Poster Proposal for SIGCSE 2017

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Title:
Coding for All: Computer Science Outreach for All Ages and Budgets

Abstract:
Many feel K-12 computer science requires a large tech budget, a classroom full of laptops, tablets or robots, and an experienced tech teacher. This belief is not unfounded as the majority of online computer science teaching materials require modern technology and Internet connectivity, making these tools inaccessible to the low-tech classroom. As a solution, we developed SAS® CodeSnaps, a free tool that provides an engaging coding experience with minimal technology. One iPad and one robot (www.sphero.com) are all that is needed for every student in a classroom to code. With CodeSnaps, students program together using printable coding blocks. When their program is ready, they “snap” a picture using the CodeSnaps app which digitizes their code and executes it on a robot, allowing students to see their program execute in the real world. In this poster we present lesson plans for both a single engagement with students as well as week-long introduction to CS fundamentals centered around the CodeSnaps app. We also discuss results from two pilot studies designed to measure student engagement during these lessons.

Significance & Relevance of the Topic:
Advocates for K-12 computer science education are making great strides at the state and federal level toward increasing computer science’s presence in U.S. public schools (e.g. the White House’s Computer Science for All initiative). As this movement gains momentum, and CS education becomes an expectation of parents and administrators, classroom teachers benefit from the wealth of high-quality instructional materials available for free through organizations such as Code.org. However, in schools without a large technology budget, it can be difficult to find engaging CS lessons instruction due to the technology requirement of most CS instructional tools. Offerings for “unplugged” activities are minimal and are often simply a single lesson.

In an effort to reach as many budding computer scientists as possible, we at SAS® Curriculum Pathways® created SAS CodeSnaps, a hybrid coding tool. CodeSnaps provides a collaborative coding environment to students in a classroom with at least one iPad and one robot. It does also does not require Internet connectivity during the lesson, which is especially important in low-tech classrooms. CodeSnaps is available at no cost and coding blocks are printable from pdf documents online in an effort to make coding accessible to as many classrooms and students as possible.
Content:

**Driving Question.** How can we broaden participation in computer science by designing resources for low-income or poorly funded schools so that they do not fall behind in the current push for CS education? In order to engage low-technology classrooms, we developed CodeSnaps, a collaborative coding environment, and several coordinating lesson plans. These plans have been refined over testing with thousands of students covering the full range of K-12. This poster will present details of these lesson plans and results from two pilot studies.

**Pilot Study 1.** Researchers engaged SAS summer campers ($N = 78$; ages 7-12; 38 female) in a series of three low-tech, introductory coding lessons (total time: 3 hours): 1) *Painting with Sphero*, a primer activity where students in groups of ten took turns navigating Sphero, a robotic ball, using a joy-stick style interface on an iPad through paint to create large pieces of art; 2) *Human Obstacle Course*, an unplugged activity where students worked in pairs—one blindfolded (the computer) and one giving commands (the coder)—to navigate an obstacle course; 3) SAS *CodeSnaps*, a hybrid activity where students worked in groups of three—one domain expert, one lead developer, and one tester—to navigate Sphero through an obstacle course using the CodeSnaps app and printed coding blocks.

Using a 5-point Likert scale, participants were asked “how much did you enjoy playing with robots this week?” and “how much did you enjoy coding this week?” 88% of participants said they either enjoyed or wanted to “play with robots everyday” after engaging in the week’s activities. Similarly, 79% said they either enjoyed or wanted to “code everyday” after the week’s activities. When asked to select one or more of the activities they enjoyed the most, 69% said Painting with Sphero, 19% said Human Obstacle Course, and 47% said SAS CodeSnaps.

**Pilot Study 2.** Researchers engaged a group of Girl Scouts participating in a regularly-scheduled summer camp ($N = 53$; ages 11-14; 53 female) in the CodeSnaps activity as described in the Pilot Study 1 (total time: 1 hour). The lesson further focused on the acceptance of making mistakes and being able to fix them, a recent suggestion in encouraging girls in tech (*Teach girls bravery, not perfection*. Saujani, 2016). Following the activity, participants were asked to respond to a series of researcher-created questions regarding their experience.

Of the participants, 75% or strongly agreed that they learned a lot about coding during the activity, 79% agreed or strongly agreed they learned a lot about software development roles, 82% agreed or strongly agreed they learned a lot about the software development process, and 96% agreed or strongly agreed that they enjoyed the day’s activity. Additionally, 34% said following the activity they were more confident in their STEM abilities and 36% said they were more interested in a STEM career. When reflecting on their favorite part of the day’s activity, participants made comments such as “when we saw our mistake and fixed it [immediately] like a team,” “being the lead developer,” “figuring out the code and testing it,” and “setting guidelines for the robot.”