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

Secretary

Nurse

Teacher

Cashiers

U.S. Dept of Labor 2009
Leading Occupations for Women - USA

All of these jobs use TECHNOLOGY!

Secretary
Nurse
Teacher
Cashiers

U.S. Dept of Labor 2009
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

From NCWIT Factsheet - 2019
Percent of Women College Degrees in Computing in United States

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

From NCWIT Factsheet - 2019
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 at all levels

• Focus on
  • Secondary
  • College
  • Academics/Researchers
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

- Greenfoot
- Scratch
- LEGO
- Snap!

• 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

CompSci 94, Fall 2013
Home

CompSci 94 is an introductory programming course that teaches fundamental computer science concepts. This version of CompSci 94 uses the tool Alice to create 3-D virtual worlds. You will learn programming constructs such as looping, selection, and data structures, along with how to control objects (raise hands, flap
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.
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
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

Science
4th Grade

• Rock Cycle by Debra Ludde (2012)
  ○ Alice World (Finished)
  ○ QuickTime Movie
  ○ Rock Cycle Rubric
  ○ Lesson Plan (.docx)

• Magnet Lab Sort by Dawn Delk (2013)
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
Increasing Diversity in Computing 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%

SIGCSE China 2019
Increasing Diversity in Computing
Higher Levels
Increasing Diversity in Computing Graduate Student Level – CRA-W

• 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
Increasing Diversity in Computing Faculty Research 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
Increasing Diversity in Computing
Multiple Levels, Workshops/Conf.

• CRA-W
  • Programs for undergrads, graduates, faculty/researchers

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

• 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!