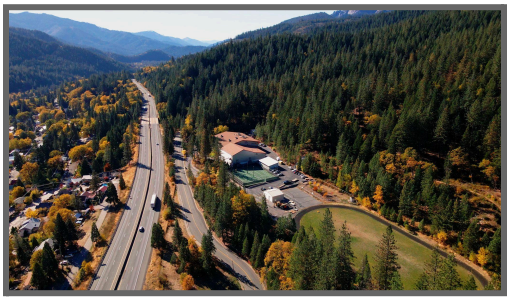
Computer Science Teacher Brief:
A Hybrid Course Approach for High School Settings



___ PROBLEM OF PRACTICE _____

In rural and small-town schools, increasing opportunities to learn science, technology, engineering, and mathematics subjects, including Computer Science (STEM-CS) can be hindered by geographic isolation, lower populations, limited tax bases, disproportionate state funding, staffing scarcity, and limited access to broadband (Arsen et al., 2022; Showalter et al., 2019 & 2023). For rural and small-town high schools, this often means students have limited access to advanced coursework, extracurricular programs, and teachers trained in specialty subjects (Saw & Agger, 2021; Grant 2023). This short brief highlights how one small, rural high school is addressing these barriers and increasing opportunities for Computer Science (CS) instruction while balancing high school course requirements within the constraints of a limited master schedule.

What is Computer Science?

Computer science is the science of computing and can be defined as the study of computers and algorithmic processes, including their principles, their hardware and software designs, their applications, and their impact on society; CS builds on computer literacy, educational technology, digital citizenship, and information technology, which are distinguished from computer science as they focus on the use of computer technologies rather than understanding why they work and how to create those technologies (CCSIP, 2019).

Why Computer Science Education Matters

CS education prepares students with versatile skills to work, innovate, and solve problems in a world that is increasingly shaped by computer technologies (Huang & Looi, 2021). Computational thinking skills and practices are fundamental to virtually every career path that students will encounter, as these skills are not limited to the technology sector or STEM-CS fields but are

ubiquitous across industry sectors. For example, wireless sensors, smartphones, and GPS technologies are increasingly utilized in agriculture to optimize farm productivity; the film, media, and entertainment industries are powered by computerized visual effects; and computing has become central to the automobile industry, the practice of medicine, and finance (CCSIP, 2019). Despite the availability of computers in schools, opportunities to learn computer science are not ubiquitous, particularly for small, rural, and urban schools (Code.org et. al., 2023).

Setting and Context

SPOTLIGHT SCHOOL: Dunsmuir High, in Siskiyou County, California, is a "rural, distant" school . It serves about 65 students in grades 9-12.

COMMUNITY: Dunsmuir is a railroad town of about 1,700 located in the Sacramento River Canyon. About 16% of families live below the poverty level.

TEACHER: Alysia Garcia

"I teach freshmen and sophomore English, Desktop Publishing (yearbook), drama (when student interest is there), an Academic Recovery Class (making up credit, taking electives), and a Communications/Computer Applications class."

"I think CS should be a required class for all high school freshmen. It is integral to our daily lives. It is difficult to teach CS in our area. There are not a lot of industry partners located here to help get kids interested in a career path. ***But I want to be kind of a guidepost for others in the area*** *to be able to integrate CS in a different sort of way because we have a lot of small schools."*

Alysia's CS background: She mastered the Exploring Computer Science curriculum through CS4NorCal's professional learning summer institutes in 2021 and 2022 and in 2023 completed an apprenticeship to become an ECS facilitator. *"At first I did not know how this would help me as opposed to being one more thing to do. But, I attended a second summer and the training actually served as a gateway to getting my CTE credential. When I first started teaching the material, I was learning while teaching but became more familiar and confident when teaching the lessons again."*

Challenges

*"The **hardest thing with a small school** is we need to have a schedule where everyone gets their requirements, and we only have nine teachers. Our school is on a six-period schedule. There are only so many periods I can teach. I can only do an introductory course."*

"Many students are interested in Computing and Technology, but very few of them have taken the time to learn on their own. Most of my students know how to use the technology really well, but not how it actually works/functions."

PROMISING APPROACHES

California's Computer Science Strategic Implementation Plan recommends integrating CS content in grades K-8 and offering a minimum of one introductory CS course at the high school level. In small and rural high schools, offering a stand-alone specialty course is not only difficult within a limited master schedule but is further constrained by staffing and credentialing requirements. National CS frameworks further promote the integration of computational skills and pedagogies across K-12 content and offer other practical approaches such as revising outdated credit-based courses or pre-existing technology education courses

Alysia created opportunities for CS instruction by revamping the school's existing Computer Applications course, which is a required freshmen elective. She describes her course here:

"My Communications/Computer Applications class is a year-long mandatory course for all freshmen and is a general education requirement for graduation. I proposed the idea of doing communications, like speech, debate and presentation along with computer science because there's a foundation of skills freshmen come into high school not having. I blend basic communication, presentation, and collaboration skills that students need along with CS."

"I find that these may seem disparate at first, but how often do we use communication skills in CS? Our daily lives consist of communicating through technology. The CS curriculum that I use includes education technology (typing, Microsoft products) and Exploring Computer Science. The ECS curriculum already combines

CS and communications. Since I have a computer lab and small class sizes, we do a couple weeks in the lab and then we take a break and go a couple weeks in the classroom. It is a good, nice change of pace for the students. They like to move."

Why ECS is a good fit

"ECS is a good fit because I have freshmen who are in need of computer basics. They need to learn how to collaborate and problem-solve on top of learning CS concepts. Problem-solving and communication are embedded into the very foundation of ECS. It has a high floor and a low ceiling so that students of all different abilities can engage with the content. When I do the ECS units in my classroom, I see an increase in engagement. The lessons are designed to be very hands-on and partner/group-oriented."

Dunsmuir's required freshman course now integrates dedicated instructional units on computer science and communications content, exposing all students to extended content and learning opportunities. In rural areas, meeting the needs of all learners may often require adaptations to the curriculum and re-organization of resources. Alysia's interdisciplinary approach allows for the deeper application of speech and debate standards as found in the CCSS for ELA/Literacy and College and Career Readiness Anchor Standards for Speaking and Listening, engages students in CCSS Mathematical Practices and NGSS Practices through CS content, and collectively reinforces the development of critical 21st Century Skills such as communication, collaboration, and critical thinking.

Actionable Advice

Innovate with the Master Schedule: Consider scheduling electives at the end of the day as one strategy to offer students more elective options. Alysia's journey with revamping her school's Communications/Computer Applications course began by integrating ECS content over one semester, which proved difficult. With a change in the bell schedule, it shifted into a year-long course which created space to diversify content and augment instruction with extended learning opportunities. For example, students now engage more deeply in speech and debate content standards than was possible during her core English course. Additional advice offered by Alysia:

- Maximize CS curricular content but realize that you do not have to teach every lesson. Alysia can introduce five of six ECS curriculum units by selecting lessons in 3-week chunks. She pairs content down to what she thinks is most important, appropriate and feasible for her learners.

- Try to incorporate relevant and emerging topics, such as AI
- Supplement CS instruction with video, especially when it comes to data and AI concepts
- For CS concepts, focus on the process rather than the right answer

Alysia also shared strategies she uses to keep students engaged:

- Alternate between classroom and lab time *(unplugged and plugged)*
- Create mini-presentations *(e.g., start with whiteboards or single slides using Google or PowerPoint)*
- Design class competitions
- Have students work in pairs and small groups

Start with Small Adaptations

Educators are encouraged to use CA Content Standards to design specific curricular and instructional strategies that best deliver the content to their students. Consider exploring how CS concepts and practices align with core content areas and augmenting lessons with CS activities. Or consider a curriculum that is already aligned to CA math, ELA, and CTE standards, such as ECS.

Remember, students can explore CS topics, such as algorithmic thinking, searching, sorting, and logic without computers! Unplugged activities are designed to introduce fundamental CS principles through hands-on learning, can be adapted to a range of learning levels, and offer a low-tech entry point for building CS knowledge and skills. When selecting content, be sure to account for students' interests and readiness, which are central to their engagement and learning.

THINGS TO CONSIDER

Who can teach CS?

California does not have a single-subject credential in CS, however, options include:

- Secondary teachers with single-subject credentials in Mathematics, Business or Industrial and Technology Education are authorized to teach CS courses that are coded as core academic courses.

- If a CS course is coded as Career Technical Education (CTE), teachers with a Designated Subject CTE Credential in Information and Communication Technology are authorized to teach the course.
- Teachers who hold a single-subject credential in another subject area can receive an Introductory or Specific Supplementary Authorization in CS after completing a college major in CS, 20 semester units or 10 upper division semester units in CS or graduate-level coursework.

The Communications/Computer Applications class highlighted in this brief is considered a general elective, covering several subjects rather than a single designated subject. Alysia holds a single-subject credential in English and motivation to learn and teach principles of CS, which made this CS-infused course possible. She also recently earned a Designated Subject CTE Credential in Information and Communication Technology.

Get connected

Regardless of school location or size, CS teachers can feel isolated in their roles as they are often the only, or one of a few, people in their schools teaching the subject. If you are interested in learning and teaching CS, look for opportunities to connect with colleagues through your local CSTA Chapter.

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RESOURCES

CS4NorCal: A grant-funded project that provided CS training and resources for teachers. All resources are *no to low-cost* and offer year-round workshops and support. Check it out!

CSTA California Far North Chapter: Established as a CS Community of Practice to provide ongoing CS training, resources, and tools and to help support and connect all teachers interested in and teaching computer science. Get involved!

Exploring Computer Science: The Exploring Computer Science curriculum has a modular, six-unit, design and was developed around a framework of both computer science content and computational practice with periodic revisions to keep the material relevant and updated. It is also A-G approved and aligned with Career and Technical Education (CTE) pathways, such as: Information Technology; Engineering and Design; and Arts, Media and Entertainment Technology.

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