Computer Science Segregation

Creating Opportunities

Jane Margolis and Joanne Goode

Editor's Note: *This is the second of a two-part series on the diversity research of Jane Margolis and Joanna Goode in the Los Angeles Unified School District (LAUSD) that led to the book* Stuck in the Shallow End: Education, Race, and Computing *(MIT Press, 2008). Part one focused on the research. Part two focuses on resulting initiatives.*

Our 2001-2004 research uncovered serious disparities in computer science (CS) education in LAUSD public high schools that could only be addressed with multiple levels of intervention.

We began these efforts by forming the Computer Science Equity Alliance (CSEA), a K-12/university collaboration that included university educational researchers, university computer scientists, and school district officials. CSEA's mission is to increase the quality of high school CS learning opportunities for traditionally underrepresented students in the LAUSD. Our goal is to help deepen the capacity of LAUSD to offer and support high-quality, college preparatory CS classes, and to subsequently increase access to rigorous learning in high schools with high numbers of African-American and Latino students.

Currently, our major CSEA project is to create the curriculum for a new college preparatory CS course, Exploring Computer Science. This project will:
• Create a new college-preparatory CS high school course that teaches the foundational, creative, collaborative, interdisciplinary, and problem-solving nature of CS;
• Assure college admissions credit for this course as a high-level mathematics elective;
• Produce instructional materials, including a guide for teachers featuring an inquiry-based approach to learning and teaching;
• Provide teacher professional development to support this course, and involve teachers centrally with course development;
• Design this course to assure that the curriculum is engaging, meaningful, and relevant for diverse communities of students, and is available at public high schools, especially those with high concentrations of students of color.

We are also building support for these efforts amongst counselors and principals throughout the district. This is all part of our strategy to create sustainable changes in the district pursuant to our mission of broadening the participation in computing.

Applying the research to the classroom

It is our hope that this university/district collaboration will also provide a model for partnerships between higher education, including community colleges, and school districts to increase the support for teaching and learning of CS in K-12 education. Colleges and universities are in a critical position to help support professional development and provide student outreach opportunities. Teachers play an important role in voicing the unique challenges they have in their work of teaching

COMPUTER SCIENCE SEGREGATION

continued from page 1

K-12 CS courses. When teachers have the opportunity to come together to discuss issues of curriculum, pedagogy, and diversity in CS, the entire enterprise of computing education is strengthened.

In order to broaden the participation of computing in middle school and high school education, teachers must reflect on how their recruitment strategies and classroom teaching strategies attract (or repel) traditionally underrepresented students. We believe that CS teachers should make a special commitment to re-evaluate their pedagogy and curriculum. How can you connect CS to the issues that are important for students in their different communities? How can you present different types of role models so that students can see diverse images of computer scientists? It is very important to consider whether you, as a teacher, are teaching CS in an engaging way that draws on the cultural knowledge of a diverse body of students.

How can you connect CS to the issues that are important for students in their different communities?

Interventions

Since few schools in LAUSD offer rigorous computing courses, a key intervention is to simply assure that quality CS classes are offered in the schools. This requires meetings with the principals and district leaders so that they understand the importance of these learning opportunities for all students. This is a challenge during the years of NCLB, high school exit exams, and all the testing pressures that are present in the schools.

In addition, teachers must be offered professional development. CS is a subject that is continuously changing. In response to this dynamic nature of the discipline, we have offered a summer institute for teachers for four years where teachers are able to review the course content, develop an engaging pedagogy, learn from each other, and talk about broadening the participation in their courses.

Students must also be supported. For this reason, CSEA has offered monthly Advanced Placement Computer Science (AP CS) Readiness classes at UCLA for the past five years. These classes provide students with supplemental instruction in preparation for the AP CS exam.

Recruiting

Since the dominant stereotype of a CS student is a white or Asian male who is obsessed with computers and spends all of his time in front of the computer, a generic or untargeted recruitment pitch in classes will often miss students who see themselves as different from the stereotype. We have found that when teachers and counselors are purposeful in specifically encouraging girls and underrepresented minorities to consider enrolling in a CS class it can widen the pool of students who even hear the recruitment message.

Purposeful Recruiting

Effective Ideas from Jane Margolis and Joanna Goode

1. Begin early

Many schools create the academic course offerings schedule more than six months in advance of the new year! Thus, computer science (CS) teachers should check with administration early on to ensure the course will be offered to students. Without the course in place, it is difficult to recruit students to study CS in addition to the rest of their academic workload.

2. Recruit from mathematics and art courses

It is important to realize that the foundation of CS is mathematics, not computer literacy skills. In fact, the only prerequisite for Advanced Placement CS is Intermediate Algebra. Thus, visiting Intermediate Algebra mathematics courses in the spring before students begin meeting with their counselors to choose courses for the following year is a good idea to reach targeted and prepared students. But, don't forget the students who are interested in graphic arts, film, and animation! They also are potential CS students.

3. Personally invite students to join the course

Assure them of their qualifications for the course if they have completed the appropriate mathematics courses. We have found that CS is a term many find intimidating, but telling students they are already qualified and you want to invite them to your course has been met with great success. As a result of such a personal invitation letter, one of our teachers had over sixty students enroll in the course.

4. Work with counselors

Ensure they are familiar with the prerequisites, the academic content of the course, and the narrow stereotypes that cause them to overlook many potential students. A brief factual sheet to leave with the counselor could be helpful. Since counselors are the folks who interact with students and steer them towards coursework, it is vital that all the counselors be familiar with your course and your desire to recruit more students, especially underrepresented students. Once again, these meetings with counselors should take place in the winter of the prior year before counselors begin meeting with students.

5. Encourage CS students to invite their friends

Friends could attend the class, either the same year or following years.

6. Target groups of friends

Especially females and underrepresented students may enroll in the course if they know they will not be "alone." Our research has shown these students are more likely to be retained if they have a social support network in the classroom.

Listen and Share

Jane Margolis speaks with CSTA about her research in the Los Angeles Unified School District. The findings are reported in the book, *Stuck in the Shallow End: Education, Race, and Computing*. Margolis describes the disparities found in computing education opportunities among schools within the district, and the steps being taken to resolve some of the key issues. Our conversation will open your eyes to conditions in computer education, encourage you to question old assumptions, and inspire you to look at equity issues from a new perspective.

csta.acm.org/Resources/sub/Podcasts.html

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ACM founded CSTA as part of its commitment to K–12 computer science education.

COMPUTER SCIENCE SEGREGATION
continued from page 2

A purposeful recruitment message includes an explanation of how all different kinds of students find the problem-solving of CS to be interesting, challenging, and meaningful, and how computing can solve problems in local communities and in our larger society. A list of strategies for recruiting more students, especially females and students of color, into high-level CS courses can be found in this issue of the *Voice*.

Successes

Our partnership with LAUSD has been very successful—including our relationship with district leaders and a community of CS teachers who have really extended themselves in all ways to re-think how they are teaching CS. Our initial efforts to increase access to an AP CS course were successful in that, after two years of teacher professional development and student support programs, the number of girls enrolling in the course quadrupled, the numbers of Latinos quintupled, the number of African Americans doubled, and overall enrollment in the course almost tripled. Our most important ongoing success is building a community of teachers and real collaboration with leadership of the LAUSD and with a core group of committed teachers.

Technology to the Rescue

Long-distance Computer Science

Robb Cutler

Editor's note: *Teaching computer science (CS) in real-time to students thousands of miles away is not the typical high school teaching job, even in our high-tech world. In this article, Robb Cutler explores the potential and limitations of teaching students in Taiwan from his California home.*

In February, I received a call from a good friend who happens to be the principal of the Taipei American School (TAS). He explained that his computer science teacher, Dave Wittry, had recently passed away unexpectedly and that I needed to "drop everything and come to Taiwan to teach right away."

Unfortunately, travelling to Taiwan at that time would have meant putting my new business on hold and being away from my family for a minimum of four months. It just wasn't possible. Instead, I suggested that we might be able to arrange things so that I could teach the classes virtually. After some discussion, he agreed to give it a try.

It was important to provide curriculum continuity for the students in Introduction to Computer Science and AP Computer Science AB classes, and to prepare those students for the AP exam in May. It was also important that students had a learning experience that was as close to a "normal" classroom experience as possible, in spite of the fact that the teacher's voice would be coming out of a computer speaker rather than a body in the front of the classroom.

On a typical day, I would login to Blackboard, TAS's web-based course content management system, and start the combination chat and whiteboard application. I would also login to Skype and make

a voice connection with the teacher who monitored the class in Taiwan. Students logged in as they arrived and I would start class. After taking attendance and answering any homework or lab-related questions, I would spend about 15-20 minutes introducing a new CS topic or technique. Students were able to ask questions either

> ## I also learned one day in April, when I showed up for class an hour early, that Taiwan doesn't have daylight savings time.

by speaking or by typing their question in the chat application, and both the students and I were able to draw pictures on the virtual whiteboard as necessary.

The remainder of the class period was devoted to student lab and project work. At any time, I could demonstrate using a free web-based service called ZohoMeeeting (*www.zoho.com*); students could see my desktop and I could see theirs as they demonstrated their programs. Homework and lab were assigned and collected using the Blackboard system.

In general, the classes went well. The students were bright, motivated, and genuinely interested in CS. They were completely unfazed by having a virtual teacher and extremely comfortable with the various electronic tools we used to conduct class.

Of course, we had our share of challenges. Surprisingly, the biggest hurdle was keeping up with the various schedule changes at the school. A last-minute assembly would cause my class to start fifteen minutes earlier than normal—something I didn't find out about until I

logged in fifteen minutes late! I also learned one day in April, when I showed up for class an hour early, that Taiwan doesn't have daylight savings time.

There were the occasional technical glitches as well. Sometimes the amount of Internet bandwidth we had available just wasn't enough to support a clean video or voice connection over Skype or smooth animation when students were presenting their projects. The Blackboard Web site often dropped student connections, causing students to have to repeatedly reconnect. Furthermore, I found that it's extremely difficult to draw a good binary search tree quickly using a mouse!

From a pedagogical perspective, I missed being able to respond to the subtle clues that indicate student understanding or lack of it. Unfortunately, in an online environment, that contextual feedback is missing, making it much more difficult to know if your teaching is effective.

All in all, the classes were a success; the students, their parents, and the school were all happy with what the students learned; the introductory students put together some very interesting projects; and the AP students did well on the exam. While virtual teaching had its limitations, it was certainly a satisfactory solution under the circumstances.

I was reminded why teaching is so important and so fulfilling when on the last day of class, the other TAS CS teacher arranged Pearl Milk Tea Day (a CS tradition at TAS) to celebrate the life of Dave Wittry. Each student remembered Dave and personally thanked me for my teaching. It was a touching moment and a special way to end the year.

CSTA Members in the News: *Technology Teacher of the Year*
Congratulations, ALAN CUNNINGHAM and DALE YOCUM!

Alan Cunningham, science and technology teacher at Arlington High School in Arlington, Oregon, has been named TechStart "Technology Teacher of the Year." The award recognizes teachers for excellence in STEM (science, technology, engineering, and math) education. It is based on the educator's teaching and learning activities, including work with students in and outside of class, work with other teachers, service to the community, and continued learning.

Honorable mention was awarded to Dale Yocum of the Catlin Gabel School in Portland, Oregon. Dale is an engineering and robotics teacher in the middle school. The selection committee is comprised of CSTA-Oregon members and industry professionals. TechStart is the educational foundation of the Software Association of Oregon.

Meet the Authors

Susan Boone
Westside High School, Houston, Texas
Susan taught mathematics for 20 years before turning her attention to teaching technology applications for the last 7 years. She has also written Web design curriculum and teaching materials.

Robb Cutler
Robb is the president of Tutor Crossing (*www.tutorcrossing.com*), a Web-based business devoted to building a community of tutors, students, parents, and schools. Robb is also the past president of CSTA.

Dr. Joanna Goode
College of Education, University of Oregon
Joanna is an assistant professor and previously worked as a mathematics and CS teacher at an urban Los Angeles area high school. Her research examines why so few females and students of color study CS.

Jane Margolis
Graduate School of Education and Information Studies, UCLA
Jane is a social science researcher. She focuses her research on social inequities in education and for the last fifteen years has concentrated on the gender and race gap in CS education.

Pat Phillips
Editor, CSTA Voice
Pat taught CS at Craig High School in Janesville, Wisconsin for 20 years. She operates her own educational technology consulting business and is currently directing a Web design curriculum pilot program.

Samuel K. Puich
Neumont University, Utah
Samuel is the Provost and Chief Academic Officer of Neumont University in South Jordan, Utah. He has over twenty years of experience in the classroom at both the high school and collegiate levels. His interests in education center on problem and project-based learning.

Alfred Thompson
Alfred is the K-12 Computer Science Academic Relations Manager for Microsoft. He taught high school CS for eight years, has written several text books, and has been an AP CS reader.

Out and About the Community

Digital Games Conference
Alfred Thompson

There is a lot of buzz among computer science (CS) teachers about teaching CS using game development. But there are a lot of questions as well. Can you really teach the important CS concepts in a curriculum focused on game development? What teaching and development tools are available? Does it really work in classrooms? The Fourth International Conference on the Foundations of Digital Games is an event that tries to answer these questions and many more.

Organizers are eager for high school teachers to participate in the event. They understand the need for getting students interested in CS at an early age—before they get to college. They also believe that when teachers and students understand the value of the game industry to business and education, prejudices will diminish and excitement in CS will grow.

Previously known as Academic Days in Game Development and Computer Science Education (GDCSE'08), this unique conference brings together educators and industry experts to explore game research and the breadth of game use in CS education. This is a serious academic conference held in a locale that encourages networking and informal conversations like few others. The information is both forward looking and immediately actionable.

The agenda will include presentations on using games in first programming courses, new teaching tools, and using media such as music and art in CS. Industry leaders will describe the demand for serious CS skills and opportunities for students who can combine those skills with advanced mathematics and physics for exciting careers. Teachers will learn first-hand from higher education faculty about opportunities and CS programs so that they can better advise their students.

The Foundations of Digital Games Conference will be held onboard the Disney Wonder leaving from Port Canaveral, Florida, on April 26, 2009, with port calls in Nassau and Castaway Cay, Bahamas, and returning on April 30, 2009.

Information is available at the conference Web site *foundationsofdigitalgames.org/*.

College Connection

Neumont University
Pat Phillips

Editor's note: *This dialog with Samuel K. Puich, Provost and Chief Academic Officer of Neumont University, is a continuation of our series of interviews with CSTA institutional members. Please share with your students these details about the computer science (CS) programs at Neumont University.*

The Neumont University campus is 48,000 square feet of glass, marble, and steel, located along the west bank of the Jordan River in South Jordan, Utah. The campus is situated within miles of some of the nation's largest technology employers including eBay, Oracle, Novell, and CA. Neumont University, founded in 2002, offers three degree programs: Associate of Science in Computer Science, Bachelor of Science in Computer Science, and Master of Science in Computer Science.

CSTA: What draws students to your program and what keeps them there?
Puich: Neumont University's "hands on," learn-by-doing formula is the key draw for our students. Although we lecture and discuss topics, students have the opportunity to use the tools, test the theories, and apply the principles in actual project environments.

In the first third of a student's program, the courses are designed to nurture professionalism, develop critical-thinking skills, and expand technical knowledge as they work in both individual settings and collaborative groups.

The second third of their education focuses on applying fundamental principles to solving problems and creating actual projects. Students take what they have learned, and under the facilitation of a professor, define, design, and develop a solution to a problem in their interest area.

In the final phase, students work under the direction of an actual company. They have the opportunity to develop applications and contribute to projects and assignments being completed by these companies.

CSTA: What skills can students acquire before college that will help them succeed in your program?
Puich: Because Neumont University is an accelerated program, the best skills that students can possess when they enter our doors are good study habits. Students should be prepared for the fast pace and be ready to work very hard. It is a challenging program but also very rewarding and satisfying.

Students should also have an adequate mathematical background. Although no CS experience is required, it is very helpful.

CSTA: What cool careers are your graduates prepared for?
Puich: Our students can prepare for a career as a software engineer, software architect, Web designer, mobile device developer, entrepreneur, software project manager, information technology consultant, information assurance and security expert, midrange platform developer and administrator, system administrator, digital designer, or a game developer.

CSTA: What topics will students study?
Puich: In addition to the technical topics, students will build a strong resume and portfolio with courses that build skills in professionalism, collaboration, communication (both oral and written), and problem-solving.

CSTA: Tell us a bit about the social environment of the CS program.
Puich: At Neumont, students have an opportunity to immerse themselves in our techno-centric environment and enjoy LAN parties, coding competitions, science and robotics clubs, and more. Plus, Utah is a great place to live! It's as diverse in people and cultures as it is in seasons and landscapes. More information about life in Utah can be found in the Student Living section of the Neumont Web site at *www.neumont.edu/students*. Currently 30 percent of our student population comes from Utah, with the other 70 percent coming from 48 states and 13 different countries.

Classroom Tools

Web Design Curriculum Available
Susan Boone

Like many teachers, I have found that rapid technology and curriculum changes have made it necessary to continually recreate my Web design curriculum over the years. So, keeping my curriculum

up-to-date has been a daunting task. Fortunately, there are teaching and learning tools that are making my job easier.

The new semester-long curriculum, *Introduction to Web Design Using Microsoft® Expression® Studio*, provides an extensive collection of creative resources that thoroughly span Web design knowledge and skills. It promotes meaningful, real-world, collaborative learning experiences. This curriculum uses Microsoft Expression Studio (the replacement for FrontPage) and incorporates several of the topics and goals in Level II of the *ACM Model Curriculum for K-12 Computer Science*. Student activities concentrate on the objectives found in Topic 9: Ethical Issues, Topic 10: Careers in Computing, Topic 12: Web page Design and Development, and Topic 13: Multimedia.

The standards-based curriculum also aligns with *21st Century and ISTE NETS for Students* standards and goals.

The current beta version of this curriculum is being tested in 45 schools across the country. A revised version that includes the suggested revisions from pilot teachers will be available in time for second semester. It will be updated yearly to keep it fresh and current.

I had the opportunity to use Expression Web software and a curriculum unit and tutorial with my students last spring. The software is simple to use and incorporates many familiar Microsoft interface features. The recently released 8-module curriculum is available for download at *www.microsoft.com/facultyconnection/precollegiate*

Curriculum topics include:
- Beginning HTML with CSS
- Internet history and future
- Web standards and accessibility
- Communication for the Web
- Creation of Web media
- Team planning, development, and publishing of Web sites
- Optimization and usability testing
- Career exploration

Bits and Bytes

Our Favorite Strategies

Editor's note: *One of the best things about visiting with fellow computer science (CS) teachers is sharing effective classroom strategies. Here are a few favorites from members of the CSTA Board of Directors.*

Michelle Friend Hutton
The Girls' Middle School, Mountain View, California
mfh@csta.acm.org

I write programs "live" in front of the class. I connect my computer to the projector and start with a blank window. While I'm writing the program, I interact with the class, explain ideas, get feedback, and ask for ideas. For example, when I demonstrate the use of conditionals, we write a small program that asks for the user's name and then gently insults siblings, but compliments parents and teachers.

I enter code as the class dictates. After we write part of the program together, finishing it becomes a homework assignment. Students engage in this activity because they see their ideas appearing on the screen.

I know this is an effective strategy because I get to model good programming practices and habits for remembering to close braces, finding missing semicolons, or debugging errors and unexpected results. Best of all, I make mistakes! Not only can I show how to fix errors, but students see that even experienced programmers are not perfect.

Margot Phillipps
Lynfield College, Auckland, New Zealand

I understand that recently the U.S. Democratic nominee for President was asked some tricky CS-type question. He paused, thought, and then said, "Well, I wouldn't use a bubble sort." So, it is now publically a disreputable algorithm!

However, the bubble sort is a wonderful example for illustrating the value of accurate and detailed algorithms. I draw vertical lines on the whiteboard, place a number above the spaces, and randomly select students to stand in a position in the array. I explain the sorting rules and ask one student to sort the selected students in order of height, according to the rules. As one of the students has to step forward to exchange places, it conveys the idea of the temporary storage space.

I know this is an effective strategy because the actual experience of "seeing" the sort enables students to better understand not only the sort, but also the need for detailed algorithms for implementing processes and evaluating efficiency.

Barb Ericson
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Assigning an open-ended project such as an image collage using media computation, an Alice movie, a Scratch game, or a robot dance, engages students in creating something they personally care about. I know this is an effective teaching strategy when I see students think deeply about what they are doing and use the concepts being taught to solve problems they want to solve in their personalized project.

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I think it was one of the Unix gods from the 70s who said, "make it right before you make it better." This is especially true in writing and designing programs. It is very much easier to make changes to a working program, or to see how a working program could be improved, than it is to get something working in the first place. Because of this, I rely heavily on example code and encourage students to combine their own code segments and cannibalize from themselves rather than always starting from scratch. I know this is an effective strategy because it fits the basic mantra of the scientific method: don't try to evaluate several variables all at once; test the changes one at a time.

FINANCIAL IMPACT OF DIGITAL GAMES

Sales (including hardware, software and accessories)
2006 . . . . $12.5 billion
2009 . . . . $18.8 Billion

Consumer age group of greatest % of growth . . . 35 and older

Young people (12-17) who play digital games
Boys 99%
Girls 94%

SOURCE: *The NPD Group*
(www.npd.com/press/releases/press_080131b.html)
www.cnn.com/2008/TECH/ptech/09/16/videogames.survey.ap/

MARK YOUR CALENDAR

Consortium for Computing Sciences in Colleges
(CCSC: Southeastern)
November 7-8, 2008 in Augusta, Georgia
cs.furman.edu/ccscse/

Texas Computer Education Association (TCEA) Convention
February 2-6, 2009 in Austin, Texas
www.tcea.org/convention/2009/attendees/Pages/default.aspx

SIGCSE 2009
March 4-7, 2009 in Chattanooga, Tennessee
www.cs.arizona.edu/groups/sigcse09/

Richard Tapia Celebration of Diversity in Computing
April 1-4, 2009 in Portland, Oregon
tapiaconference.org/2009/

Consortium for Computing Sciences in Colleges
(CCSC: Mid-South)
April 3-4, 2009 in Martin, Tennessee
www.ccsc-ms.org/

Consortium for Computing Sciences in Colleges
(CCSC: Central Plains)
April 3-4, 2009 in Bolivar, Missouri
www.ccsc.org/centralplains/

Consortium for Computing Sciences in Colleges
(CCSC: Southwestern)
April 3-4, 2009 in San Diego, California
www.ccsc.org/southwestern/2009/

Consortium for Computing Sciences in Colleges
(CCSC: South Central)
April 24-25, 2009 in Hammond, Louisiana
www.sci.tamucc.edu/ccsc/

Consortium for Computing Sciences in Colleges
(CCSC: Northeastern)
April 24-25, 2009 in Plattsburg, New York
www.ccscne.org/future/index.shtml

International Conference on the Foundations of Digital Games
April 26-30, 2009 leaving from Port Canaveral, Florida
foundationsofdigitalgames.org/

Oregon Game Programming Challenge (OGPC)
May 16, 2009

NECC 2009
June 28–July 1, 2009 in Washington, DC
center.uoregon.edu/ISTE/NECC2009/

CSTA Institutional Member K-12 Outreach Programs

TechTopia Challenge
November 14, 2008, February 6, 2009, and July 31, 2009
Neumont University in Jordan, Utah
www.tech-topia.com

RESOURCES

Here's more information on topics covered in this issue of the *CSTA Voice*.

Page 1: Teaching to Change LA *tcla.gseis.ucla.edu/divide/about*
Page 1: Computer Science Equity Alliance *www.apcsla.org/*
Page 1: *Stuck in the Shallow End: Education, Race, and Computing* (MIT Press 2008)
Page 1: Supporting Girls in CS by Programming with Graphics
 apcentral.collegeboard.com/apc/members/courses/teachers_corner/27701.html
Page 3: Snipits Podcasts *csta.acm.org/Resources/sub/Podcasts.html*
Page 4: Taipei American School *www.tas.edu.tw/*
Page 4: Skype *www.skype.com*
Page 4: Zoho *www.zoho.com*
Page 4: Blackboard *www.blackboard.com*
Page 4: Leadership Cohort *csta.acm.org/About/sub/LeadershipCohort.html*
Page 6: International Conference on the Foundations of Digital Games
 foundationsofdigitalgames.org/
Page 6: Neumont University *www.neumont.edu*
Page 6: *Plain and Simple: Microsoft Expression Web* (Microsoft Press 2007)
Page 6: *Introduction to Web Design Using Microsoft Expression Studio*
 www.microsoft.com/facultyconnection/precollegiate
Page 6: A Model Curriculum for K-12 Computer Science
 csta.acm.org/Curriculum/sub/ACMK12CSModel.html
Page 6: 21st Century Skills *www.21stcenturyskills.org/*
Page 6: ISTE Nets *www.iste.org/AM/Template.cfm?Section=NETS*