Rethinking Perkins to Expand Access to K-12 Computer Science

The most significant issue facing K-12 computer science today is a lack of access to high-quality computer science in our nation's schools. Nine out of ten parents want their child to learn computer science, while some estimates show that only one in four schools offer computer science classes.[1] States and districts can and should be using the Federal Carl D. Perkins Career and Technical Education Act (often referred to as the "Perkins" program) to expand equitable access to middle and high school computer science courses as part of a K-12 pathway for students.

Computer science is ***foundational*** — every student in our education system should have exposure to it in grades K-12. Students who learn computer science will learn computational thinking skills that can be applied to any field of study and have a better understanding of the technology driving our modern world. Computer science also supports students in preparation ***for college and careers***. Computer science courses can start students down a pathway toward the highest-paying[2], fastest-growing[3] jobs in the U.S. (most requiring a four-year degree). And computer science knowledge underpins multiple computing-related jobs that may not require a four-year degree. Computing jobs are now the number one source of all new wages in the U.S.[4]

This duality—computer science is both foundational throughout all grades and supports college and careers—can confuse both education policy and implementation. Truly rigorous and engaging courses and content sometimes do not fit neatly in a predetermined CTE "pathway" as, historically, courses aligned to an advanced degree or Baccalaureate program were not the target of high school vocational programs. Broad computer science courses often don't easily lead to an industry "certification" in a fast-moving field. CTE programs are focused on late middle to high school-only students and might include only *some* career-focused students. It is critical that states and districts view computer science as something that every student should have access to throughout their K-12 experience. The duality that computer science is foundational and career-focused is a powerful part of what students get from studying K-12 computer science. States and districts should embrace a vision that computer science is both academic *and* vocational and adjust policies and implementation to meet that goal.

Perkins is the largest federal funding source for high schools in the U.S. and governs decisions about CTE programs in the U.S. Most computer science courses that exist in today's high

[1] Gallup/Google (2015) http://computer scienceedu.gallup.com/home.aspx
[2] BLS Occupational Employment Statistics www.bls.gov/oes
[3] BLS Employment Projections www.bls.gov/emp
[4] http://blog.code.org/post/144206906013/computing-occupations-are-now-the-1-source-of-new

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school are implemented within CTE pathways, so the Perkins Act has a powerful influence over the implementation of computer science in our high schools[5].

As efforts to bring K-12 computer science to every student expand across the U.S., questions often arise related to the implementation of computer science and CTE programs. Our view is that ***every*** student should have access to high-quality and rigorous computer science courses. These courses should view computer science as a broad field—more than just programming/coding—and encompass such subjects as data analysis and the Internet. And these should be rigorous—too often basic IT literacy courses (learning to use a technology or application) are called "computer science," further confusing the issues. Below we highlight some key questions related to implementation of CTE pathways and examples of where states or districts are taking an approach closely aligned with the vision that every student should have access to computer science.

Summary of Recommendations:

In general, we recommend:

- Computer science courses should be offered in both CTE and non-CTE academic programs and dual-coded appropriately, and these courses should be used to meet a state's graduation requirements for both CTE programs and academic core subjects.
- Computer science courses should be available to all high school students whether or not they are CTE pathway completers.
- Dual-coded computer science courses should be eligible for Perkins funding.
- The courses can be taught by CTE and non-CTE certified teachers who are prepared to teach computer science.
- States should clarify that one of the Advanced Placement (AP) Computer Science (either AP CS Principles or AP CS A) exams can substitute for an end-of-pathway industry certification, as well as an early college credit option.

A state's Perkins plan and CTE system relies upon multiple intersecting aspects of the education system, including teacher certification, course coding/requirements, and graduation pathways. The recommendations in this document can help a state begin to create a coherent system that leverages both Perkins and the Every Student Succeeds Act (ESSA) to ensure that all students are college and career ready.

[5] Code.org survey of teachers that have gone through Code.org's professional development as a representative sample of implementation in the U.S. and CSTA's survey of computer science teachers.

Questions and Answers about Computer Science and Career and Technical Education

Q: Does computer science belong in CTE programs of study, academic pathways, or both?

A: Both. In many schools, a computer science course is coded as either CTE or academic. This type of coding can limit access to the course to a fraction of the student body. For example, the placement of computer science in academic pathways in Texas has limited its growth and availability to students in CTE pathways. And in some New York schools that only offer computer science in CTE pathways, only students enrolled in CTE programs are allowed to take the courses.

The 2006 reauthorization of the Perkins Act called for rigorous and challenging academic and career and technical instruction, and the U.S. Department of Education's 2012 report *Investing in America's Future: A Blueprint for Transforming Career and Technical Education* recommends "allowing rigorous CTE courses to be counted for academic credit" (p. 12). And because computer science is both foundational and vocational, it is uniquely positioned to satisfy this policy goal. Rather than attempting to develop separate CTE and non-CTE programs, schools should open up enrollment in CTE computer science courses to all students. These courses should be coded as both academic and CTE (or create a unified course code that bridges both areas). Dual-coding is one way for states and schools to implement computer science in both pathways without duplication of content, staffing concerns, or differing levels of rigor. And computer science courses that are part of a CTE pathway can receive Perkins funding even if it is open to students in academic pathways.

Often, state course coding systems are organized with separate sets of codes for CTE and academic courses. To implement computer science in both pathways, Arkansas has created a new section of course codes for computer science. Courses in this section can be taken in either a CTE or academic pathway. Likewise, in Maryland, computer science courses are dual-coded. These courses can be taken as an elective, applied toward a graduation requirement in mathematics or technology education, or in a CTE pathway. California recently created two different course codes for the AP Computer Science Principles course: one code for the course taught in a CTE program, and one code for the course taught in an academic pathway. As a result, some school districts also created dual codes for the course in order to implement computer science in both pathways.

Collaboration across CTE and academic departments is critical. Computer science standards in Florida were jointly written by the CTE and academic departments. The standards are in the academic science standards and are also being incorporated into CTE courses for next school year. In Idaho, new computer science standards were developed with the consultation of both university computer science departments and industry. A potential outcome of this is that these standards may in the future apply to both CTE and academic courses.

Q: How are teachers certified to teach computer science?
A: Teachers should have options to become certified to teach computer science whether their primary certification is in CTE or an academic subject. Often the teacher of a computer science course has to have a particular certification in order for the course to fulfill a particular graduation requirement or to be eligible for Perkins funding or funding associated with ESSA. For example, in California, only CTE-certified teachers can teach CTE-coded computer science courses, and in Texas, a computer science teacher must be certified in mathematics for the course to count towards the mathematics science graduation requirement.

We recommend teachers be allowed to teach a computer science course that is designated as part of a CTE or academic program as long as they satisfy the certification requirements for either program. That is, teachers who are certified as CTE or non-CTE but are prepared to teach computer science in their respective category should be allowed to teach the course in both categories. Ideally, computer science would bridge CTE and academic, and teachers would only need one license to be able to teach it (a license that similarly bridges CTE and academic). This is the case in Maryland, where both CTE and academically certified teachers can teach computer science classes; and in Arkansas, where a new computer science endorsement can be obtained by teachers regardless of whether their primary certification is in an academic subject or in CTE. If it isn't possible for certification to bridge CTE and academic, then academically certified teachers should have the opportunity to become certified to teach computer science in a CTE pathway without being required to obtain broad CTE certification, and vice versa. For example, Texas requires computer science teachers to have an academic computer science certificate and CTE teachers may earn this certificate as well. Idaho recently created computer science certifications for CTE and academic courses using the same Idaho-developed standards. Although an academically certified teacher must have the CTE certification to teach computer science in a CTE pathway, only one additional course is required.

Q: How can Perkins funds be used to expand or support computer science programs?
A: As long as computer science is part of a CTE pathway, Perkins funds can be used to expand computer science programs or provide professional development for computer science teachers. Funds can support both full computer science pathways and computer science courses that are part of other CTE pathways. Perkins funds can also be used to support career exploration and development courses in 7th and 8th grade. States can also build on recent changes made to professional development programs in Title II of the Elementary and Secondary Education Act to integrate CTE and academic professional supports. Teachers who are teaching computer science courses within CTE programs should have access to Title II professional development funds.

If a computer science course is dual-coded as CTE and academic, then the course, the students who take it, and the teachers who teach it should it should be fully supported by Perkins and the same resources supporting academic coded courses (such as Title II of ESSA funding). With dual coding, Perkins funds may be used to purchase equipment needed to

enhance current programs, and both Perkins and Title II funds can be used support computer science teacher professional development. In Idaho, for example, dedicated state funding can be used to purchase classroom equipment or software for courses only if they are listed as CTE programs. And in Arkansas, Perkins funding may be used as long as a course is part of a CTE pathway. Because all computer science courses in Arkansas will be dual-coded as both CTE and academic, Perkins funding can be used for all approved computer science courses in the state and these courses can also tap into traditional academic funding sources.

Q: Can students enroll in a CTE pathway and also be on a college-preparation track?
A: Yes. Modern CTE programs have generally moved away from separating "CTE" students from "college bound" students. Instead, CTE pathways can and should prepare students for both college and careers. A goal of the 2006 reauthorization of the Perkins Act is to integrate rigorous and challenging academic and career and technical instruction. States should consider developing CTE pathways in computer science, like those that exist in Maryland and Delaware. A CTE program in computer science expands pathway options as a key component of accountability requirements of college and career readiness. States should offer options for students to demonstrate career readiness, including passing advanced courses, college-level courses in a career field, or completing internships. International Baccalaureate pathways in computer science prepare students for college and careers and can be funded by Perkins.

The 2013 *Career Technical Education and Advanced Placement* report from the National Association of State Directors of Career Technical Education Consortium recommends that AP courses should be embedded within CTE programs of study, as these courses prepare students to pursue postsecondary education. State accountability formulas and points systems should be set up to encourage CTE pathway completers to take AP courses. In Maryland, one of the first states to create a full computer science CTE pathway, students take two AP Computer Science courses. Both Maryland and Arkansas have flexible pathways that allow students to take advanced classes for college credit or, in Arkansas, complete internships in computer science.

Q: Are the only students allowed to take computer science courses those who are CTE pathway completers?
A: No. Although some states require students to be enrolled in a pathway, this is not required by Perkins law. In fact, one Perkins indicator, 6S1: Nontraditional Participation, measures CTE *participants* (i.e., a secondary student who has earned at least one credit in a CTE course). States should create accountability plans that do not penalize schools for having more participants and fewer completers. Students should be able to choose to take a computer science course that is coded as a CTE or an academic course—and ideally, they won't even notice the difference. Under a CTE or academically coded course, the student should be counted similarly to any other student taking a CTE-coded course, and counted as a CTE participant. For dual-coded courses, this is not an issue. Some districts and states allow and encourage CTE participants without requiring them to complete pathways. For example, in Los Angeles Unified School District, students can take courses outside their pathway, as long as the

courses chosen do not deter them from meeting graduation requirements and fit in their schedules, and in Maryland, any student can take a course in any CTE pathway.

States should also be encouraged to incorporate computer science and other career-focused courses and credentials in their high school graduation requirements and scholarship programs. For example, computer science courses in a CTE track could be allowed to count towards math or science graduation credit. In Arkansas, all high school computer science courses were co-developed by the Department of Education and the Department of Career Education through a committee system. Therefore, all of these computer science courses will be eligible as an academic computer science flex credit (allowing a student to reduce his or her math or science graduation requirements by one), or as a career focus credit if the flex credit is not needed. In Maryland, students who are not enrolled in a CTE program can count an AP Computer Science course as their fourth-year mathematics graduation requirement or as their technology education requirement.

Q: Can AP exams count as end-of-pathway exams?
A: Yes. AP can be an acceptable end-of-pathway assessment for students and states should try to reduce barriers for students by accepting this as the end of pathway exam. One of the accountability measures under current law is that students demonstrate "technical proficiency," which is typically satisfied with an industry certification exam. For courses like the AP Computer Science courses, which already have robust assessments, it makes little sense for students to have to take a second exam in addition to the AP to demonstrate technical proficiency. It is clear that current law and implementation allow AP exams to serve as acceptable for meeting the proficiency requirement. The 2013 *Career Technical Education and Advanced Placement* report from the National Association of State Directors of Career Technical Education Consortium outlines AP courses that align to each of the 16 federally defined Career Cluster areas, and recommends that AP courses, as appropriate, should be part of students' CTE pathways. In one school district in Idaho, for example, AP Computer Science A is the capstone course for the computer science pathway. In Maryland, a satisfactory score on an AP Computer Science exam can meet the technical proficiency requirement.

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Expanding Computing Education Pathways (ECEP) Alliance

Appendix: Example K-12 Computer Science Pathways[6]

Perkins funding can support late middle and high school course implementation. As districts evaluate how to bring computer science to *every* student, they should build out complete pathways throughout a student's K-12 experience by evaluating how a elementary school program can prepare students for a potential CTE pathway.

Ultimately, course pathways should be driven by state standards. The number of standards, whether they are grade-specific or grade-banded, and whether they are voluntary or mandatory will affect the choice of implementation. A consistent exposure to high-quality computer science across a number of grades will benefit students and serve as the foundation for computer science for every student.

Below are implementation examples to serve as guidance for districts. A computer science experience can range from a few hours a week to a semester- or year-long course. For the purpose of the examples below, it is assumed that elementary school includes grades K-5, middle school covers grades 6-8, and high school covers grades 9-12.

The different examples are organized by an estimate of the total amount of focused computer science instructional time that the model may allow, from least to greatest. The examples within each grade band are not mutually exclusive; many options can be combined to create additional avenues for computer science instruction.

Elementary school implementation examples

1. Integrated into the general classroom
2. Integrated into an existing special (e.g., media arts, computer lab)
3. Independent special (e.g., every year, kindergarten to grade 5)

Middle school implementation examples

1. Integrated into math, science, or other subjects
2. Independent course at a particular grade level or at all grade levels

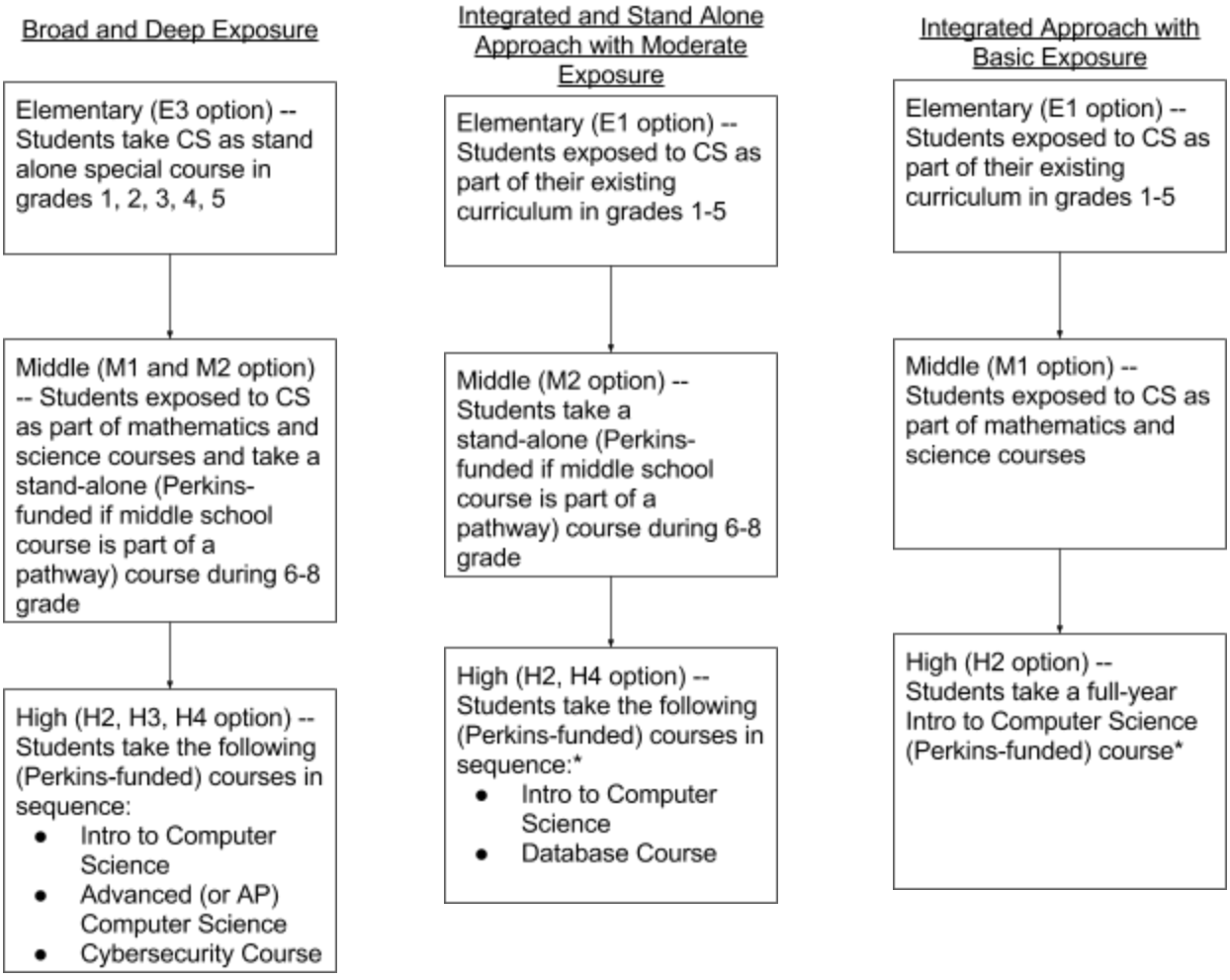
High school implementation examples

1. Integrated into math, science, or other subjects
2. Introductory course
3. Advanced course (e.g., honors, IB, AP)
4. CTE courses (e.g., cybersecurity, database administration, networking, game design)

[6] This section expands on the pathways presented in the K–12 Computer Science Framework, www.k12cs.org

As schools and districts implement K-12 computer science pathways, Perkins funding might be used in a variety of ways to support middle and high school courses. (Our reference to "pathway" here is meant to be a pathway of courses from K-12 vs. a CTE "Computer Science" pathway for Perkins). Three possible examples that mix and match the implementation examples from above reflect how a district may build out a sequence of content and courses to support students from K-12.

Sample K–12 computer science implementations



*In the "moderate" and "basic" exposure models, a student may be taking the high school computer science course or courses that are Perkins-funded as part of another CTE pathway. For example, consider two students who are taking the intro computer science course. One student is taking that course as a "participant" in the CTE pathway. The other student is taking that course and continuing on to complete the CTE pathway as defined by the district. The inability to offer a full CTE pathway in Computer Science should not be viewed as a barrier to implementation.