CSforCA

COMPUTER SCIENCE FOR CALIFORNIA

INTEGRATING COMPUTER SCIENCE INTO OTHER SUBJECT AREAS

Computer science (CS) education isn't just about developing computer scientists.

CS is foundational learning to understand our technological world, much like how we teach biology to understand life around us, or we teach Language Arts to develop better communication skills. As we expand access to stand-alone CS classes, a growing number of schools are integrating CS in other subjects as a way of exposing students to CS and having them see its relevance to their lives. Integrating CS in other disciplines:

- Expands opportunities for a more diverse range of students to experience CS
- Enables students to engage in a critical examination of technology's role and impact
- Builds student agency in problem solving to support their communities
- Exposes students to access different career pathways and high income potential

What is integration?

Integration is a classroom strategy that involves learning and applying a variety of subject matters within the same lesson. CS is a discipline that can be integrated with other subjects and provides learners a clear picture of how our complex society functions with technology. It also exposes students to many professions that use computer science. Computational thinking can deepen understanding of subject matter content and, vice versa, this content can be useful to explore computing.[1] Computational thinking develops critical thinking and problem-solving skills across subject matter, underscoring how the concepts of computing can be combined with other fields of study to assist in problem-solving.

CS is most frequently integrated in math and science disciplines. However, as CS is increasingly recognized as foundational learning in all disciplines, interest is growing among educators about how best to integrate CS learning in fields such as art, music, history, writing, and language arts. These fields can provide creative pathways for students to encounter CS who might not have exposure to CS. Whether it be in elementary, middle, or high school, students can create interactive stories in language arts or discuss the consequences of peer-to-peer networks with copyrighted files in ethics class, as well as collect and analyze data or create visualizations in science or math class.

CS INTEGRATION IN SCHOOLS:

Integration can be a CS on-ramp for a school or district, serving as a bridge for CS to ultimately exist as a stand-alone class, or several stand-alone classes.

With CS integration, schools can:

- reduce the pressure to create a new class
- help faculty and administration understand that CS isn't something too complicated to bring to students
- address the lack of CS credentialed teachers and the finite amount of time in the master schedule
- support bringing new technologies into classrooms, inspiring new ways of working and problem solving in various subject areas

[1] Weintrop, D., Beheshti, E., Horn, M., Orton, K., Jona, K., Trouille, L., & Wilensky, U. (2016). Defining computational thinking for mathematics and science classrooms. *Journal of Science Education and Technology*, 25(1), 127-147.

INTEGRATION SUPPORTS EQUITY IN CS

Integration can help facilitate the development of CS instruction that is culturally responsive, helping students engage in learning that meaningfully connects to their interests and those of their community. And because CS has become integral to the functioning of our communities and our democracy, issues of social justice can also be explored through lessons in CS.

Integrating CS in other disciplines has the potential to expand access to students who often don't have access to CS, like English Learners. For many students learning English, their schedules don't allow time for an elective. When CS is integrated in existing required courses and is not an elective outside the regular course load, students have exposure to this foundational learning. Programming environments like Scratch allow students to switch back and forth between English and their home language, encouraging them to engage with the technical vocabulary of both languages.

Curriculum Standards:

- The **University of California Curriculum Integration (UCCI)** provides examples of integrated courses that meet both CTE and General Education requirements. *https://hs-articulation.ucop.edu/guide/news-resources/uc-curriculum-integration*
- The appendix to the **California K-12 CS Standards** has alignment maps to all state standards. The San Diego County Office of Education has these organized in a **padlet**. *https://www.cde.ca.gov/be/st/ss/computerscicontentstds.asp, https://padlet.com/mark_lantsberger/y9ia59my8fno*
- The **CS Content Standards database** lists examples for CS activities that align with CS standards and with the standards from other subject areas. *https://www2.cde.ca.gov/cacs/cs*
- The **Next Generation Science Standards** has CS principles embedded as "Using Mathematics and Computational Thinking" in Science and Engineering Practices. *https://ngss.nsta.org/Practices.aspx?id=5*
- CS standards are aligned with **Career and Technical Education (CTE)/Information and Communication Technologies (ICT) standards**. ICT encompasses both Information Technology and more recent technologies, specializations, and concepts such as cyber security, the Internet of Things, software development, data science, artificial intelligence, virtual reality, and augmented reality. *https://www.cde.ca.gov/ci/ct/gi/itsector.asp*

More Information:

- The **Journal of Computer Science Integration** publishes papers with a specific focus on K-12 computer science integration that are accessible and of interest to educators and researchers. *https://jcsi.redlands.edu*
- **PiLa-CS**, a National Science Foundation (NSF)-funded project based out of New York City that supports emergent bilingual students, provides example units and strategies. *https://www.pila-cs.org/educator-resources*
- **History in Data**, an NSF-funded project out of the University of Michigan, has students build data visualizations in history classes as part of an inquiry process. *https://theory.engin.umich.edu/stories/how-cs-is-changing-education*
- **EarSketch**, **Sonic Pi**, and **TunePad** integrate concepts from music and CS. *https://earsketch.gatech.edu, https://sonic-pi.net, https://tunepad.live*
- The **C-STEM Math-ICT Curriculum** from UC Davis provides K-12 students with up to 13 years of integrated learning of math and computer science. *https://c-stem.ucdavis.edu/curriculum*
- **Bootstrap** has created integrated computing programs for algebra, physics, and data science. *https://bootstrapworld.org*
- **Project GUTS** (Growing Up Thinking Scientifically) is an integrated science and CS program for middle school students. *https://www.projectguts.org*
- **CS First** has various lessons that integrate CS with language arts concepts like characterization, dialogue, narration, and figurative language for grades 4-8. *https://csfirst.withgoogle.com/c/cs-first/en/curriculum.html*
- The **Introduction to Data Science (IDS) Curriculum** teaches students to reason with, and think critically about, data in all forms. *https://www.idsucla.org/introduction-to-data-science-curriculum*
- **RAISE** is a series of lessons and activities on concepts of artificial intelligence and the ethical implications those concepts entail, such as algorithmic bias. *https://raise.mit.edu/aiethics.html*
- **CSforCA's Computational Thinking brief** provides more information about employing CT for integration. *https://csforca.org/wp-content/uploads/2021/02/CSforCA_onePager_CT-2.pdf*