Middle School Computer Science Engagement Through Google CS First

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Abstract

This study focuses on efforts to implement the Google CS First curriculum in two middle schools in Fall 2015. Widely used throughout U.S. schools and informal learning environments, CS First is designed to increase confidence, develop educational risk taking, grow perseverance, and provide a sense of belonging within and among learners (Google CS First, 2017). To participate, educator facilitators register, set course dates, and specify the number of participants; Google then provides learning materials and lesson guides. The lessons are taught exclusively online and are designed to require minimal instruction; educator facilitators are most active beginning and end of the CS First learning events to provide feedback on student work and answer basic computer troubleshooting questions. Not only does this learner-driven approach not require the educator to have extensive knowledge of computer science, but also it allows the program to be more accessible to informal learning environments venues such as libraries, clubs, and after school programs.

Purpose and Research Questions

Other than a pilot study conducted by Google's research division (Goodman, 2014), few researchers have published studies or evaluations of CS First. Google's Scratch programming language, developed and deployed from MIT, is widely been documented by researchers for over a decade (Maloney, et al., 2004). However, CS First is unique: while there are many similar self-paced and class-based online coding programs (e.g., Code.org, Pythonroom, Codecademy), those programs do not require CS First's human interaction; it also differs from Microsoft's Technology Education and Literacy in Schools (TEALS) program, which includes fewer online components but more preparation for computer science classroom teachers. CS First requires a school or a "sponsor"; a physical class setting or location; computer access; and a "code guru" (defined by Google as a club leader).

As the demand for computer science students steadily increases (Nager & Atkinson, 2016), the need to understand the usefulness of this intervention for increasing student interest in computing; and exploration of the necessary components for implementing Google CS First in schools makes this study particularly timely and important.
This study aims to answer one main research question (RQ) and three underlying questions:

RQ. To what extent does Google CS First engage middle school students in computer and technology-related activities?
RQa. To what extent does CS First engage students behaviorally?
RQb. To what extent does CS First engage students cognitively?
RQc. To what extent does CS First engage students emotionally?

Theoretical Framework

The researchers used Possible Selves theory (Stake & Mares, 2001) as a framework to align cognitive, behavioral, and emotional engagement with Google CS participants' end-of-module and end-of-unit survey results. This theory posits that possible selves, what a person perceives as potentially possible, drives self-regulation and persistence, particularly in learning environments.

Research Design

This study utilized a sequential explanatory mixed method design to analyze the student engagement in Google CS First Storytelling unit's four modules. We also explored external factors impacting engagement such as the environment, number of other students in the course, the location, proctor characteristics, and characteristics of teachers who volunteered their classes for the program.

Participants. Nineteen participants from School A and 74 participants were drawn from School B, two urban middle "technology" schools primarily attended by underserved populations. Table 1 lists student demographics and school academic indicators.

Table 8. Participating School Demographics

Characteristic	School A Tue & Thurs	School B Mon, Wed & Fri
African American students (%)	89.7	53.4
Females: Males (n)	50:50	51:49
Qualifying for free/reduced lunch (%)	63	46
School grade 2015	F	C
Florida reading & math ranking 2015	Lowest 10%	Top 50%

Source: *StartClass, 2017*

Data Collection

The Google CS First online database automatically compiled end-of-module student survey responses. These surveys included multiple choice and open response questions such as "Do you think you would make a good computer scientist?" The multiple-choice questions pertained to the students' perceived sense of self success in the field of computer science. We manually transferred data to an editable medium in which the data could be sorted. We generated descriptive statistics from students' responses.

Data Analysis

We used the multiple choice questions repeated at the beginning and the end of the unit for pre/post comparisons. We also used the multiple choice questions as a proxy for engagement because they reflected student retention from the previous lessons.

For the open ended questions, we categorized students' comments by type and extent of engagement (Stake & Mares, 2001). The three main categories of engagement used were emotional engagement (e.g., statement of a positive or negative personal reaction), cognitive engagement (e.g., indication of outside problem solving), and behavioral engagement (e.g., evidence of reaching out for help or offering help). We created a codebook extracted from engagement-related elements in the open response comments. We established inter-rater reliability by coding and comparing a section of student responses

Preliminary Findings

Preliminary findings suggest an interesting picture of the students' engagement in the Google CS First lessons. For example, on several occasions, students who had a very low module completion rate reports a high indication of enjoyment in the open-ended questions; in contrast, other students indicated very low content comprehension and negative comments, but had extremely high module completion rates. Preliminary multiple-choice question analyses suggest a relationship between the students' perceived success and multiple choice answer correctness. This link may be expected given a similar study of students' problem solving that also used the Possible Selves Theory that concluded that self-concept was key to student success (Cross & Markus, 1994); however, the relationship between success and enjoyment requires further study because a large portion of the students who indicated a lack of enjoyment in the lesson also demonstrated high retention and accuracy in multiple-choice questions. Our next steps include student and teacher interviews to explore the relationship between self-perception, enjoyment, and aptitude in CS First.

Keywords: google cs first, middle school, computer science, educational technology, engagement

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