Attracting K-12 Students to Computing

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• Started in 2004 with 2 goals
  ◦ Increase the quantity and quality of high school computing teachers
  ◦ Increase the quantity and diversity of computing students
• How?
  ◦ Teacher workshops
    • Summer and during year
  ◦ Summer camps for high school students
    • 2 one-week camps
What do we offer now?

- **Teacher workshops**
  - 4 weeks in summer
  - 10 1-day during school year

- **Summer camps**
  - High school – 2004
  - Middle school - 2006
  - 4th – 5th graders - 2009

- **Seeded summer camps**
  - at 11 other sites

- **Operation Reboot**
  - Retrain unemployed IT workers to be computing teachers

- **Competitions**
  - Alice, Scratch, AP CS A

- **Lending Library**
  - Robotic kits

- **Cool Computing Days**
  - Field trips

- **Workshops with youth-serving organizations**
  - Girl Scouts, YWCA, etc

- **Webinars**

- **Distance learning web site**
What have we tried?

- Scratch
- Alice
- CS Unplugged
- Media Computation
- Greenfoot
- PicoCrickets
- Pleo robots
- LEGO robots
- IPRE robots
- Android cell phones*
- Wearables (LilyPad)*
Summer Camp Results

- Positive changes in attitudes with
  - PicoCrickets
  - Scratch
  - Alice
  - Media Computation
  - Pleo robots
  - LEGO robots

- Elementary aged summer camps
  - More changes
  - Better gender split

- Seeded camps also get positive changes in attitudes
  - Scratch
  - Alice
  - LEGO robots
  - Web design
  - 3d game art and design
  - Gamemaker
  - Web development for phones
Overall Results

- Overall females have statistically significant positive changes in
  - "I am good at computing"
  - "I know more than my friends about computing"

- Negative changes for
  - "Computer jobs are boring"
  - "Girls can do computing"

- Best results with Girl Scout workshops and summer camps
  - Both ours and "seeded" ones
Female leader affects

- Female lead with male participants
  - Increased "Girls can do computing"
  - Increased "I am good at computing"
  - Increased "I know more than my friends"

- Female lead with female participants
  - Increased "Programming is hard"
  - Decreased "I like computing"
  - Increase "I know more than my friends about computing"
Male leader affects

- Male lead with female participants
  - Decreased "Programming is hard"
  - Decreased "Computer jobs are boring"
  - Increased "I am good at computing"
  - Increased "I know more than my friends"

- Male lead with male participants
  - Decreased "Girls can do computing"
• Lots of interest
  ◦ One high school camp > 100 applications
• Two main choices
  ◦ Google Android phones / tablets
  ◦ I-Phone / I-Touch – Only on Apple computers
• Google Android
  ◦ App Inventor – drag-and-drop programming
  ◦ Works best in Chrome browser
  ◦ Program user interface in browser
  ◦ Add event handling in separate program on your computer – blocks editor

Cell phone programming
- Works on any platform
- User interface is created in the Designer
  - Runs in a browser
- Programming is done in the Blocks Editor
  - Uses Java
Ria Galanos is a math/computing teacher who has taken workshops with ICE.

She has run our computing summer camps.

She has taught App Inventor for Android phones:
  - In her high school class.
Teacher workshops - 2004-2010
Middle school summer camps
Elementary school summer camps
• By teaching teachers we can impact more students
  • Teachers grow classes over time
  • >100 applicants in 2011 and 30% female
• By growing AP CS A
  ◦ Can increase majors
    • About 19% of students who take AP CS A major in CS
    • vs 3% who don't
Jan Cuny of the National Science Foundation has a goal of 10,000 AP CS Principles teachers by 2015.

NSF proposal CE21st century
- Due April 27th, 2011

http://csprinciples.org/
- 5 pilot sites now
- 10 pilot sites in fall 2011

Currently about 2,000 AP CS A teachers


10,000 teachers by 2015
Situation in 2004 in Georgia

- Programming and Systems Management Course
  - Very broad programming course
  - Lots of cookbook Visual Basic
- About 44 AP CS A teachers
  - No experience with Java or OO
- Computing in Business and IT dept
  - Many teachers who used to teach keyboarding and computer applications
    - But these courses were being moved to middle school
- 44 schools (11%) offering AP CS A out of > 400 schools
- 389 exams taken
- Mean grade was 2.58 (3 is passing)
- 66 black (17%)
  - mean 1.18
  - 5 passed (7.5%)
- 70 females (18%)
  - mean 1.91
  - 21 passed (30%)

AP CS A in Georgia in 2004
• Unknown number of schools
  ◦ Data available from 2007-2008 and on
• 13,872 exams taken
• Mean grade was 2.84
• 483 black (3.4%)
  ◦ Mean 1.85
  ◦ 130 passed (27%)
• 2252 females (16%)
  ◦ Mean 2.48
  ◦ 1037 passed (46%)
Which state do you think had the most exams taken in AP CS A in 2004?

a) California
b) New York
c) Texas
d) Maryland
e) Georgia
<table>
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<th>Rank</th>
<th>State</th>
<th>Exams Taken</th>
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<td>1.</td>
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Num exams taken in 2004 & 2010
• Computing in the Modern World
  ◦ ACM Level II
  ◦ About ¼ web design, ¼ networking and hardware, ¼ programming, ¼ ethics, careers, history

• Beginning Programming
  ◦ ACM Level III
  ◦ Introduction to textual programming language
  ◦ Simple loops, conditionals, arrays, lists, etc

• Intermediate Programming
  ◦ ACM Level III
  ◦ More complicated programs
  ◦ Software engineering, graphical user interface

• Advanced Placement CS A
  ◦ Counts as a science for graduation
• Started with Java Media Computation
  ◦ Too hard for teachers with no experience
• Moved to Alice and Java Media Comp
  ◦ Still too hard for teachers without experience
• Started with Scratch and Alice
  ◦ Easier for teachers without any experience
  ◦ More familiar to computer application teachers
    • The challenge is getting them to teach and test computing concepts
• This year focusing on Scratch
  ◦ Pico Crickets and CS Unplugged
• Beginning Programming
  ◦ Alice and Java Media Computation
  ◦ CS Unplugged Activities
• Intermediate Programming
  ◦ App Inventor for Google Android Phones
  ◦ CS Unplugged Activities
  ◦ Greenfoot
  ◦ Media Computation
• Advanced Placement Computer Science A
  ◦ CS Unplugged
  ◦ GridWorld
  ◦ Exam preparation
Tips for Working with Teachers

- Teachers are very busy
  - Large class sizes and often no planning time
  - Don't have large chunks of time for learning programming
  - Don’t have time to develop lesson plans, tests, etc
- Teachers need financial support
  - Food, parking, hotel, books, stipends, etc
  - But, they won't always show up
- Teachers vary tremendously
  - Some are excellent
  - Some can't cut and paste
- Teachers don't like to sit and listen to you!
  - Need hands-on work
- Teachers need year-round support
  - Answer questions, help with issues
• Numbers served
  ◦ How many teachers / schools / students?
• Teacher workshops
  ◦ 407 teachers from 244 schools since 2004
    • Data from registration, attendance sheets, and post surveys
• 851 students attended our summer camps since 2004
  ◦ Data from registration and surveys
  ◦ Statistically significant changes in attitudes
    • Mostly about confidence and interest

Measuring impact?
In 2004
- 389 exams
  - 319 males
  - 70 females – 18%

In 2010
- 692 exams
  - 574 males
  - 118 females – 17%
AP CS A in Georgia

- 44 schools in 2004
  - Schools offering AP CS A: 11%
  - Schools not offering AP CS A: 89%

- 66 schools in 2011
  - Offering AP CS A: 16%
  - Not offering AP CS A: 84%
AP CS A in Georgia - Diversity

**2004**
- White: 56%
- Asian: 21%
- Black: 17%
- Hispanic: 2%
- Other: 2%
- Not Stated: 1%
- Native: 1%

**2010**
- White: 60%
- Asian: 22%
- Black: 10%
- Hispanic: 4%
- Other: 1%
- Not Stated: 3%
- Native: 0%
Which of the following AP courses had the most exams in 2010 in Georgia?

a) Biology
b) Calculus AB
c) Chemistry
d) Statistics
e) Computer Science A
• 2010 Calculus AB
  ◦ total 7,256
  ◦ % female 49.9% (3,621)
  ◦ % black 16.35% (1,187)

• 2010 Biology
  ◦ total 5,358
  ◦ % female 56.8% (3,045)
  ◦ % black 17.59% (943)

• 2010 Chemistry
  ◦ total 3,683
  ◦ % female 48.4% (1,785)
  ◦ % black 14.79% (545)

• 2010 Statistics –
  ◦ total 5,115
  ◦ % female 52.7% (2,696)
  ◦ % black 17% (873)

VS Other Georgia AP exams?
- **Girl Scout – 2005**
  - Weekend workshops
  - Trained counselors at camps
  - Dad and Me and Mom and Me workshops

- **YWCA – 2007**
  - Afterschool workshops

- **Cool Girls – 2008**
  - Started afterschool
  - Now weekend workshops
  - Summer camp in 2010

**Targeting girls**
• Over 1,000 girls took a workshop with us since 2005
  ◦ Girls mostly show an improvement in confidence
• Hard to follow-up with them
  ◦ We don't have contact information as registration is handled by the youth-serving organization
• Tried a Cool Computing Day for informal programs
  ◦ Mostly got summer camp kids to come
• Planning a survey in our required freshman course for majors
• At least 3 kids from our computing summer camps are at Georgia Tech in CS
  ◦ Self identified
• One African American male
  ◦ Originally wanted to be a professional basketball player
  ◦ Didn't even want to go to our camp
    • Mom signed him up
  ◦ Won most outstanding Junior in computer science!
• Two female students
  ◦ One only did our camp between 10th-11th grade
    • No computing classes in school
  ◦ One came to camp, but didn't decide to major in CS till got into Georgia Tech

Long term impact?
Another way to measure impact

- Survey of students in intro CS courses in most colleges and universities in Georgia
  - 38% of all public high schools in Georgia had at least one teacher attend our CS workshops.
  - Those high schools generate 65% of CS1 students from Georgia
  - and statistically significantly more women and URM students in CS1.
Field Trips

- Cool Computing Days
  - About 200 high school students and teachers
  - Student Panel
  - Corporate Panel
  - Research Talks
  - Hands-on with PicoCrickets and Pleo
  - Raffled off prizes
Lessons learned

- Some schools will be late
  - Some will want to leave early
- Students like the free lunch the best
- Students prefer hands-on activities to talks
- Students like a tour of campus
- Students prefer hearing from undergraduates
  - To hearing from professors
- Students love to win prizes in a raffle
- Hard to get students to take follow-up surveys
  - Best to do a post survey at the end of the event
Where to go for more information?

- Our website has links to all of our activities
  - [http://coweb.cc.gatech.edu/ice-gt/](http://coweb.cc.gatech.edu/ice-gt/)

- Detailed descriptions of our 4 hour workshops
  - [http://coweb.cc.gatech.edu/ice-gt/1460](http://coweb.cc.gatech.edu/ice-gt/1460)

- New distance learning website with tutorials and projects for Scratch, Alice, Pleo, wearables, and Android phones
  - [http://ice-web.cc.gatech.edu/dl/](http://ice-web.cc.gatech.edu/dl/)

- Survey results from activities are at
  - [http://home.cc.gatech.edu/gacomputes/19](http://home.cc.gatech.edu/gacomputes/19)
The state supports teacher workshops
  ◦ But the amount has decreased over the years

Toyota Foundation – 1 year grant

Gift from Microsoft - PicoCrickets

Atlanta Women's Foundation – equipment

National Science Foundation
  ◦ Broadening Participation in Computing – 5 years
  ◦ Operation Reboot – 3 years
  ◦ REU and RET
  ◦ STARS alliance scaling grant

Income from summer camps

**Funding?**
• What have you tried that has been successful?
  a) Camps or workshops for students
  b) Teacher workshops
  c) Competitions
  d) Visits to schools
  e) Field trips to your college or university