\textbf{Supporting Secondary Teachers}

NSF Site Visit to “Georgia Computes!”

\textbf{December 5, 2008}

\textbf{Strategy for Growing Teachers}

- Multi-year approach
  - 3-4 years from no experience to CS AP
  - Training business teachers
- Training teachers for Georgia's curriculum
  - Year 1 – first computing course
  - Year 2 – second computing course
  - Year 3 – third computing course
  - Year 4 – AP CS

\textbf{Activities to Support Teachers}

- \textbf{Context}
  - Georgia curriculum revision
  - Based on the ACM model curriculum
  - CS endorsement
    - Voluntary endorsement for CS teachers
- \textbf{What we provide}
  - Teacher Workshops
    - To increase the number and quality of computing teachers
  - Lending Library
    - To allow teachers to try out LEGO robots and PicoCrickets in the classroom
  - Teaching resources, e.g., AP Database
    - Database of multiple choice questions

\textbf{Original Georgia HS Curriculum}

- Was originally very broad and content-based (vs. outcomes-based)
- Started with Computer Applications
  - Word, Excel, Powerpoint, etc
- \textbf{IT Foundations}
  - Computer literacy course
  - Programming and Systems Management
    - Broad programming course
      - Introductory programming concepts
      - Databases
      - GUI
      - Software engineering
  - AP Computer Science

\textbf{New Georgia HS Curriculum}

- Based on the ACM model curriculum

\textbf{CS Endorsement}

- Georgia Tech was part of the committee that created a CS endorsement for CS teachers
  - Voluntary endorsement
  - Based on NCATE standards
  - Can be added to any existing teaching certificate
- Adopted by the PSC in Dec 2007
  - Two institutions are planning on offering it:
    - Kennesaw State University
    - Columbus State University
      - Via web-based
Teacher Workshops 2008

- Computing in the Modern World
  - CS unplugged, Kinesthetic Learning Activities, LEGO NXT robots, Scratch, Alice
- Beginning Programming
  - Media Computation and Alice
- Intermediate Programming
  - CS Fairy Tales, Media Computation, Greenfoot, and GUIs
- College Board Endorsed CS AP A and AB
  - CS unplugged, Media Computation, Role Playing

Beginning Programming

- Alice and Media Computation

Intermediate Programming

- GUIs, Greenfoot, Software Engineering, Media Computation

CS AP A and AB

- Object oriented analysis and design, object-oriented programming, searching, sorting

In-Service Short Workshops

- PicoCrickets
- LEGO NXT Robots
- Alice
- Exam preparation
Impact of Teacher Workshops

- 262 unique teachers took 1 or more workshops since 2004
  - from 9 states and 1 country (Bermuda)
- Number of schools in Georgia offering AP CS has increased from about 44 in 2004 to 91 in 2008
  - more than any surrounding state except Florida
- We are working with Alabama, Florida, and South Carolina
  - Florida's Virtual High School is using our Media Computation approach and IPRE robots

Number of Schools offering CS AP A

<table>
<thead>
<tr>
<th>State</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Georgia</td>
<td>91</td>
</tr>
<tr>
<td>Alabama</td>
<td>9</td>
</tr>
<tr>
<td>Tennessee</td>
<td>18</td>
</tr>
<tr>
<td>South Carolina</td>
<td>24</td>
</tr>
<tr>
<td>North Carolina</td>
<td>49</td>
</tr>
<tr>
<td>Florida</td>
<td>92</td>
</tr>
</tbody>
</table>

Impact on Students

- Georgia had big growth in students taking the CS AP A exam in 2008
  - Smaller growth nationally
- We reminded Georgia teachers to recruit women and minorities for 2006 and 2008
  - Saw increases each time we did this
  - In 2007 we didn't remind teachers to recruit
    - Saw a dip in women and minorities

Comparison to Other States

- States with large numbers of AP readers, similar programs, or similar populations are still declining

Impact on Teachers

- Experienced teachers learn ways to present material
  - Motivating and fun approaches
  - One teacher commented that she learned new ways to present recursion
    - Students scores rose to above average
  - Object-oriented concepts
- Inexperienced teachers focus on the content
  - Difficulty adopting the pedagogy
  - "She was able to relate it to like careers and real-world and things like that which made it more interesting. So, I didn’t feel like I could do the same and be genuine because I didn’t know enough about the topic to do the same"

Teacher Resource: AP Database

- We have a database of AP type multiple choice questions
  - Students can take a sample exam with a specified number of questions.
  - They get immediate feedback and are told why each answer is right or wrong

Challenges

- Principals send teachers with no experience to teach AP CS after just 1-3 weeks of training.
  - Not always a problem!
  - Teachers are overwhelmed and quit or switch to a more introductory course
  - Principals then hire a qualified person or use the virtual high school
- Turnover in teachers
  - Average teacher teaches only 7 years
- Hard to buy new books
  - Once every 7 years
- Teachers need support
  - Help installing software, help with programming problems, answering questions, etc
- Interest in more formal training
- Turnover in people at the Dept of Education
  - Need to educate them on the history and convince them of the need
Future Plans

• Target majority minority schools and all female schools
  – Google Rise grant proposal to start summer camps at local high schools
• Do more in teacher workshops on diversity
  – ideas from Stuck in the Shallow End
• Develop more material for teachers
  – lesson plans, projects, work sheets
• Offer more computing competitions at Georgia Tech
  – AP Bowl
  – RoboCup Jr
  – Training for FIRST Tech Challenge
  – Alice

Quotes from Teachers: On Challenges

• "I did what you weren’t supposed to do because my school decided they wanted me to teach AP CS without having the programming knowledge, so I did all three at one time in one summer, and I’m actually signing up for next summer. By the time I went to teach it, I realize I didn’t learn as much as I would have liked. I learned a lot about beginning Java programming.”
• "Arrays. When somebody would say ‘arrays’, I thought, what in the world are they talking about?”
• "They (the kids in the class) don’t want to learn the fundamentals. They want to learn how to use it to do with it what they want to do with it. That’s not a bad thing. I’m not an expert at Java programming, so I’m not to the place yet where I can gear it to something they are interested in."

Quotes from Teachers: On the Workshops

• "Not only does she present materials to us, but she presents how to teach it to other people, specifically teenagers.”
• "This was the best (non-college credit) workshop I have ever taken”
• "...using these little kidle tools that you can buy at Toys ‘R Us to show these advanced topics really engages the students in our classroom and gets them hooked at least for the first day. When you do start talking at a higher level or at a more abstract level, they already have the main idea. If you’ve never taught computing before, it wouldn’t have been obvious to go to Toys ‘R Us and buy this little toy.”
• "What I’ve needed, I’ve gotten whether it’s inspiration on new areas or new methodologies like working with computational media which is so more effective with kids than just designing a banking account class.”

Dissemination

• Other states have run teacher workshops using our materials
  – Florida and Massachusetts
  – Barb ran a teacher workshop in Maryland
  • Scratch and Media Computation
  – Barb worked with Jeff Gray in Alabama
  • Discussed ideas with area AP teachers
• Papers on our teacher workshops have been published at SIGCSE
• Barb is part of the advisory board for Jane Margolis's BPC grant in LA

Evaluation – Outputs

• X teachers attend beginning and intermediate workshops (X teach using workshop material)
  
<table>
<thead>
<tr>
<th>Year</th>
<th>Beginning Programming</th>
<th>Intermediate Programming</th>
<th>AP CS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>24</td>
<td>24</td>
<td>30</td>
</tr>
<tr>
<td>2008</td>
<td>27</td>
<td>17</td>
<td>27</td>
</tr>
</tbody>
</table>

  • Most teachers use:
    • Practice database of AP test items (Y: 2 = 77.3%)
    • Powerpoint slides (Y: 1 = 44%; Y: 2 = 63%)
    • Projects/exercises (Y: 1 = 42%, Y: 2 = 68%)

Results – Outputs

• High school and undergraduate faculty throughout the state offer regional middle and high school day camps.
  • 2006 - 2007:
    • Columbus State University (MS = 21; HS = 21)
    • Darton College (MS = 12)
    • Kennesaw State University
  • 2007-2008:
    • Georgia Tech Savannah (MS = 10; HS = 18)
    • Georgia Southwestern (MS = 11; HS: 19)
    • Kennesaw State University (MS = 40)
    • Albany State University (MS & HS = 7)
• X middle and high school students engage in contextualized computing via regional summer day camps
  • 2007: >33
  • 2008: 114
Results – Outputs

- Step Fellows influence school decisions to offer CS AP
  - One at the beginning of the program and another just started.
  - Difficult to recruit STEP fellows.

Results - Outcomes

- Double the number of High School teachers in Georgia capable of teaching AP computer science.
  - 2004: 44
  - 2008: 87
  - 2009 (Target): 88

- 50% increase in the number of high schools offering CS AP.
  - 2004: 44
  - 2008: 91
  - 107% increase

- Double the share of CS AP seats now going to women and minorities

![Graph showing AP CS A Female Test Takers in Georgia]

- Double the share of CS AP seats now going to women and minorities

![Graph showing AP CS A Female Test Takers in Georgia]
Results - Outcomes

- Double the share of CS AP seats now going to women and minorities

<table>
<thead>
<tr>
<th>Racial/Ethnic Group</th>
<th>2004 Baseline</th>
<th>2009 Target</th>
<th>2008 Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Indian</td>
<td>2</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Black</td>
<td>66</td>
<td>132</td>
<td>84</td>
</tr>
<tr>
<td>Mexican American</td>
<td>1</td>
<td>2</td>
<td>5 (met)</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
<td>18</td>
<td>22 (met)</td>
</tr>
<tr>
<td>Other Hispanic</td>
<td>8</td>
<td>16</td>
<td>20 (met)</td>
</tr>
<tr>
<td>Puerto Rican</td>
<td>0</td>
<td>1</td>
<td>5 (met)</td>
</tr>
</tbody>
</table>

% Scoring 3 or Higher on AP CS A

- 70 out of 84 scored a 1