Diversity Challenges & Opportunities in K-12 Computer Science

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Richard Tapia Celebration of Diversity in Computing

Portland, OR
Broadening Participation in Computing for Los Angeles Students

Computer Science Equity Alliance

CSEA

UCLA
The Initial Strategy:
Increasing Enrollment in AP Computer Science

- **Professional development**: Week-long professional development sessions each summer
- **Student Outreach**: Monthly “AP Readiness” workshops for teachers and students, led by university and K-12 computer science instructors
- **Curricular Materials**: Secured district-wide common curriculum
- **Connection to Local Teaching Community**: Built a community of practice amongst district computer science teachers to discuss curriculum, pedagogy, assessment, recruitment techniques, and related topics.
Need to Change Strategies

- No computer science certification pathway, so teachers need intensive professional development for content and pedagogy
- AP Computer Science is not the best course to draw K-12 students into computing
  - Too steep of a learning curve for many students without a preparatory course
  - Too few students enrolled in computer science, making it a difficult course to maintain
  - “Boring” – programming-centric, didn’t tap into familiar technologies
New Direction: *Exploring Computer Science*

**Features**
- Inquiry-based curriculum
- Each unit finishes with a large, unit project
- Daily instructional plans, assignments, rubrics, and discussion notes are included

**Instructional Units**
1. Human Computer Interaction
2. Problem Solving with Computer Science
3. Web Design and Animation
4. Programming with Scratch
5. Data Modeling and Python
6. Robotics with Lego Mindstorms
Realities of Urban Schooling Systems

- District leadership and priorities shift
- School administration changes
- Teacher assignments change (schools/classes)
- Federal (*No Child Left Behind*) and state (High School Exit Exams) policies drive priorities and funding
- Despite initial installation, hardware is not adequate to teach classes of computer science
- Courses have to meet many requirements to be sustainable
- There is little money for computing resources
Looking Ahead

• Building K-12 CS Education needs Local Support
  
  (local curriculum, teacher communities, student outreach, role models)

• Building K-12 CS Education needs State and National Support

  (teacher certification, curricular sequence, education policy inclusion, funding, image campaign)
The High School Perspective

John Landa
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Computer Science Teacher
South East High School
My Story

- College/Career Path Influences
  - AP Computer Science
  - My Uncle (Electrical Engineer)
- BS in EECS from Berkeley
- Former .com-er
My School – South East High

- LAUSD
- Low performing school
- 99.9% Latino
- Many English Learners
- Many students come in without exposure to Computer Science
How To Become A Teacher

- I started teaching Math while earning my credential
- Obstacle
  - Getting qualified teachers into the classroom
  - Howard’s story
    - Have you seen Pirates of The Caribbean 2?
  - Daniel’s story
How to Start Teaching CS

- “If you ever want to start APCS, I’ll teach it”
- Enter Jane and Todd
- I had to take an auxiliary (and 4 preps)
- Recruit your own students
  - Students cross-tracking
  - Split Roster
- No Books until February
- Obstacle II
  - Administration/Counseling
    - Open minded?
    - School needs
Easing the Transition

- Summer Institute/PD
  - Local APCS workshops hard to find
- UCLA Engineering tutoring
- UCLA AP Readiness
- Community of Teachers
  - Normally only one CS teacher per school
- ICT Curriculum
- Obstacle III
  - Is this enough PD?
Current Trends in Schools

- Small Learning Communities
  - Each SLC has a theme (career focus)
  - Electives support theme
- 4x4 Schedule
  - 8 classes a year instead of 6
  - More room for electives!
- Obstacle IV
  - Getting the teachers in place
  - Informed counselors
Student Results

- **Juan**
  - Lacked Motivation in 9th/10th grade
  - Talked about getting a 2 year degree
  - CS has been his motivation
  - Will study CS at Fresno St.
  - Will be first in his family to attend college

- **Other Students**
  - Didn’t pass the AP Test
  - Majoring in CS
  - First CS class was easy
Exploring Computer Science

- Expose students to Computer Science without having to take AP
- Pre-AP
  - Can be a feeder class
- Engaging
- Relevant to students
- Appropriate pedagogy
Student Work

- Scratch Timing Game
- Data Modeling Final Project
  - Earthquake data from UCLA Center for Embedded Networked Sensing.
New Partnership for Progress:
How CSTA Can Help You Create Change

CHRIS STEPHENSON
New Economic Realities

• Jobs in computing represent the fastest growing segment of the economy with demand predicted to wildly outstrip our ability to produce workers

• Without a sufficient number of highly skilled CS professionals, we will lose our competitive edge in key areas such as IT, communications, health....

• Globalization means access to world-wide talent and even states now must compete against the global talent pool for jobs
Classroom Realities

“Being the only CS teacher at my school I work alone on creating lessons, assignments, tests, etc., and I have no one to lean on. As technology changes I have no time to learn and practice the new information. When I am absent from school there are no substitutes who can step in where I can actually leave a real lesson (not that I would have them teach a new concept, but they cannot support the students). In my eyes, my district is so afraid of the technology that I am not allowed to teach what the kids are interested in, they must take classes at the local community college after their regular school day ends, or just wait until college. Our school does not enforce our prerequisites for any of my computer classes and students come in not ready/able to do the work. There is only one introductory CS course students can take and then AP. There is no other class for students to take—they become interested in CS and then can't do anything with it!”
Decentralized Decision-Making

The decision-making authority for publicly funded schools in the U.S. is exceedingly complex, but it is safe to generalize in the following ways:

- Decisions regarding the distribution of federal funding are made at the federal (national) level but these primarily affect low-income urban schools.

- Most of the funding for schools is determined locally, so the quality of individual schools varies enormously based on the wealth of the school community.

- Decisions regarding teacher qualifications and teacher certification are made at the state level and the rules differ markedly from state to state.

- Decisions about curriculum are made at the local level (there are no national curriculum standards for any academic discipline), so what students learn varies enormously from school to school and even from classroom to classroom.
Systemic School Issues

• Restriction of the curriculum to "core subjects" (the 19th century cannon)

• A focus on remedial learning at the expense of opportunities for rigor and engagement

• Confusion about the nature of computer science itself

• CS education is so fragmented that a CS course designation has no real meaning

• So many schools are placing their computers in the tech department that universities no longer believe that high school CS courses are academic courses like other sciences and math
Lack of Understanding of CS

- Computer Science courses are often confused with educational technology courses (vocational courses rather than rigorous academic courses)

- Computer science is not keyboarding or using applications such as word processors, spreadsheets, or databases

- Computer science is not the same as using computers to enhance learning in other academic disciplines (just having computers in the school does not teach students the fundamentals of computer science)
CSTA’s Goals and Objectives

Creating a community of individuals and organizations working together to address critical issues in K-12 computer science education.

**Promote a Better Understanding of Computer Science:** Provide visibility, influence policy, and generate resources that illuminate computer science as an essential academic discipline.

**Develop Research and Resources:** Conduct original research and serve as a direct-to-practitioner channel for the dissemination of research and resources that address current knowledge gaps.

**Support National Standards:** Facilitate the implementation of national curriculum and teacher certification standards to support consistent excellence in learning and teaching.

**Support Teacher Excellence:** Provide multiple levels of professional development to improve teachers’ technical knowledge and pedagogical skills.

**Opportunities:** Promote computer science as a field of study and as a career destination that provides a wealth of opportunities to students regardless of their gender, race, or socio-economic status.
CSTA Leadership Cohort

- The Leadership Cohort workshop (July 2008) provided teacher leaders from 17 states with valuable resources and training to assist in their leadership and advocacy efforts
- Worked to create local CSTA chapters
- Held meetings with school, district, and state representatives
- Created CS strand at state level conferences
- CSTA Advocacy Toolkit
- Presentation for business and industry
- Workshop for teacher leaders from remaining states to take place July 7-9 in Chicago
• For computer science teachers, the challenge of becoming and remaining exemplary educators is hampered by systems of pre-service education and teacher certification that are profoundly disconnected from the discipline of computer science and the needs of teachers and students. This white paper addresses a number of aspects of the crisis in high school computer science teacher certification. It includes a comprehensive description of the issues relating to certification, a review of the relevant research literature, a selection of examples of current teacher certification models, and a set of recommendations for a multi-level model that will provide detailed requirements for educators from multiple pathways, including new teachers, teachers from other disciplines with computer science experience, teachers with no computer science experience, and people transitioning to teaching from business and industry.
Curriculum Resources

• The **ACM Model Curriculum for K-12 Computer Science**: sets the context for computer science within K-12 education today and provides a framework for state departments of education and school districts to address the educational needs of young people and prepare them for personal and professional opportunities in the 21st century.

• The **Level II Objectives and Outlines** document presents the learning objectives, assessment measures, and sample educational activities for the Level II course, which is recommended for all students in grades 9 or 10.

• The **Level III Objectives and Outlines** document presents the learning objectives, assessment measures, and sample educational activities for the Level III course which is intended for students who may be interested in continuing their education in computer science and other computer-related disciplines at the college level.
The College Board announced the elimination of the AP CS AB (data structures) exam, leaving only the AP CS A exam starting next year. They formed a Review Commission to determine what CS AP should look like and to create a new course. The commission met for a year. NSF began talking to College Board about creating a new, more engaging and accessible exam. Two meetings were held to get more feedback from colleges and universities on the future of AP CS. The AP CS Development Committee will now be charged with updating the CS A exam (and possibly adding some materials from the former AB exam). A new Review Commission has been formed (but has not yet met) to devise a new (pre-A) AP CS exam.
Careers Resources

• The **IT is all about me** poster invites students (especially young women) to consider a career in the computing disciplines and makes connections between popular professions and computer science.

• The **Imagine Your Future in Computing** brochure helps students make connections between the technologies they use every day and the courses and the career opportunities available to them.

• The **Computing Careers and Degrees** brochure provides key information about computing careers and educational pathways.
New Equity Initiatives

- Spanish-language version of the **Consider your future in computing** brochure
- Work with NCWIT on the K-12 Alliance and the **Gotta Have IT** kit (5000 copies to be distributed at NECC)
- New CSTA shareable poster
- Upcoming town hall and workshop with the Anita Borg Institute
- Articles and features in CSTA publications focusing on equity issues
- Equity focus of the 2009 CSIT symposium
New Research

• Database of teacher certification requirements for every state
• Results of the 2007 CSTA National Secondary Computer Science Survey
• State-level data from the 2007 CSTA National Secondary Computer Science Survey
• Results of the 2005 CSTA National Secondary Computer Science Survey
• New national survey of 36,000 high school CS teachers is now underway and will give us a six-year view of high school CS in the U.S.
CSTA Publications

- Complete overhaul of CSTA website (csta.acm.org)
- **CSTA Voice** (now published bi-monthly)
- CSTA Advocate blog (blog.acm.org/csta/)
- Podcasts on key issues in K-12 CS education
- Videos on improving outreach to K-12
Repositories and Databases

• The Source web repository is a searchable database with more than 200 unique resources: lesson plans, modules, presentations
  o Every resource is reviewed by a committee of experts to ensure that it is complete, relevant, appropriate, and pedagogically sound
  o The classification system links directly to the ACM Model Curriculum so you know immediately which course and learning outcomes it addresses

• CSTA provides a searchable database of the CS teacher certification requirements for every state
Professional Development

• Teacher Engagement in Computer Science (TECS) Workshops across the country to help teachers improve their technical and teaching skills (*more than 96 workshops held*)

[Image: TECS Logo]

• The annual Computer Science and Information Technology (CS&IT) symposium brings teachers together with the innovative thinkers in the field to share solutions and strategies. CSIT 2009 will take place Saturday June 27 in Washington, DC

[Image: CSIT 2009 Logo]
New Customizable Poster

• Poster created as part of CSTA’s commitment to helping colleges and universities improve their K-12 outreach

• CSTA will distribute copies directly to its members and at its professional development events

• CSTA will make available a customizable pdf file so that colleges and universities can add their own logos and contact information
What Next?

- Work on CSTA sustainability issues including new grant opportunities
- Work with EPC to strengthen U.S. education policy relating to K-12 CS
- Leadership and advocacy training for 60 more teacher leaders
- Double the number of local CSTA chapters
- Major membership promotion to grow U.S. membership
- Put policies and procedures in place for international chapters
- Continued work on AP CS Commission
- Release of the new Level I Objectives and Outlines document for grades K-6
- Distribution of the teacher certification white paper
- Presentations at ITiCSE
- Possible trip to meet with key K-12 CS leaders in New Zealand and Australia
- 2009 National High School Computer Science Survey
- Workshop to train volunteers to evaluate and classify materials for the Source repository
- CSIT 2009 in Washington, DC June 27, 2009
- Hopper Conference Town Hall and Teacher Workshop
Discussion

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