Weaving Computing into all Middle School Disciplines

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Outline

• Motivation
• Adventures in Alice Programming Project
• Curriculum Materials
• Impact
• Future Work

Problems with Computer Science in Grades 1-12

1. Computer Science is not in many schools
   Few high schools teach AP computer science
   Fewer middle schools teach computing
   Not even required at the college level

2. Students don’t know what it is
   Not keyboarding, PowerPoint, spreadsheets

3. Where are the women and minorities?
   Number of underrepresented groups in computer science is low
Why Schools Should Teach Computer Science (CS) – (from NCWIT.org)
• Computer Science gives students vital 21st century skills
  – C.S. underlies most innovation today
• C.S. means rewarding careers
  – Predicted shortage of technical jobs in the future
  – Wide range of options in CS (health, environment, finance, arts, security ...)
• C.S. is more than just technology
  – CS teaches design, logical thinking and problem solving

Where does Computer Science fit in middle and high schools?
• Technology
• Science
• Mathematics
• Language Arts
• History
• Foreign Language
• Music
• Art

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
Alice Course at Duke - 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

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

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!
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Adventures in Alice Programming

• 2-week Teacher workshops
  – Over 200 teachers, middle school, high school, some elementary
  – First week Teach Alice, Practice
  – Second week - Develop Lesson Plans
  – One-week follow-up workshop the following summer
  – Summers 2008-2015, funding for lodging
• Main Sites:
  – Duke University, Durham, NC
  – Charleston/Columbia, SC
  – San Jose, CA (starting 2014)

Integrating Computing into all Disciplines

• Teachers attending are from all disciplines:
  – Language Arts
  – Mathematics
  – Science
  – History
  – Foreign Language
  – Music, Art
  – Media, Technology
  – Business
Using Alice in Middle/High Schools

• Teachers
  – Examples in lecture
  – Make interactive quizzes
  – Make worlds on concepts for students to view
• Students
  – Projects (in place of a poster, a model)
  – To take or build quizzes
  – To view and answer questions about a world
  – Older students can do more with Alice.

Recruiting Teachers

• NC Dept of Instruction –
  – Mailing lists
  – send info on professional development opportunities
• Attend and present at conferences (ask teachers!)
  – North Carolina Career and Technical Education Conference
  – North Carolina Catholic Schools Education Conference
  – Durham Public Schools Technology Showcase
• Give them Education credits/hours
• Pay teachers – how much?
  – First Workshop - $500/week
  – Second Workshop - $50/week

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• Motivation
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• Curriculum Materials
  – Over 90 tutorials available for free
  – Beginner, advanced, challenges, projects
  – Paper handouts and video
• Impact
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Getting Started Tutorials

• One-hour tutorial
  – Covers placing objects, setting camera views, basic commands, writing methods and events
• 3 versions of it – pick story your students will like
Getting started tutorial
One hour

3-4 Part getting started tutorials
• One long story in three or four parts (about 3 hours)
• 4 stories to pick from

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
Topical Tutorials – CS Topics

- Who is taller? Making decisions
  - conditional
- Making a fancier chicken
  - Inheritance
- How to get all ninjas to kick at the same time
  - List
- How to visit all your friends
  - Making methods flexible - parameter

Animation Tutorials

- Camera
- Lighting
- Adding images and sound
- Invisible objects
- Changing scenes
- Putting real people in Alice

Animation tutorial: Scene Change

Animation Tutorial – Camera views following a person
You can put anyone in an Alice world

The ITiCSE 2014 boat trip

Sample Project Tutorials

- Discipline Specific
- Sample games

Tutorial for Project: Book Report

Charlotte's Web by E.B. White

Foreign Language simple
Cooking Spanish – More detailed

Tutorial for Simple Game – Control boat, earn points

Cooking Spanish – setting the table

Tutorial for Adventure Game – Find objects in order
Keyboarding

Challenges

- A world that is mostly built
- Has missing pieces (challenges)

Harry Potter Challenge

- Mix of programming and math challenges

Harry Potter – Math/computing Level 1 Charms - before
Harry Potter – Math/Computing
Level 1 Charms - after

Biology – Punnett Squares

Other Example Challenges
Boat

Calculator

Helper Objects

- Quiz objects
- Timer object
- Score object
- Fader object – for scene change world
Teacher Developed Lesson Plans

- Over 170 lesson plans
- Organized by discipline and grade level
- The teachers spend

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Grade Level</th>
<th>Lesson Plan(s)</th>
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</table>
| English             | Pre-K/Kindergarten | - Seasons by Susan Smith (2012)  
                      |                           |   - Lesson Plan .pdf and .doc  
                      |                           |   - Alice World Seasons.a2w
                      |                           |   - Lesson Plan .pdf and .rtf
|                     | 6th Grade    | - Vocabulary by Courtney Rudder (2012)  
                      |                           |   - Vocabulary World.a2w  
                      |                           |   - Word Trees.a2w       |

Example Science lesson

When the condensation gets too heavy in the atmosphere, it falls back to Earth as PRECIPITATION.

History Lesson on Civil War Battles

- Teacher created sample world
- Students add scenes to it

Go back in time and visit civil war sites

Fort Sumter - Where the Civil War Began  
April 12, 1861

Sample Science Lesson (cont)

- Objective: Learn to explain the water cycle using Alice
- Learn some Alice – beginner tutorial
- Hands on Experience with water
- View teacher demo world and answer questions
- Create a storyboard on your world
- Implement your world on the water cycle
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Impact

• Number of teachers
  – Over 200 teachers since 2008
• Number of students
  – Teacher Workshop 2012 and 2013
    • Our teachers have taught Alice to 2900 students
• Google Analytics on our curriculum website
  – Since Sept. 2012 – over 20,000 users

Recent Outreach Events with kids

• Taught 3 sixth grade math courses Alice for an hour
• Ran 1-hour to 3-hour Saturday workshops on Alice

Alice Symposium June 2013

• Around 120 people
• Papers, invited talks, posters
What a middle school kid can do with Alice – from teacher Chari Distler

No Superheros in Alice

What a 6th grader can do with Alice - teacher Chari Distler

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Future

- Beginner Workshop July 2014
  - More workshops in summer 2015
- Converting paper tutorials to video
- Developing Assessments for our tutorials
- Creating more challenges
- Integrating Alice with math

Adventures in Alice Programming web site
www.cs.duke.edu/csed/alice/aliceInSchools

Questions?