Integrating Computer Science into Middle School Mathematics
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**Goal:**
We have been researching ways to integrate computer science and computational thinking into middle school math topics using Alice. According to the Computer Science Teachers Association (CSTA), computer science education is at a "crisis" in K-12 education in the United States, and students need to gain more exposure to programming at an earlier age to solve this problem.

**Implementation:**
- Tutorials to build Alice worlds related to math and teach Alice programming concepts.
- Alice worlds to practice math concepts.
- Math challenge worlds.

**Mapping**

- **Common Core Standards for Mathematics 5th - 12th grade**
- **CSTA Level 2 Standards**

**Tutorials**

**Math Tutorials**

- **Alice Concept Tutorials**
  - Arrays
  - Programming the Tetris piece motion
  - Astronaut-lit-ark (short)
  - Astronaut-lit-ark (long)
  - Astronaut-lit-ark (longer)
  - Astronaut-lit-ark (longest)
  - Astronaut-lit-ark (longest)

**Alice Concept Tutorial (cont.)**

- Arrays
  - Programming the Tetris piece motion
  - Astronaut-lit-ark (short)
  - Astronaut-lit-ark (long)
  - Astronaut-lit-ark (longer)
  - Astronaut-lit-ark (longest)
  - Astronaut-lit-ark (longest)

**Games**

- **Fractals**
  - Fractals to learn fractals
  - Fractals to learn fractals
  - Fractals to learn fractals
  - Fractals to learn fractals

** Worlds**

- **Basketball Math**
  - This Alice world is a basketball game that helps students practice multiplying decimals and whole numbers. The game is over, and they receive points if the dunk hits the rim within the time limit.

- **Order of Operations**
  - This world allows students to interactively practice the order of operations by clicking on the operator that should be done next in an expression. The expressions used in this world are all numeric, and the students will be able to solve them at the end.

**Mapping**

- **Common Core Standards for Mathematics 5th - 12th grade**
- **CSTA Level 2 Standards**

**Oak Grove Middle School**

On November 30, 2012, we taught three 6th grade classes throughout the day. In each class, we:

- Showed demos of Alice
- Went through the shortened Astronaut-Humvee tutorial with the students and built their own Alice world.
- Had them try out some of the math Alice worlds (Fractions or Order of Operation)

In general, we found that the students were really excited and enjoyed using Alice!

**Summer Workshops**

**Alice Teacher Workshop**

- We hosted 2 teacher workshops over the summer. 25 teachers attended the beginner two-week workshop and 9 attended a week-long follow-up workshop. At these workshops we:
  - Introduced the teachers to Alice
  - Showed them some of our work and demoed other Alice worlds.
  - Taught them how to program and build worlds in Alice by going through tutorials.
  - Gave them an opportunity to create and present possible lesson plans to show how they would use Alice in their classes.

**Teacher Survey**

We surveyed 9 teachers about the classes that they taught, their opinions about the Common Core and CSTA standards, their views on using Alice in their classes, and new Alice tools that they would find useful.

- **Challenges**
  - Their were many mixed views about the new Common Core Standards.
  - None of the teachers had ever heard of the CSTA computer science standards.
  - They wouldn’t be able to take the time to teach students Alice.
    - Reserving laptops/computer labs for students
    - Using class time to teach students how to use Alice when they have other things to teach
    - Getting support and permission from administration

**Activity Day Schedule**

**SIGCSE March 6-9, 2013**

- We presented a poster on Integrating Computer Science into Middle School Mathematics using Alice.
- We ran a workshop called “Experimenting With and Integrating Alice 2.3 into Many Disciplines” with Steve Cooper, Wanda Dann, and Jacobo Carrasquel, during which we displayed some of our Alice math materials.

**Results**

- 20 total students (14 for the morning and 12 in the afternoon)
- 1 student withdraw from the survey
- 1 Engaged in 1 discussions
- 5 American Indian
- 1 White American Indian
- 1 Black American Indian
- 1 Hispanic American Indian
- 1 Asian
- 5 All Other Indian
- 1 All Other
- 1 All Other American Indian
- 1 Other American Indian
- 1 Other Indian
- 1 Other
- 1 Teacher
- 2 Students

**Demographics**

- Overall, our survey results align with national demographics.
- The number of students who are female is slightly lower than the national average.
- The number of students who are non-white is slightly higher than the national average.
- The number of students who are upper-middle class is slightly lower than the national average.

**Activity Day**

**March 23, 2013 (Morning and Afternoon)**

- **Activity Day Schedule**
  - 10:00 AM - 12:00 PM: Integrating Alice in Many Disciplines with Steve Cooper, Wanda Dann, and Jacobo Carrasquel.
  - 1:00 PM - 3:00 PM: Workshop on Alice 2.3 in Many Disciplines.

**Teacher Survey**

- 9 teachers responded to our survey.
- Overall, there were many mixed views about the new Common Core Standards.
- None of the teachers had ever heard of the CSTA computer science standards.
- They wouldn’t be able to take the time to teach students Alice.
- Reserving laptops/computer labs for students
- Using class time to teach students how to use Alice when they have other things to teach
- Getting support and permission from administration