Increasing the Diversity in Computing at All Levels

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Thank you for inviting me!
• From Duke University in Durham, North Carolina, USA

Leading Occupations for Women - USA

Nurse
Secretary
Cashiers
Teacher

All of these jobs use TECHNOLOGY!

U.S. Dept of Labor 2009
SIGCSE China 2019
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Percent of Women in Computing Workforce in United States

26% of computing workforce who were women in 2018
3% of computing workforce who were African-American women in 2018
6% of computing workforce who were Asian women in 2018
2% of computing workforce who were Hispanic women in 2018

Percent of Women College Degrees in Computing in United States

57% of 2017 bachelor's degree recipients who were women
19% of 2017 Computer and Information Sciences bachelor's degree recipients who were women
19% of 2017 Computer Science bachelor's degree recipients at PhD-granting universities who were women
37% of 1985 Computer Science bachelor's degree recipients who were women

Increasing Diversity in Computing at all levels

• Focus on
  • Secondary
  • College
  • Academics/Researchers

BS Degrees in CS over the years
Female VS Male

Data from Freshmen Survey trends 1971-2015, Cooperative Institutional Research program, Higher Ed. Research Institute, UCLA
Increasing Diversity in Computing
Attracting Women/Girls with Alice Programming

Alice Programming Language
• Create interactive stories or games
• Learn programming in an easy way, drag-and-drop your code
• Problem solving with visual feedback
  • Logical thinking, Computational thinking
• Along the way, learn computer science concepts:
  • Loops, classes, methods, functions, arrays
• Developed by Randy Pausch at CMU
• alice.org

Why Alice?
• Lots of other great tools for teaching programming
• Alice is easy to use, drag-and-drop, objects already exist
• Storytelling - Attractive to both girls and boys

Bring on Alice Virtual Worlds!
• Alice is
  • Hands-on!
  • Interactive!
  • Visual!
  • Less Error prone
  • Exciting Results right away!
• Alice has the potential to excite kids about computer science in the same way that experiments excite kids about chemistry, physics and biology!
Alice Course at Duke University – CompSci 94
www.cs.duke.edu/courses/fall13/compsci094

Success - Alice attracts diverse group
• At Duke
  • CompSci 4 Spring 2005
    22 preregister, 30 enroll (12 female + 3 African Amer.)
  • CompSci 4 Fall 2005
    20 preregister, 31 enroll (17 female – 1 African Amer.)
  • CompSci 4 Fall 2006 – 2 sections
    64 students, 33 female, 7 African Amer.
  • CompSci 4 Fall 2007 – 2 sections
    84 students, > 50% female
  • CompSci 4 Fall 2008 – 2 sections
    100 students, > 50% female
  • Same for Spring 2009, Fall 2009...
  • Advertised in school paper
    • picture of ice skater
  • Web site of animations
  • This course is now CompSci 94

Increasing Diversity in Computing Secondary Schools

Success - Alice Excites 4th-6th Grade Girls
• Duke Femmes Event, April 07
• 60 girls – 4 groups of 15
• Taught them Alice for an hour
• Handout to take home
Adventures in Alice Programming

www.cs.duke.edu/csed/alice/aliceInSchools

Adventures in Alice Programming is a project for integrating the programming language Alice into middle schools and high schools in the state of NC, based in the Durham, NC region. Originally, the target schools were the schools in Durham county, Vance county, Person county and Chatham county. We have now expanded to schools throughout NC. We have also taken a few teachers from other states.

Note that this is the page for the NC site. See information about other sites and more history with this project here.

Impact

• Number of teachers
  • Over 400 teachers learned programming with Alice since 2008

• Number of students
  • Our teachers have taught Alice to over 10,000 students

• Google Analytics on our curriculum website
  • Since Sept. 2012 – over 50,000 users

Curriculum materials

• Over 200 Tutorials on animation and computing topics

• Over 200 Teacher lesson plans

Adventures in Alice Programming

• 2-week Teacher workshops
  • Over 400 teachers, middle school, high school, some elementary
  • First week Teach Alice, Practice
  • Second week - Develop Lesson Plans
  • Follow-up workshop the following summer
  • Summers 2008-2017, funding for lodging

• Main Sites:
  • Duke University, Durham, NC, USA
  • Charleston/Columbia, SC, USA
  • San Jose, CA, USA
  • Lincoln, Nebraska, USA

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Example: Getting Started Tutorial teaches:

- Placing objects
- Moving objects
- Setting up Camera tripods and moving between views
- Using built in methods and writing your own
- Gluing objects together
- Adding sound, 2D pictures to enhance world

Run 4 Alice Symposia

- Around 100 people each

Online Alice Coursera Course

- Launch in Fall 2019,
  - Beta testers in Summer 2019
  - www.coursera.org

Increasing Diversity in Computing
College Level – Intro Programming
Increasing Diversity in Computing
College Level – Intro Programming

- Harvey Mudd College – Claremont, CA, USA
  - Redesigned Introductory programming
    - Creative problem solving
    - Team-based projects
    - emphasizing fun and helping society
    - Split course into two sections
      - Prior programming experience
      - NO programming experience

- Increased ratio of women in computer science from 10% to 40% in five years

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College Level – Peer Led Team Learning (PLTL) in Computer Science

- 8 universities
  - Duke, Georgia Tech, Univ Wisconsin Madison, Univ Wisconsin Milwaukee, Loyola, Beloit, Rutgers, Purdue

- Actively recruit incoming first-years
- Sign up to take Intro CompSci PLUS an additional problem solving course
- Problems solving led by peer leaders

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College Level – PLTL Results

- Why did women enroll in the course?
  - 71% - because they received an invitation
- Why did men enroll in the course?
  - 80% - they know they are interested in CS
- Females in PLTL received higher grades than those not in PLTL
- Advantages for Peer leaders
  - Leadership skills, increased confidence

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College Level – Intro Programming

- Duke University – Durham, NC, USA
  - Redesigned Introductory programming
    - Real problems with large datasets
    - Variety of areas
      - Finding proteins in long strands of DNA
      - Which state had most earthquakes in past 30 days
      - Write a Recommender system for books/movies
    - Highlight people in CS: > 50% women

- Increased ratio of women in first programming course to 50%
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Higher Levels

- Computing Research Association Women (CRA-W)
- Grad Cohort
  - For graduate students in first three years
  - Over 400 students in 2019
  - 2 day mentoring workshop every year
  - Senior academic/researchers as mentors

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Graduate Student Level – CRA-W

- Career Mentoring Workshops
  - Early Career Workshop
    - Assistant Professors, early researchers
  - Mid-career Workshop
    - Associate Professors, mid-career researchers
  - Advice on promotion, negotiation, mentoring, visibility, teaching, effective management, networking

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Faculty Research Level – CRA-W

- Grace Hopper Conference
  - Annual mentoring conference
  - 20,000 women in computing

Multiple Levels, Workshops/Conf.

- ACM-W Celebrations
SIGCSE – Supports a lot of programs that increase diversity

• Supported female students to attend conferences (ACM-W)
• Supports female graduate students to attend CRA-W Grad Cohort
• Supported CRA-W Mentoring Workshops
• SIGCSE itself – board members, leadership has been diverse

Increasing Diversity in Computing

Summary

• Encouragement and mentoring
  • At all levels!
• CS Introductory courses (college/secondary)
  • Real world problems with large data sets
  • Problems that benefit society
  • Problems where one can be creative
  • Diverse Role models

• Lets draw more women into computing!