



Voice

Diversity

The Voice of K–12 Computer Science Education and its Educators

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Inside This Issue

FEATURES

- The Big Idea*
- Diversity and the New English Curriculum Perceived Abilities Impact Participation Kids Can Code and You Can Help Them*
- The “I AM...” Campaign*
- Faces of Computing Winners*

COLUMNS

- Classroom Tools*
- Diversity Leadership*
- Tools for Diversity Professional Development*
- Curriculum Resources*
- CS Spotlight*
- K–8 Community Building*

INFO BRIEFS

- Keep Up with CSTA! Staff*
- Contribute to the Voice*
- Contact Info*
- Meet the Authors*
- Mark Your Calendar*

IN THE NEXT

VOICE

Computational Thinking

The Big IDEA: Moving Beyond Equity

Mark R. Nelson

Many groups are addressing the equity challenges in computer science (CS) education, and there are many examples of outstanding work. As we start 2016, we should take a moment to celebrate the progress.

Yet, there is much more to be done. The Google (services.google.com/fh/files/misc/images-of-computer-science-report.pdf) and Gallup (services.google.com/fh/files/misc/searching-for-computer-science_report.pdf) reports of the past year laid out the challenges of equity in K–12 CS education in stark relief. The numbers related to gender and racial equity in CS improved over the past decade, and yet, the percentage of individuals from underrepresented groups appears to remain largely the same.

With this in mind, perhaps it is time for CS education to move beyond just the concept of “equity.” I propose we replace equity with a larger idea—or rather, a big IDEA. We need to think about equity as part of an intertwined construct that encompasses Inclusiveness, Diversity, Equity, and Access (IDEA).

- **Inclusiveness:** creating an environment or culture in which anyone can feel welcomed, respected, supported, and valued.
- **Diversity:** recognizes all the ways in which people differ—both demographically (e.g., race, gender, and geography) and culturally (e.g., ideas, perspectives, and values).
- **Equity:** the guarantee of fair treatment, which may include offsetting the effects of barriers to a group participating, such as conditions that contributed to historical

underrepresentation.

- **Access:** creating a level playing field by ensuring that individuals have the tools and resources needed to participate.

K–12 CS education is challenged in each dimension of this IDEA. Inclusion is not fully possible in cases where there are clear inequities, where there is a recognized lack of diversity on many measures, and where known barriers to access exist. In such cases, deliberate steps are required to achieve the full IDEA. It will not happen on its own or by itself.

Improving the IDEA of CS education requires commitment to make the change by many parties. Over time, the IDEA may become just part of our culture, but without conscious effort and intent, such a goal is unlikely to happen on its own.

CSTA is committed to fostering an inclusive environment, which welcomes different values and perspectives, uses the unique qualities of its membership, and encourages the incorporation of a wide variety of members’ experiences and perspectives as the organization faces the challenges of an ever-changing teaching and learning environment. We will continue to support and grow initiatives that improve inclusiveness, diversity, equity, and access in K–12 CS education.

Today, CSTA represents more than 22,000 teachers and supporters of K–12 CS education across 130 counties. In the year ahead, CSTA will pursue and launch several initiatives based on this IDEA. Keep an eye out for those announcements and more, including the upcoming launch of our new website.

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Diversity and the New English Curriculum

Jane Waite

In England, we have a new computing curriculum. By law, all pupils starting at the age of five years, in state schools, are entitled access to the new curriculum. Previously, lessons centered on children becoming effective users of technology. Our new ambitious computing curriculum combines computer science (CS), digital literacy, and information technology with an emphasis on computational thinking and creativity. Details about the new curriculum can be found at: www.gov.uk/government/publications/national-curriculum-in-england-computing-programmes-of-study.

The new curriculum was introduced just one academic year ago, and teachers are working to meet requirements for teaching algorithms to 5 year olds, decomposition to 8 year olds, and abstraction to 12 year olds. At age 14, students select subjects to study for formal examinations. They can choose Computing General Certificate of Secondary Education (GCSE) (tested at 16) and A-level CS (tested at 18).

Providing lessons that provide all students with the opportunity to reach their full potential is not easy, even when we are secure in subject knowledge and pedagogy. This is even more challenging in that most computing teachers of pupils aged 5 to 11 do not have any computing qualifications, and many secondary computing teachers previously taught IT and have little CS background. The good news is that, in England, Computing At School (CAS) (www.computingatschool.org.uk) is ready to help.

CAS is a grassroots organization supporting educators and promoting collaboration. CAS participates at many levels, including influencing national policy; working with exam boards; offering online forums, discussion groups, hub meetings, crowd-sourced resources;

and supporting a network of trained, master teachers.

Within CAS, the “#include computer science for all” community (casinclude.org.uk) works to ensure that all students have the opportunity to study computing. This dedicated group of volunteers lead workshops, raise awareness, and gather resources.

Exam data shows that in 2015, only 9% of the A-level computing test takers were girls. There was a significant increase (111%) of students taking the GCSE computing exam with 16% girls. This gender imbalance is even worse in the industry. The latest figures from the Institute of Engineering and Technology show that women make up just 3% of IT and computing engineers in the UK.

It is much harder to find statistics of other criteria such as race, disability, or economic status. Initiatives around addressing the gender imbalance are on the increase, such as the Network Rail competition (www.coulditbu.co.uk), where young women can win up to £9000 towards their university tuition.

Organizations such as STEMettes (stemettes.org.uk), Code First: Girls (codefirstgirls.org.uk), Little Miss Geek (ladygeek.com/#littlemissgeek), Black Girls CODE (blackgirlscode.com), run a variety of hands-on events to motivate and educate. Carrie Anne Phibin offers interviews, panel discussions with graduate CS students, and on technology-related topics at Geek Gurl Diaries (geekgurldiaries.co.uk). There are websites by dedicated teachers exploring inclusion such as James Winchester’s SEN Classroom (senclassroom.wordpress.com).

There are some larger scale initiatives on the horizon such as the digital skills programme, London Enterprise Panel (www.telegraph).

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CSTA Voice is a quarterly publication for members of the Computer Science Teachers Association. It provides analysis and commentary on issues relating to K–12 computer science education, resources for educators, and information for members. The publication supports CSTA’s mission to promote the teaching of computer science and other computing disciplines.

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co.uk/technology/news/11974257/Mayor-of-London-launches-5m-digital-skills-programme.html), which seeks to “increase and improve the provision of industry-relevant digital training and education in London” (with a focus on East London). The programme is aimed at young people and will have a positive impact on Black, Asian, other ethnic minorities, and women by supporting social capital initiatives to improve access to the industry for these underrepresented

groups.

Here in England, there is a growing number of initiatives aimed at addressing inequality of opportunity across our diverse school population. These efforts are often led by small groups or they are narrowly targeted to a particular population or geographic area. Perhaps this is as it should be—diversity means different, no one size will fit all.

Perceived Abilities Impact Participation

Samantha Nix

It’s a scene that computer science (CS) teachers must be familiar with: students finish writing their code, take a deep breath, and hit “run.” We all know the next part of the story—that the code is going to come back with errors or bugs, especially if this is the student’s first attempt.

Educators generally do not see these occurrences as indicators of students’ future success in the field. However, burgeoning evidence suggests that students may interpret these experiences as signals of their ability or suitability for a field of study. In CS, where debugging is a daily routine, this is alarming.

One only has to turn to media representations of scientists and the work that they do to notice

given enough effort.

In contrast, students who believe in the “fixed mindset” perspective are more likely to give up on tasks that they perceive as difficult, because they believe that they would not find the task challenging if they already possessed the required level of ability or intelligence. Notably, girls with the highest test scores appear to be the most vulnerable to the fixed mindset perception.

In our research, my colleagues and I sought to understand the relationships between students’ perceived ability under challenge and gender (Nix, Perez-Felkner, and Thomas, 2015). We specifically wanted to know how, together, perceptions and gender might relate to high school

Celebrating the discovery of a bug could go a long way in minimizing the anxiety that we have trained people to feel when they believe they have done something incorrectly.

what education research is currently telling us: there is a wide perception that to be good in science, you have to be innately talented. Recent studies have shown that both academics and non-academics perceive some fields—mathematics, physics, CS, and engineering—as requiring brilliance for success. These are the same fields with the lowest participation of women. CS, in particular, seems subject to stereotypes about the type of person who participates, sending messages to women that they do not belong.

Furthermore, decades of research by Carol Dweck and her colleagues describe the impact of students’ perception of intelligence as “fixed” or “malleable.” Students who believe that they can grow in their intelligence or ability are more likely to pursue answers to the most difficult questions on assessments, because they believe themselves to be able to answer the questions

science course selection, persistence in STEM, and specific college major two years after high school. We used the National Center for Education Statistics’ (NCES) *Education Longitudinal Study* (ELS) data, which surveyed over 16,000 10th graders in 2002 and then followed that cohort until 2012. The 10th and 12th grade surveys included our measures of perceived ability under challenge, which were averages of students’ confidence in their ability to understand the most difficult and complex material, and use mastery-oriented behavior in general, verbal, and mathematics domains.

It turns out that perceived ability under challenge mattered, irrespective of gender. Students’ likelihood of taking the highest level of high school science coursework increased by about 30%, with heightened perceived ability under mathematics challenge in 10th grade. In addi-



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tion, both young men and women saw a 60% increased likelihood of selecting and persisting in physical sciences, engineering, mathematics, or CS (PEMC) fields, with increased perceived ability under challenge in both 10th and 12th grade.

However, we also found that high school girls were significantly less confident in their abilities compared to high school boys. Where high school boys, on average, scored above the mean in 10th and 12th grade measures of perceived ability under mathematics challenge, high school girls simply met the mean. Therefore, high school boys were significantly more likely to overrate their ability to understand the most difficult texts, learn the most complex material, or use mastery-oriented behavior in mathematics compared to girls. Yet, women on the high end of the perceived ability under mathematics spectrum, and who most highly agreed that anyone could learn to do mathematics, were about 3.3 and 2.3 times more likely, respectively, to major in a PEMC field compared to women who did not hold those beliefs.

What can CS teachers do to increase their students' perceived ability under challenge? Dweck and her colleagues have focused on increasing "growth mindset," by providing students with readings about the flexibility of

the human brain (see www.mindsetworks.com). Teachers may also feel empowered to create their own interventions. In an environment of increased standardized testing, it might be helpful to remind students that the practice of science, particularly CS, requires making and correcting mistakes.

Celebrating the discovery of a bug could go a long way in minimizing the anxiety that we have trained people to feel when they believe they have done something incorrectly. Girls—especially if they have rarely encountered difficulty in or out of the classroom—may benefit from one-on-one assistance in interpreting their reaction to a challenge and developing mastery-oriented behavior to deal with that challenge. Finally, teachers might ask guest speakers to expound on their experiences with difficulty or challenge in their field, to break down the perception that raw talent is the source of success in STEM.

REFERENCE

Nix, S., Perez-Felkner, L. C., & Thomas, K. (2015). Perceived Mathematical Ability under Challenge: A Longitudinal Perspective on Sex Segregation among STEM Degree Fields. *Frontiers in Psychology*, 6. doi: 10.3389/fpsyg.2015.00530.

Kids Can Code and You Can Help Them

Grechen Huebner

Math is a fundamental skill used in every aspect of our lives. But what would happen if we waited until students entered high school to offer mathematics? Imagine how many students would slip through without even a practical understanding of math. Imagine the missed opportunities for advances in physics, astronomy, and economics. It's not a pretty picture.

Now, imagine if computer science (CS) was included as an integral part of a child education beginning in kindergarten right alongside math. Imagine how many more students would be interested in coding, robotics, and technology; and the possible advances in medicine, education, space exploration, and more.

We understand that implementing CS in the elementary school has challenges related to time, resources, and knowledgeable teachers. Our mission at Kodable (www.kodable.com) is to make CS accessible to everyone. Below are four

suggestions for easing the challenges of including coding in elementary school.

1. You don't have to know how to code

When we started Kodable in 2012, there was a handful of tools for teaching coding to young students. Luckily, the past three years have seen a spectacular boom of CS resources. Many are available and the majority are for people just beginning to teach coding. Our goal at Kodable is to keep things simple. Our curriculum explains exactly what CS concepts students are learning, how they apply to programming, and how to explain them. We also include lesson objectives, screen-free activities, vocabulary, and video lessons for you to use that are designed for the new-to-programming teacher.

2. Start small

Start with a club, one class, or a lesson every other week. After a successful roll out, expand to include more students in the coding fun. Treat this time as an experiment. Students will get a kick out of being guinea pigs and it is a great way to start conversations about learning as you go, resilience, and trying new things.

3. Get support

Invite colleagues to visit your class to see how students are learning. Get the conversation about coding started. When administrators hear about coding from multiple sources in the school or district, you're more likely to get their attention and support. For even more support, join our weekly twitter chat, #KidsCanCode, every Tuesday night at 8pm EST. We cover a different coding education topic every week with an active

group of educators who are passionate and willing to help. You can catch up on past chats in the archives (blog.kodable.com/category/kidscancode-chats).

4. Find the time

The majority of educators we talk to set aside 40-60 minutes a week to teach coding. To fit a variety of schedules, we designed our curriculum to be implemented with as little as 20 minutes a week while also meeting 27 Common Core State Standards. If you have more than 20 minutes, you can easily combine a screen-free lesson with self-driven learning from the playlists.

Introducing coding at a young age is as fundamental as math or reading. You don't need programming experience to begin having a huge impact on kids' futures.

The "I AM..." Campaign

CSTA is getting ready to go live with a new face in January 2016 as we unveil the first phase of our migration to a new website, membership portal, and eventually a new look. We would like to showcase some of our member's faces — the faces of computer science teaching today!

As we put on a new face, we want to show the faces of our members. After the new site goes live, each month for the remainder of 2016 we will select a set of member photos from those submitted for inclusion.

CSTA is proud to launch this "I AM..." photo initiative during CSEdWeek to kick things off! It's easy to enter.

- Take a photo of yourself.
- Fill out the form at: csta.wishpond.com/photo-contest.
- Complete the statement "I AM ..."
- Enter how many CS students you have.
- Submit your photo and form.

CSTA management will choose up to three (3) entries to receive a US\$25 gift card. Winning entries will be selected randomly from those received prior to 11:59 pm (PST) on December 31, 2015, and will be notified in January. The contest is open to all active CSTA members. You inspire us! Show us your creativity and have some fun!

Faces of Computing Congratulations Winners

High School: Xavier College Preparatory High School (Phoenix, AZ)

Kassidy MacIntyre, Brittney Robinson, DJ MacIntyre, Teacher: Catherine Wyman

Middle School: Gymnasio Amfipagiton (Corfu, Greece)

Angelos Mouzakitis, Foteini Mouzakiti, Konstantinos Mouzakitis, Giorgos Mouzakitis, Dimitra Vlaserou, Korina Konstanti, Georgia Avloniti, Esmeralda Ntrizi, Vasiliki Argirou
Teacher: Sotirios Fotiou

Elementary School: Elementary School Djura Jaksic (Kac, Serbia)

Gojko Panic and Darko Birac, Teacher: Jasmina Jerkovic

Meet the Authors

Laura Blankenship

The Baldwin School

Laura is the Chair of CS and the Dean of Academic Affairs at an all-girls' independent school in Pennsylvania.

Grechen Huebner

Kodable

Grechen is a founder, game designer, and curriculum specialist for Kodable, a programming curriculum for elementary schools.

Pau Lai

UC Berkeley

Paul Lai is a PhD candidate at UC Berkeley School of Education. He studies literacy and learning for immigrant and non-dominant youth.

Frieda McAlear

LPFI

Frieda is a Research Assistant at the Level Playing Field Institute.

Omoju Miller

UC Berkeley

Omoju is a PhD Candidate and CS Education Researcher.

Mark R. Nelson

Executive Director, CSTA

Mark joined CSTA in June 2015, with more than 25 years of experience in education and education-related organizations.

Samantha Nix

Florida State University

Samantha is a PhD student in the Higher Education program at FSU. She studies college students' resilience and its impact on educational outcomes.

Jane Waite

Department for Education, UK

Jane worked in the IT industry and as a primary teacher. She now works to support computing teachers in London.

Stephanie Weber

EngageCSEdu

Stephanie is the Content Manager for EngageCSEdu, a collaborative project between NCWIT and Google.

Sheena Vaidyanathan

Los Altos School District

Sheena teaches sixth grade in California.

Classroom Tools

Graphic Novel Helps Introduce Coding to Diverse Students

Paul Lai

In her fifth year of teaching computing, Melissa Dohm found an engaging way to introduce the concept of binary to her diverse students at Ochoa Middle School in Hayward, California. She discovered *Secret Coders*, a graphic novel created to teach coding to adolescents.

Secret Coders, written by Gene Luen Yang (himself a longtime Bay Area CS teacher) and drawn by Mike Holmes, premiered its first volume in October 2015. The graphic novel unfolds the story of Hopper and Eni, two intrepid pupils in a Hogwarts-like private school, where instead of mysteries coded in magic spells, the secrets are revealed through fundamental coding concepts.

Melissa's CS students have always responded enthusiastically to lessons about binary which she taught using a binary magic trick, but getting them to conceptually understand binary was challenging, usually requiring a full week wrestling with the idea. This year, however, Melissa used *Secret Coders*. The graphic novel includes a scene when Eni, one of the protagonists, introduces binary to Hopper, his new friend at the school. Rather than using strictly mathematical language, Eni uses a game (with pennies and boxes drawn with sidewalk chalk), as a means of unlocking the strange and intriguing secrets of the school.

Melissa borrowed the game for her lesson, emulating Eni's instructions to Hopper on the board with boxes and magnets: color in thirteen boxes, but every column has to be completely full or completely empty. When she asked if students had figured out the puzzle, every hand was raised. The graphic novel provided a visual, play-based way for students to understand the "yes" and "no" configurations for every number up to 15.

Guiding students through the comic book's opening scenes, she immediately noticed high levels of attention and interest. "They couldn't put it down," she notes. "They responded to the way *Secret Coders* taught binary as part of the mystery. What normally took a week for me to teach, most of the students understood within a day."

After reading *Secret Coders* alongside lessons about the history of binary and other related topics, Melissa found higher levels of comprehension from her students, more active participation, better assessment results, and enthusiasm in teaching others.

Melissa especially valued the lesson's effectiveness with her diverse students, including supports for students with special needs. For one of the female students who had difficulty with basic math, Eni and Hopper's story, along with the magnets and columns of boxes, provided representational tools that allowed her to grasp how binary works.

"The kids are really curious what happens next in *Secret Coders*" Melissa says. She plans to use future installments of the graphic novel, having seen how providing a story and characters to care about, along with the smart visual lessons that can be conveyed through comics, augments lessons in interesting and hands-on ways.

Secret Coders, as well as instructional resources, can be found at: www.secret-coders.com.

Editor's note: Read more about using Secret Coders in the middle school classroom in the rest of the interview with Melissa Dohm in the CSTA Advocate Blog (blog.csta.acm.org/2015/12/18/graphic-novel).

Diversity Leadership

CSTA Leading the Way

Editor's note: CSTA will be launching a new website in early 2016. Some of the following links may change. If you need help locating a resource on the new site, please contact CSTA customer service at: customerservice@csta-hq.org.

CSTA members have an abundance of resources to use in their computer science (CS) diversity efforts. From posters to lessons, from events to activities, the variety is impressive.

Advocacy Tools

Improving the diversity of the CS classroom begins with making CS available to all students. Advocacy Tools can help you mobilize your community around the goal of providing a quality CS program in all schools (csta.acm.org/Advocacy_Outreach/sub/AdvocacyTools.html).

Curriculum Resources

The *CSTA K–12 CS Standards* is definitely a first-stop in formulating a CS curriculum that supports diversity at every step of a student's CS educational path. Additionally you will find useful examples of ways in which the learning standards can be met in your classroom (csta.acm.org/Curriculum/sub/CurrResources.html).

Brochure, Poster, and Videos

The collection includes inspiring posters showcasing a wide variety of careers and professionals, as well as brochures and videos perfect for setting a welcoming tone in your classroom (csta.acm.org/Resources/sub/BrochuresPostersVideos.html).

Contests

Each year several student contests are sponsored that are intended to appeal to a diverse audience of students. The winners of the most recent "Faces of Computing" contest appear on page 5.

Reports

The collection of reports includes "Addressing Core Equity Issues in K-12 CS Education: Identifying Barriers and Sharing Strategies," a collaboration of CSTA the Anita Borg Institute and the University of Arizona that focuses on the critical absence of women and underrepresented minority students from computing at the K–12 level (csta.acm.org/Communications/sub/Reports.html).

Tools for Diversity

Resources for Creating a Diverse CS Classroom

Laura Blankenship

Editor's note: Laura is Chair of the CSTA Equity Committee and would appreciate feedback. Her email is laura.blankenship@csta-hq.org.

Creating an equitable classroom environment is vitally important to improving the gender and racial balance in the field of computer science (CS). Teachers at all grade levels can help make all students feel like CS is a field they would enjoy and find success. Creating the right environment

is not as difficult as it sounds and there are resources to help. In addition to the abundance of resources from CSTA*, there are many other organizations working to more fully diversify CS education and careers.

General Resources

First, I'd recommend reading two books, *Unlocking the Clubhouse* and *Stuck in the Shallow End*, by Jane Margolis. The first addresses the issue of gender and the second focuses primarily on race. They both provide a foundation in the societal and psychological barriers to pursuing CS for certain groups of students and provide ideas about recruitment and retention.

The Tapestry Workshops, funded NSF, offer an in depth experience to help high school teachers make their courses appealing to all students. Resources from past workshops are posted on the Tapestry wiki (cstapestry.wikidot.com). For more information about the Tapestry workshops visit: www.cs.virginia.edu/tapestry.

Knowing our biases can help us change our actions to overcome them. Harvard's implicit bias tests are a great way to identify personal biases and help you examine and redirect your classes. Take tests related to gender, race, religion, and more at: implicit.harvard.edu/implicit/takeatest.html.

Curricular Resources

Assignments and activities send messages to students as to whether they belong in CS or not. The resources below offer guidelines for assignments, as well as specific examples to make your class engaging and successful for all students.

EngageCSEdu (www.engage-csedu.org): Aimed primarily at the early courses in college, this site hosts a collection of curated and reviewed assignments. Search by topic, language, or practice.

NCWIT (www.ncwit.org/resources/top-10-ways-engage-underrepresented-students-computing/top-10-ways-engage-underrepresented): Aimed primarily at engaging women, this list of practices and links to assignment ideas curated by NCWIT can help broaden the appeal of CS to underrepresented groups.

CS for All (www.cs.hmc.edu/csforall): Harvey Mudd College has made significant changes to its introductory CS course to improve the retention of underrepresented groups. Fortunately, they have put much of their work online.

Teaching Practice and Physical Space

Recent research shows that creating an overly geeky-looking classroom environment turns off girls and makes them feel like they don't belong. So take down the Dr. Who poster and work on creating a more neutral space. Two research studies explore this idea. The first is available from NCWIT at: www.ncwit.org/resources/how-does-physical-environment-affect-women%E2%80%99s-entry-and-persistence-computing.

Read about another study in this Conversation article: theconversation.com/want-more-girls-to-be-interested-in-computer-science-change-some-classroom-stereotypes-47136.

In addition to the physical space, student-student and teacher-student interactions can make a big difference. Promising practices from NCWIT include classroom strategies that make everyone feel welcome and successful (www.ncwit.org/resources/how-do-you-retain-women-through-inclusive-pedagogy).

Encouragement

Encouragement is a major factor in whether students from underrepresented groups continue in CS and succeed. Google released a white paper about the impact encouragement has on girls (docs.google.com/file/d/0B-E2rcvhnIQ_a1Q4VUxWQ2dtTHM/edit?pli=1). It includes advice for increasing the appeal of CS courses to all students.

*CSTA DIVERSITY RESOURCES

- csta.acm.org/Communications/sub/DocsPresentationFiles/ABI-CSTAEquityFinal.pdf
- blog.csta.acm.org/2011/04/28/equity-part-1-why-should-we-care-about-issues-of-equity/
- blog.csta.acm.org/2011/09/20/equity-based-teaching-practices/
- csta.acm.org/Communications/sub/CSTAVoice_Files/csta_voice_01_2013.pdf

Professional Development

A Certificate in CS Education

Editor's note: College of St. Scholastica is a CSTA Institutional Member that offers a unique professional development opportunity for educators. We interviewed Jennifer Rosato, an assistant professor of Computer Information Systems, for this article.

Overlooking Lake Superior in Duluth, MN, the 186-acre College of St. Scholastica campus is a beautiful setting with a mix of new and historic buildings. Home to traditional undergraduate, graduate, and online courses, St. Scholastica has embraced the non-traditional student and seeks to support ambitious professionals.

CSTA: Tell us about the Certificate in Computer Science (CS) Education at the College of St. Scholastica (CSS)—what is it, and what content will teachers learn?

Rosato: The Certificate is a set of four courses that prepare secondary teachers to teach CS. The certificate begins with Computational Thinking, which provides an overview of the discipline, and some of the major factors that influence developing effective teaching and learning environments in the CS classroom. The next two courses specifically target Advanced Placement courses: CS Principles and CS A. The final course, CS Methods & Capstone, dives into the pedagogical content knowledge needed to be an effective CS educator and includes a capstone project that teachers prepare for use in their school. Each course, similar to our M.Ed. program, includes a diversity strand that considers how best to recruit and retain underrepresented students in CS courses.

CSTA: Why is this certificate important for CS teachers?

Rosato: Through efforts like CSEdWeek and Hour of Code that are raising awareness of the importance of CS in a 21st century education, many schools are interested in offering more CS, whether it's in after-school settings, as part of other courses, or as standalone courses. However, very few in-service teachers had access to CS courses as part of their training. This certificate program

offers that training to educators to prepare them to teach in a new discipline. While there are many workshops and other professional development opportunities, the certificate is more comprehensive and in-depth than others.

CSTA: The Certificate is an online program—how does that work?

Rosato: CSS uses Blackboard, a learning management system for online courses. Each course is divided into eight modules. For 16-week courses in the fall and spring semesters, one module is covered every two weeks. For the condensed 8-week summer courses, we cover one module each week.

CSTA: Teachers could choose to gain CS education on their own—what is the benefit to completing this Certificate alongside other professionals?

Rosato: CS teachers are often isolated in their schools or districts and have few opportunities to discuss course content and teaching methods. Participating in this certificate program will give teachers a regular opportunity to share ideas, ask each other questions, and talk to experts in the field. They'll also get to learn from teachers around the U.S. and hear how different states approach CS at the K–12 level.

CSTA: Talk more about the value of the Certificate—what does it mean in terms of professional qualifications?

Rosato: While this Certificate is not designed to meet any endorsement or licensure requirements for a particular state, individual courses or the entire Certificate may help teachers meet those requirements. Because the Certificate is offered entirely online, teachers from any state can participate. In fact, this year, we have had teachers from New Jersey to Hawaii and Texas to Minnesota. All the courses are at the graduate level and may benefit teachers in their district's salary structure.

CSTA: How can teachers expect to complete this course while maintaining a busy professional schedule?

Rosato: At the graduate level, students are expected to spend a total of 48 hours on coursework per credit. So, each course in the Certificate (3 credits each) would be a total of 144 hours or approximately 18 hours/week for 8 week courses and 9 hours/week for 16 week courses.

CSTA: How does the Certificate program teach to nationally recognized standards?

Rosato: The very first course, Computational Thinking, introduces the CSTA K–12 CS Standards as a framework for teachers to consider concepts appropriate for various grade levels and how those concepts build upon each other. Course assessments throughout the Certificate ask teachers to identify standards being addressed in the teaching materials they review or develop. By successfully completing the Certificate, teachers will also meet all four of the International Society for Technology in Education (ISTE) Standards for CS Educators.

CSTA: How is this program unique to the College of St. Scholastica?

Rosato: This is the only online program that is designed specifically for in-service secondary educators. There are some programs for pre-service teachers and some programs for in-service teachers in specific states; however, in the

past, programs have struggled with enrollment numbers. By not making the program specific to any particular state, we hope to broaden the audience enough to make the program sustainable and meet the needs of educators throughout the nation.

CSTA: How can teachers learn more about the program or apply?

Rosato: Prospective students can learn more about our Certificate in Computer Science Education at go.css.edu/CertCSE or by contacting Admissions Counselor Heidi Bergstedt at (877) 287-8751 or hbergstedt@css.edu.

Curriculum Resources

EngageCSEdu
Stephanie Weber

Every day there seems to be a new product or program that operates faster or better than the model before. Our students are like sponges, soaking up computers, cell phones, tablets, and video games as fast as we can produce them. So why, with the diversity of technologies on the market, are we not seeing the same diversity in our computer science (CS) classrooms?

According to the latest data provided by the College Board, of the students taking Advanced Placement (AP) CS A in 2015, only 22% were female, up from 17% in 2000. Although we're making some progress in attracting girls to CS, there is more work to be done. One tool that can help teachers attract and keep more girls and women in their CS courses is EngageCSEdu (www.engage-csedu.org), a partnership between The National Center for Women & Information Technology (NCWIT) and Google.

EngageCSEdu is a comprehensive collection of instructional materials for introductory CS courses. These materials were created and contributed by college faculty members from across the country, and can be used in AP, CS1, and CS2 courses. EngageCSEdu includes nearly 1500 peer-reviewed lessons, labs, projects, and assignments in a dozen or more programming languages, including Scratch, Python, Javascript, and C++. All of these materials come with a Creative Commons license which allows them to be freely used and, in some cases, modified by the instructor for use in the classroom.

The goal of the EngageCSEdu project is to improve the retention of girls and other underrepresented students in computing by helping educators increase students' engagement and satisfaction with their computing courses. This is accomplished, in part, by aligning the materials in the collection to a set of "Engagement Practices" (EPs) that research suggests are likely to increase student engagement and retention in the classroom. Instructional strategies and techniques, such as using meaningful and relevant content, making interdisciplinary connections, and employing collaborative learning, are just a few of the EPs discussed.

The EPs are also used to identify the most innovative and highest quality submissions for inclusion in an "Engagement Excellence" sub-collection. One example of the kind of materials you'll find in the collection is a lab by CS professors Sarah Diesburg and Ben Schafer from Northern Iowa University. "Sets and Dictionaries to Analyze Movies" asks students to work on sets in Python to analyze two

movies using data from IMDb (Internet Movie Database). Students create a dictionary with values from these movies and process the information to determine such things as intersections between movies on actors and co-actors.

How can you be involved with EngageCSEdu? Check out the EngageCSEdu project and let us know how these materials are helpful to you and your students. Use EngageCSEdu to help increase diversity and retain your students by incorporating research-based engagement practices into your classroom. And most importantly, join the EngageCSEdu community of educators who are making a difference in CS education. For more information or to learn how to get involved with EngageCSEdu, contact us at engagecsedu@ncwit.org.

LEARN MORE:

NCWIT Tips: 8 Ways to Give Students More Effective Feedback Using a Growth Mindset: www.ncwit.org/resources/ncwit-tips-8-ways-give-students-more-effective-feedback-using-growth-mindset/ncwit-tips-8

Top 10 Ways to Engage Underrepresented Students in Computing: www.ncwit.org/resources/top-10-ways-engage-underrepresented-students-computing/top-10-ways-engage-underrepresented

Pair Programming-in-a-Box – The Power of Collaborative Learning: www.ncwit.org/resources/pair-programming-box-power-collaborative-learning

CS Spotlight

Equity in CS: From Exposure to Entrepreneurship Frieda McAlear and Omoju Miller

An innovative California partnership between a university-based computer science (CS) course and a secondary level out-of-school CS program is producing strong outcomes for underrepresented students of color. In 2013, the Level Playing Field Institute (LPFI) (lpfi.org) partnered with the Exploring CS program team and the Beauty and Joy of Computing (BJC) (bjc.berkeley.edu) developers at the University of California, Berkeley, to create an NSF-funded innovative, three summer and one academic year out-of-school Advanced Placement (AP) CS preparatory course sequence for underrepresented high school students of color. The course sequence was integrated into, and ultimately extended, LPFI's five-week, three-summer STEM program for underrepresented secondary students of color, the Summer Math and Science Honors Academy (SMASH).

Since its inception in 2004, SMASH had already incorporated some of the best practices for engaging in STEM (Science, Technology, Engineering, & Mathematics) for underrepresented youth of color from the field: instructors of color and successful STEM professionals of color to serve as role models during SMASH, culturally relevant curricula, and project-based pedagogies. The CS sequence also provided an opportunity for LPFI to implement new CS initiatives and learn more about: the potential of blended learning to increase CS course access in schools and districts without any CS courses; app-development hackathon competitions as CS exposure activities for underrepresented youth of color; and collaborative, culturally responsive activities tailored to dispel myths about CS, including the misconception that computer scientists work

alone all day in front of a computer.

Additionally, the new design-thinking Hackathon curricula provided new ways of solving community problems using technology, the ins and outs of rapid prototyping, and weighing the challenges and rewards of entrepreneurship. Exposure to computational thinking, as well as pair programming projects and exercises during SMASH CS classes, helped create learning communities focused on entry into CS careers while reducing the frustration of compiling code as beginners.

LPFI found that blended learning for the AP CS preparatory courses proved to be disconnected from students' lives and previous learning experiences that are crucial to retaining students' interest and motivation. Content delivery for the AP CS courses administered by LPFI is now more reliant on in-person instruction and face-to-face coaching, supplemented by content delivered from the Beauty and Joy of Computing MOOC (www.edx.org/course/beauty-joy-computing-cs-principles-part-uc-berkeleyx-bjc-1x).

Additionally, critical discussions in SMASH courses about the social justice issues raised by CS as a field, including all of the implications of the uneven, homogeneous tech sector growth students are witnessing in California, and some of the content of Abelson's 2008 book *Blown to Bits*, continue to remind students of the relevance of pursuing CS as technology creators. We are delighted that CS Principles courses across the country will be addressing these social justice issues as well, through the following two CS Principles curriculum framework elements:

- EK 7.4.1C The global distribution of computing resources raises issues of equity, access, and power.
- EK 7.4.1D Groups and individuals are affected by the “digital divide”—differing access to computing and the Internet based on socioeconomic or geographic characteristics.

Meanwhile, back at UC Berkeley, Omoju Miller, a doctoral candidate in CS Education, was learning how hip hop lyrical analysis could increase student retention and performance in the BJC course. Inspired by Ronald Eglash's concept of “ethno-computing,” she found that the hip hop data science lab she created for BJC helped to scaffold a connection between the students' cultural landscape and the computational topic, which in turn increased their confidence in their ability to excel in CS courses overall.

More specifically, the module had a demonstrably positive effect on African-American students in the class, some of whom confided they had been “warned away” from taking CS courses by peers and even university counselors. Upon reflection, there are several elements of the BJC curriculum we've found particularly engaging for diverse students:

- The projects are chosen by the students and there is a celebration at the end of each project where the student or team presents their work to the class.
- The “Global Impact” big idea allows students to reflect on the social implications of computing all around them.
- “Computing in the News” bell ringer activities allow students to see the effects of computing innovations, and discuss data and privacy implications.
- Students utilize pair programming throughout the course, so they never feel alone.

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- The graphical coding language Snap! allows students to create interactive multimedia programs without the frustration of typos and syntax errors.
- They participate as part of a learning community.

These interventions, when viewed at a glance, reflect the innovation in approaches and tools used by SMASH and the Beauty and Joy of Computing team to attract and retain CS students who mirror the diversity in our country. They also represent developments in forging inventive, generative partnerships and iteratively integrating fresh perspectives into the curricula, pedagogies, and tools used by educators.

Frieda McAlear, Research Associate at LPFI; Omoju Miller, CS Education Researcher at UC Berkeley; Daniel Garcia, Teaching Professor at UC Berkeley and one of the co-developers of the Beauty and Joy of Computing course; and Alexis Martin, Director of Research and Evaluation at LPFI, collaborated on this article.

K–8 Community Building

Sheena Vaidyanathan

Editor's note: A lot is going on in K–8 computer science (CS) and the CSTA K–8 Task Force is prepared to help. In this interview Sheena Vaidyanathan describes the online community, discussions, chats, and future plans.

CSTA: How did the #CSK8 community chat and online discussions get started?

Vaidyanathan: In early 2015, the CSTA K–8 Task Force decided to host twitter chats on a regular basis. We discussed how to reach different groups of educators and came up with a plan of bi-weekly chats.

CSTA: What are your goals?

Vaidyanathan: We want to provide a place where CS teachers can share and learn from one another. Many of us are the only CS teacher in our schools and we definitely benefit when we connect with other CS teachers.

CSTA: How is it organized?

Vaidyanathan: The Task Force uses a Google document to brainstorm topics and questions in preparation for a chat. Members volunteer to moderate the sessions conducted with Google hangouts or a live chat.

CSTA: What kind of response have you been getting?

Vaidyanathan: It has been outstanding. We have a nice steady set of followers and are happy to welcome new participants. Educators come ready and excited to share, and many side conversations begin when teachers discover someone else with similar interests and want to communicate directly. Visit tinyurl.com/K8CSTA to view the conversations.

CSTA: How does it work?

Vaidyanathan: It's easy. Check the schedule on the Google+ community at: plus.google.com/communities/111803101139836526905/stream/00a8a67d-804b-4ee1-9c95-0852dfa0b171.

- Get a Twitter account.
- Visit Twitter from 5 pm to 6 pm PST on the scheduled day.
- Search for hashtag #csk8 to find the questions.
- Respond with #csk8 included.

CSTA: Anything else?

Vaidyanathan: The archives of past chats are available from the #CSK8 Chat Archives link at: tinyurl.com/K8CSTA.

MARK YOUR CALENDAR

Cutler-Bell Student Contest

January 1, 2016, deadline
csta.acm.org/Advocacy_Outreach/sub/Cutler-BellPrize.html

FETC (Future of Education Technology Conference)

January 12-15, 2016, Orlando, Florida
fetc.org

Congressional App Challenge

January 15, 2016, deadline
congressionalappchallenge.us

TCEA 2016

February 1-5, 2016, Austin, Texas
www.tceaconvention.org/2016

ACSL Contest #2

February 12, 2016
www.acsl.org

SIGCSE

March 2-5, 2016, Memphis, Tennessee
sigcse2016.sigcse.org
Meet CSTA staff and Board members at the CSTA booth!

ACSL Contest #3

March 11, 2016
www.acsl.org

ACSL Contest #4

April 15, 2016
www.acsl.org

CUE 2016

March 17-19, 2016, Palm Springs, California
www.cue.org/national

2016 CSTA Annual Conference July 10–12, 2016, San Diego, California cstaconference.org

Check the most recent CSTA events on the CSTA website

csta.acm.org/ProfessionalDevelopment/sub/TeacherWorkshops.html
List your CSTA event by contacting t.nash@csta-hq.org