Motivation for Integrating Computer Science into K-12

Creating Animations with Alice for Projects in all Disciplines

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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

Efforts to get Computer Science into K-12

- 10,000 teachers – NSF
  - Computing for Everyone (CE21)
  - New AP CS Principles course
- Computer Science Teachers Association
  - csta.acm.org
  - CSTA K-12 Computer Science Standards
    - Outlines topics for each grade level
- Code.org, Hour of Code
- Adventures in Alice Programming Project
  - supported by NSF ITEST and IBM

Why Alice?

- Lots of other great tools for teaching programming
  - Scratch
  - Greenfoot
  - Lego
  - Snap!

- Alice is easy to use, drag-and-drop, objects already exist
- Attractive to both girls and boys

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...
To attract students to the class...

- Advertised in school paper
  - picture of ice skater
  - Web site of animations

Success - Alice Excites 4th-6th Grade Girls

- Duke Femmes Event, April 2007
- 60 girls – 4 groups of 15
- Taught them Alice for an hour
- Handout to take home
- Event again every year since 2007!

Where could Alice help in decisions?

- Students in middle school are starting to form decisions on careers
- They have exposure to Teachers, Doctors, Astronauts, etc.
- They learn about Biology, Physics, Chemistry
  - BUT DON’T KNOW WHAT COMPUTER SCIENCE IS
  - K-12 Teachers can help expose students to CS

Introduction to Alice
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 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

Alice Developed by Randy Pausch

- Carnegie Mellon University
- Virtual Reality Researcher
- Wrote the Last Lecture
- Died of Pancreatic Cancer in 2008

The Alice Team – Alice is free!

www.alice.org
More on ... Alice Programming Language

- Has libraries of 3D objects
- Keeps Track of objects you select

Objects Have Multiple Parts that are moveable

Object Position

- Objects
  - Are positioned in 3D space
  - Have six degrees of freedom

Alice Code is Easy to Learn

Select Code, Drag-and-Drop code in program
**Play Alice Animation**

- Chicken rises, cow turns head and talks

**Discipline Specific Projects**

**Alice Demo: Kitty Story** – children’s book on handicapped child

*By Betty Stone*  
*Animated by Deborah Nelson*  

*Kitty Story*

Let’s visit Little Kitty the kitty. She lives with her Daddy, her Mommy, and her sister, Moon Song.
Sometimes her mom takes her to the doctor so that she can check out her knee. Sometimes that hurts a bit and sometimes it doesn’t.

At night, her mom or dad puts leg splints on her knees. Kitty does not like this one little bit! She does a good job of crying.

Science – Population Change

Science – Population Change (end)
Science Example
How a volcano is formed

Biology – Punnet Squares

Foreign Language simple

Cooking Spanish – More detailed
Cooking Spanish – setting the table

Focus on math
Math Example – Plotting Numbers

Keyboarding

Math Example – Rounding Numbers
Math Example - Fractions

Press 'A' for addition
Press 'S' for subtraction
Press 'M' for multiplication
Press 'D' for division

Math Example – Order of Operations

Math Stories to Attract Girls

• Danica McKellar

Math Story on Fractions
Getting Started – Curriculum Materials

Adventures in Alice Programming

- Free 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.

Curriculum Materials

- Over 90 tutorials available for free
- Beginner, advanced, challenges, projects
- Paper handouts and video

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

Getting Started Tutorial – 3 part

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

Sample tutorial: Scene Change

Tutorial – Camera views following a person

Sample Project Tutorials

- Discipline Specific
- Sample games
Tutorial for Project: Book Report

Tutorial for Simple Game – Control boat, earn points

To win this game, you must steer the boat through each ring and beat the clock. You receive one point for each ring, and there are 10 rings, so if your score is less than 10 at the end, you lose!

Tutorial for Adventure Game – Find objects in order

Challenges

• A world that is mostly built
• Has missing pieces (challenges)
Harry Potter Challenge

- Mix of programming and math challenges

Hailey Programmer and the Goblet of Java

You will receive a password at the end of each level that will be used to unlock the next level. WRITE THESE DOWN!
If this is your first time playing, select Charms.

Harry Potter – Math/Computing
Level 1 Charms - before

Harry Potter – Math/Computing
Level 1 Charms - after

Other Example Challenge
Calculator Enhanced!
Demo – Build an Alice World

Versions of Alice

- Alice 2.4 - WE WILL USE THIS VERSION
  - Good for Middle School/High School introduction to programming
  - Supported, will be around for awhile, very stable
- Alice 3
  - Good for full High School programming course to lead into a Java course
  - Still improving it, building new library

Let’s build an Interactive Alice World

Fun with Alice

The ITiCSE 2014 boat trip
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

Conclusions and Future Work

- Teachers using Alice in lots of disciplines
  - 1-2 classes in Alice to get students started
  - Students can explore further on their own
  - Teachers excited - see different ways to use it
- Projects best for integrating into a course
- More extensive use of Alice
  - Media/Business Technology - pairing up with teachers in other disciplines
  - Introductory computing class
- Alice (alice.org) and our materials at Duke are FREE
Adventures in Alice Programming web site
www.cs.duke.edu/csed/alice/aliceInSchools

Questions?