Enhancing K-12 Education with Alice Programming Adventures

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Outline
• Introduction and Motivation for Adventures in Alice Programming
• Previous Work
• Materials for Integrating Alice into K-12
  – Computer Science concepts
  – Animation and Special Effects
  – Tutorials, template worlds and classes
  – Discipline Specific
• Conclusion and Future Work

There are few women in computer science
• Many reports indicate the low number of women in computer science
  – 56% of Advanced Placement (AP) test takers are female
  – Yet only 15% of Computer Science AP test takers are female
  – There are low numbers of women at all levels of the pipeline in computer science from high school through college to graduate school to professors.

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Many students don’t know what Computer Science is when they come to college!

- Not taught in middle schools and many high schools
- What they think it is:
  - “keyboarding, spread sheets, word processing....”
- VERY EXCITING .......... NOT!

If taught, how do we introduce CS?

```java
public class Simple {
    public static void main(String[] args) {
        System.out.println("Hello World!");
    }
}
```

- Write a calculator
- Write a banking program
- Etc...

How do we Introduce and Teach Science?

- Physics – experiments
- Chemistry - experiments
- Biology - experiments

Why Can’t the Introduction of Computer Science be exciting?

- Programming – it’s always been
  - Hands-on
  - Interactive
  - Frustrating!
- What’s missing?
  - Not Getting Exciting Results
    - Easily, right away
  - Too textual-based, including errors
  - Not appealing to today’s kids in which media and technology are a part of their life!
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
• Along the way, learn computer science concepts:
  – Loops, classes, methods, functions, arrays
• Developed by Randy Pausch and the Alice Team, CMU
• Alice is FREE: www.alice.org

CompSci 4 – Alice Class at Duke

• Full semester course on Alice for non-majors
• Lecture for 10-20 minutes
• Students work on problem with computers in pairs
• Bring students back together

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
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

- Integrate Alice into high school and middle schools by training teachers
- Six sites in U.S.:
  - Durham, NC
  - Charleston, SC
  - Virginia Beach, VA
  - Denver, CO
  - Oxford, MS
  - San Jose, CA
- Durham site focuses on Middle Schools in NC
  www.cs.duke.edu/csed/alice/aliceInSchools

Duke: Adventures in Alice site

- Summer 2008 and 2009
  - 1-week and 3-week Teacher workshops
    - Over 130 teachers, mostly middle school, some high school
    - Only a few had ever programmed before
    - Taught them Alice, Developed Lesson Plans
  - 1-week middle school camps
    - Taught Alice
    - Lots of time to build their own Alice worlds
Targeting all subject teachers

• Subject teachers using Alice
  – Language Arts
  – Mathematics
  – Science
  – History
  – Foreign Language
  – Music, Art
  – Media, Technology
  – Business
• Mostly Middle school, some Elementary, and some high school subject teachers (physics, chemistry, etc)

How to Use 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.

Free Materials - Introductory Tutorials

1. Simple, Short (15 min) tutorials to try Alice
   – Add an object, use built-in methods
2. One hour starting tutorials
   – Writing methods, simple events, camera
3. Longer starting tutorials if more time/more detail (4 one-hour parts)
   – More detailed on placement of objects, writing methods, events, camera control
   – Animating a skateboarder
   – Adding sound and images

Example: 4-Part Starting Tutorial
Many short tutorials on CS Topics

- Programming – sequential and “at the same time”
- Methods (teaching characters how to walk)
- Events (buttons and birds)
- Looping
- Conditionals (making a choice)
- Functions (how tall are you)
- Lists (objects moving in unison)
- Variables (timers/scores)

Functions Tutorial using functions

Other “Fun” Topics Blended in

- Storyboards
- Changing camera views
- Scene changes and lighting
- Fading in/out
- Making Billboards
- Making objects invisible and visible
- Sounds
- Glueing objects to others

Scene Change Class includes all ground covers
Scene Change Class (2) - Tutorial Uses variables to save sky color

Scene Change Class (3)

How can Alice be used in K-12?

• Worlds created from scratch – discipline specific
• Quiz worlds
• Projects

Example: Language Arts: Kitty Story

By Betty Stone
Animated by Deborah Nelson
Example: Science – Volcano Story

Math Example
- Danica McKellar

Math Example
Improper Fractions Story

Math Example
Rounding Numbers
Quiz Worlds

- Tutorial to create a simple world

Have Created Several Quiz Templates

- Template World – Click on an object that matches the sign

Quiz Worlds (2)

- Respond to questions

English as Second Language Example
Built a template world

Putting Images in random order. Wait...
English as Second Language (2)
You put the pictures in order

English as Second Language (3)
check to see if correct

English as Second Language (4)
Annotate each picture

English as Second Language (5)
then the story plays

For another story, change list of pictures.
Other Quiz Templates

- Template World – Click on an object that is the answer
- Template Class – Quiz with “ask user” functions built in

Alice used as Projects
Project: Historical Tour

Project: Book Report

Project: Pong Game

Press Y to Begin
Project: Adventure Game

Future Work

- Running one-week and followup workshops this summer
- Continuing to work with teachers
- Creating project worlds
- One student focusing on math and spanish
- One student focusing on science – biology and chemistry

Questions?

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