	6.14	4.00
Examination		8		2.41	2.27	3.40
Practical Share of Examination			0	3.01	2.92	4.00
Examination: Location			0.3	1.68	1.75	1.00
Examination: External Supervision			0			
Examination: Employer Expert			7.7	2.44	2.30	4.00
Updating	23.7			2.68	2.69	2.60
Information Gathering		1.2		4.07	4.17	3.40
Employer Surveys			0.7	4.17	4.29	3.40
Labor Force Surveys			0.5	4.00	4.00	4.00
Update Timing		22.5		2.21	2.19	2.50
Update Involvement			15.7	2.23	2.17	3.00
Legal Def. Update Involvement			6.7	2.06	2.07	2.00

10. Appendix II: Biographies of Authors



Ursula Renold is head of the research center for comparative education systems at the Swiss Federal Institute of Technology (ETH) in Zurich. In addition, she is Chairman of the University Board of the University of Applied Sciences and Arts, Northwestern Switzerland. She was a Visiting Fellow at the Harvard Graduate School of Education between September 2012 and March 2013. Prior to this, Renold was Director General of the Federal Office for Professional Education and Technology (OPET) until June 2012. In this position, she headed Switzerland's competence center for professional education, the universities of applied sciences, and led program innovation starting in 2005. Before becoming Director General, she was head of OPET's Vocational Education and Training Division and Director of the Swiss Federal Institute of Vocational Education and Training (teacher education). During her career, Renold has launched numerous key initiatives that have had great impact on the Vocational and Professional Education and Training system in Switzerland. She holds an honorary Professorship in Professional Education at the University of Applied Labor Studies in Mannheim (Germany).



Thomas Bolli is a postdoctoral researcher in the research center for comparative education systems at the Swiss Federal Institute of Technology (ETH) in Zurich. Before starting this position in April of 2013, he was awarded a Swiss National Science Foundation grant to visit the University of Lancaster as a postdoctoral researcher. He wrote his PhD thesis on the production and measurement of knowledge capital in the research center for innovation at the Swiss Federal Institute of Technology (ETH) in Zurich. Building on this, his research interests consist of the statistical analysis of knowledge, in particular applying microeconometrics to questions regarding the economics of education, research, and innovation.



Katherine Caves is a postdoctoral researcher in the research center for comparative education systems at the Swiss Federal Institute of Technology (ETH) in Zurich. She has a bachelor's degree from the University of California at Berkeley and earned her master's degree in the field of Education. Her PhD research was on the economics of education at the University of Zurich. Her research interests center around the economic, institutional, and infrastructure foundations of strong vocational education and training (VET) systems all over the world, especially what those foundations are in successful VET systems and how they can be developed in nascent VET systems. In addition to this project, she is currently working on identifying the success factors and barriers to labor market-oriented education systems reforms with the Center for the Economics and Management of Education and Training Systems (CEMETS).



Jutta Buergi is a research assistant and intern in the research center for comparative education systems at the Swiss Federal Institute of Technology (ETH) in Zurich. She has a university degree in sociology from the University of Chile, Santiago de Chile and received her master's degree in sociology and political science from the Faculty of Arts at the University of Zurich, Switzerland. Her research interests lie in sociology of education, vocational education and training, tertiary/higher education, education policy, as well as research policy and government support of research.

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