Broadening Computer Science Participation in Kindergarten through Capacity Building

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INTRODUCTION

The national push for K-12 Computer Science education (CSed) has highlighted persistent disparities in access to quality Computer Science (CS) experiences, with teacher preparation and professional development (PD) emerging as critical factors in addressing these gaps (Rich et al., 2019; Yadav et al., 2021), particularly for students of color, girls, urban students, multilanguage learners, and Title 1 schools. To address this issue, the Snap Inc. Institute of Technology & Education (SITE) at California State University, Dominguez Hills conducted a collaborative, autoethnographic case study implementing CS activities with kindergarteners in South Central Los Angeles, demonstrating how targeted teacher training can bridge the implementation gap through simultaneous PD for both preservice and inservice teachers. This initiative is particularly crucial as research shows that children begin forming STEM identities and CS perceptions during elementary years, with studies indicating that stereotypes and feelings of non-belonging can emerge as early as age six (Master et al., 2017; Cheryan et al., 2015; McGill et al., 2024), potentially deterring students from pursuing CS pathways (Century et al., 2020; Ketelhut et al., 2020). While early CS exposure, especially for underrepresented groups, can prevent these stereotypes and promote equal opportunities (Bers et al., 2022; Bers, 2021; Codding, 2021), elementary schools still face significant implementation challenges including inadequate teacher preparation, time constraints, and curriculum integration difficulties, underscoring the urgent need for comprehensive teacher training and PD programs that support integrated teaching approaches (Rich et al., 2019; Yadav et al., 2021).

PROBLEM STATEMENT

There is currently a lack of qualified CS teachers in K-12 schools, particularly in urban, rural, and low SES settings. Numerous calls have been put forth at the state and national level to increase CS teaching capacity, however, gaps remain. While progress has been made over the last decade, nationally, only 60% of high schools in the United States offer CS (Code.org et al., 2024) Additionally, schools and students in marginalized communities are significantly less likely to have access to CS experiences due to a lack of highly qualified CS teachers (Mouza et al., 2022).

RESEARCH QUESTIONS

How can we design and implement a kindergarten CS event that:

a. Provides PD opportunities for both inservice and preservice teachers?
b. Incorporates hands-on activities for students that align with the existing kindergarten curriculum and cater to diverse learning abilities and needs, regardless of prior CS exposure?

METHODS

Design: Collaborative, autoethnographic case study (Chang, 2012).

Participants: 4 kindergarten teachers, 80 kindergarten students, and 40 preservice teachers from the COE, and from a local elementary school.

Data Collection: The primary data sources for this study were the designed artifacts iterated on throughout the event's planning and delivery. The secondary data sources were the notes, reflections, and discussions from the research team.

INSTRUCTIONAL DESIGN

The SITE team developed three integrated 20-minute CS activities for kindergarteners based on bee behavior, combining science standards on "push and pull" from the Next Generation Science Standards (National Research Council, 2013). The activities included creating dance algorithms with Post-it notes, designing arrow-based algorithms to guide bees to flowers, and programming Bee-Bot robots to collect and transport "pollen." Preservice teachers, who received training through videos, slides, and on-site sessions, facilitated these station-based activities in the school library with small groups to maintain low student-to-facilitator ratios. This approach served the dual purpose of providing engaging CS experiences for students while offering professional development opportunities for both preservice and inservice teachers, ultimately strengthening university-school partnerships.

RELEVANCE

Our research demonstrates the critical importance of early CSed integration for addressing equity gaps, particularly through strategic partnerships between COE's and K-12 schools. With California moving toward making CS a graduation requirement, our work offers timely insights for policy development in teacher preparation. The study highlights a replicable partnership model that builds teacher capacity by embedding CS into existing curricula rather than requiring new standalone programs. Our approach focused on collaborating with elementary teachers to integrate CS concepts into science and math instruction, demonstrating how COEs can support both the preservice and inservice teachers in developing CS-integrated lessons. The findings suggest that updating COE course requirements to include CSed is essential for preparing educators to meet emerging state standards and address educational equity challenges. This model's success in integrating CS without requiring specialized curriculum makes it particularly relevant for COEs seeking to establish similar partnerships and influence policy development in teacher preparation programs.

CONCLUSION & TAKEAWAYS

A comprehensive approach to advancing K-12 Computer Science education encompasses four key areas:

1. Developing integrated CS curriculum that aligns with existing standards and themes through both plugged and unplugged activities, while researching its impact on critical thinking and long-term STEM career choices.
2. Establishing collaborative PD opportunities where inservice and preservice teachers can co-develop curricula and share resources, focusing on building sustainable models and improving teacher confidence.
3. Advocating for policy changes to include CS education in teacher credentialing requirements to address equity gaps and prepare for CS graduation requirements.
4. Updating Educator Preparation Programs to incorporate CSed as an interdisciplinary component of preservice teacher training.

REFERENCES

LESSONS & RESOURCES

SITE WEBSITE

CSUDH

SNAP INC. INSTITUTE FOR TECHNOLOGY & EDUCATION