

Do Computer Science Exposure Activities Increase Pursuit of Computer Science Higher Education for Underrepresented Groups?

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Introduction and Methods

Women, African American and Latinx individuals are vastly underrepresented in computing fields and occupations relative to their overall population (U.S. Bureau of Labor Statistics, 2015; U.S. Census Bureau, 2014). To fulfill the demand in the nation's rapidly growing technology sector and increase economic opportunities for underrepresented communities, significant efforts must be made to expand opportunities in computing. Disparities in access to computer science courses at the high school level (College Board, 2015; Martin et al, 2015) affect the pursuit of computing majors in college, where students who take AP CS are 8x more likely to pursue college degrees in computer science (Mattern, Shaw & Ewing, 2011). Thus it is critical to increase access to computing courses at the high school level and track the longitudinal impact of exposure to high school computer science courses on majoring and persisting in computer science fields in higher education.

Recently there has been increased momentum to implement programs to broaden participation in computing at the high school level, including: exposure activities (hackathons, makerspaces), coding courses in out-of-school settings (Black Girls Code, SMASH), and district-wide course expansion and enrollment plans (San Francisco, Oakland, NYC). Two critical questions have emerged from these efforts: (1) Do these efforts increase interest in pursuing computing majors in high school? (2) Do these efforts have longitudinal effects in increasing participation in computing in higher education? This study will provide pilot data from a sample of high school students who participated in a multi-year summer STEM program, to explore these questions.

Methods

Demographic and college major data were collected from 370 SMASH Alumni, 66% (n=244) of whom had completed at least one computer science course at SMASH. Chi square tests were performed to explore the relationship between the computer science initiative at SMASH and majoring in Computer Science in postsecondary education.

References

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Abstract

Underrepresented high school students of color were provided with a rigorous, culturally relevant, three-year, out-of-school computer science course sequence funded by the National Science Foundation (NSF). This pilot study explores the longitudinal impact of the intervention and whether it influenced the pursuit of computing majors in college. Using data from students who participated in the program in high school and are currently pursuing computing majors in college, descriptive comparative data suggest there has been a longitudinal increase in pursuit of computing associated with the intervention. These findings illustrate the efficacy of rigorous, culturally relevant interventions to improve persistence in computer science higher education for underrepresented students of color.

What Is SMASH Academy? Program Context and Alumni Data

SMASH Academy Overview:

- o a 5-week, 3-year summer residential STEM program held at 4 sites in CA: UC Berkeley, Stanford, UCLA, and UC Davis.
- o SMASH CS Initiative: 3-year summer CS course sequence and 1 year of academic year **AP CS A** preparation.
- o Includes block programming experience (**SNAP! &Scratch**), **HTML**, and **Java** and 37.5 hours of instruction per summer.

SMASH Alumni Data:

- o 459 total alumni
- o 88% African American or Latinx
- o 67% Low-Income
- o 68% First Generation College Graduate

SMASH Computer Science Initiative Overview

Year 1

Exploring Computer Science (ECS)



Year 2

Beauty and Joy of Computing (BJC)



Year 3 & AYP

AP CS A



Findings

The percentage of alumni majoring in CS has grown significantly each year, quadrupling since 2013.

- o 63% of 318 alumni were STEM majors (n=199)
- o 6 alumni majored in CS in 2013, 17 in 2014, 28 in 2015, 49 in 2016
- o CS was the highest frequency of any declared major in 2016.

Girls of color were significantly less likely to major in Computer Science than their male peers.

- o Among SMASH alumni, computer science majors differed significantly by gender, where males were much more likely to major in CS than females $\chi^2(1, N=380)=20.06, p=.00$.

Alumni who participated in computer science courses at SMASH were significantly more likely to major in Computer Science in postsecondary education than alumni from previous cohorts.

- o The SMASH alumni who were in cohorts that participated in the computer science initiative at SMASH (2015 and 2016), were significantly more likely to major Computer Science in college than those students who completed SMASH prior to the CS intervention, $\chi^2(1, N=410)=7.69, p=.005$.

Conclusions

Computer science exposure activities in secondary education significantly increase the pursuit of computer science at the postsecondary level for underrepresented students of color.

- When comparing the outcomes of students prior to the intervention to students who participated in the CS intervention, there are significant increases in the percentages of students matriculating into computing majors in higher education (Martin et al, 2015).
- This data suggest that the intervention has longitudinal effects on not only *interest* in pursuing CS but also the *actual* pursuit of CS majors.
- This finding provides evidence to suggest that rigorous multi-year CS interventions in out of school settings can have significant longitudinal effects.

Underrepresented girls of color face additional barriers to pursuing computer science majors when compared with their male peers.

- Despite similar demographic backgrounds and identical intervention exposure, girls of color were significantly less likely to major in computer science than their male peers.
- This finding suggests that there are unique barriers facing girls of color which affect their interest and decision-making to pursue CS majors in college.
- While gender disparities in STEM and CS are well-documented, this finding indicates an important area to conduct additional research and to implement interventions with intersectional lens into the computer science initiative at SMASH.

Future Research

- Determining the minimum 'dosage' of computer science exposure activities needed to inspire highly motivated underrepresented students of color to pursue Computer Science at the postsecondary level.
- Assessing the effectiveness of additional intersectional interventions to reduce barriers to pursuing computer science for underrepresented girls of color.
- Further qualitative analyses of the complex experiences, perceptions, and barriers facing women of color at each stage in the computing pipeline and to understand effective coping mechanisms among women of color in computing.