

Let's Talk Code: A flexible professional development and implementation in computer science to expand access to CS in underserved communities

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Abstract: As the push to increase access to computer science (CS) education for all students in the U.S. grows across states and regions, schools that work with traditionally underserved populations such as Native Americans (NA) have a particular challenge in navigating this new landscape for educational systems. Most curriculums in CS can be hard to implement in schools that have not yet developed the capacity of their staff to teach CS due to the rigid sequence of topics and skills. One approach to expanding CS into these settings is to work with content area teachers to develop mobile apps that not only relate to their content but can also expose students to CS skills. The NSF-funded project Let's Talk Code recognizes the unique opportunities for Native American-serving schools and has developed an approach that could have broad appeal for secondary schools that do not have well-developed CS programs but want to increase access to CS for their students through an integrated approach that can also connect to sustaining language and culture.

Introduction

Despite decades of dedicated efforts and substantial financial investments aimed at increasing diversity in computing and tech industries, Native communities still find themselves on the periphery of these efforts. With the tech sector's ongoing expansion, it becomes imperative to include Tribal Nations and their students with opportunities to learn about computer science in order to ensure an inclusive and supportive path forward that maximizes the positive impact on Native communities and minimizes any harm.

CS education has traditionally adopted a content-agnostic and concept-centric approach to developing instructional strategies for K-12 (Pollock et al., 2017; DeLyser & Wright, 2018). While these strategies have led to some academic success among majority-white schools, this approach has been less effective among disadvantaged and underrepresented minority groups, such as Native Americans living on tribal reservations. Most programs that have emerged from federal and foundational grants to improve CS education across the K-12 system have not addressed the specific concerns, context, and needs of NA tribal schools (Carney, 2017). The widespread need for more diversity and representation in the STEM workforce, specifically among indigenous populations, further supports the need to provide NA students access to rigorous and relevant CS education that addresses their contextual needs. Computing has the lowest representation of NA students among all STEM fields (US News and World Report, 2015). The underrepresentation of NA students in computing is a critical concern, especially with the United States facing a shortage of computer scientists and technology specialists.

The Let's Talk Code (LTC) project has a multi-pronged approach to bring CS to NA serving schools first by building on existing relationships and creating new connections in schools in the Navajo Nation, the Hopi Reservation and Pueblo-serving schools in New Mexico. These initial connections were established over many years, prior to the grant, and were leveraged to then focus on CS education. The work includes strong professional development (PD) support of educators through an initial PD intensive and is sustained with regular check-ins as they develop their

implementation plans and begin work with their students. The recognition of the context of the teachers and their students is an approach that is based on theories of situated learning (Lave & Wegner, 1992).

The motivations for this project were to combine the resources, expertise, and cultural/traditional knowledge of education stakeholders serving Native American students to identify the most effective and sustainable approach to increasing CS access, interest, and college and career success for NA high school students, living on or near the Navajo Reservation and other NA-serving schools in the Four Corners region.

Findings

Some of the roadblocks the teachers encounter back at their schools are unique to their environment. For example, administrative turnover has been very high in participating and candidate high schools. As a result, some teachers who believed they had the support of their Principals have found that they no longer have that support. In addition, for a variety of reasons, teachers attending the PD have themselves moved or left at high rates. Notably, a number of teachers in participating schools are non-Native American personnel employed in temporary teaching positions. They face constraints on their tenure and choice of subject matter teaching material. Each of these factors, combined with being located in rural, often low-resourced schools, has negatively impacted participant teachers' ability to follow through on their desire to implement the project material in their classrooms or to keep in touch with their peers from PD.

In the face of these challenges, the LTC team has developed a flexible approach to involve teachers from these underserved schools in a manner that takes into account their particular circumstances but also helps to bring vital CS exposure to students who would normally not have access to this content. Recruitment starts with reaching out to administrators via email and site visit follow-ups to make sure that administrators are supportive of their teachers' participation and ultimate implementation. These cohorts of teachers are typically from the same school or at least the same school district and are teaching in a middle or high school. No prior experience with CS is expected, although we are also happy to accommodate those who do have experience.

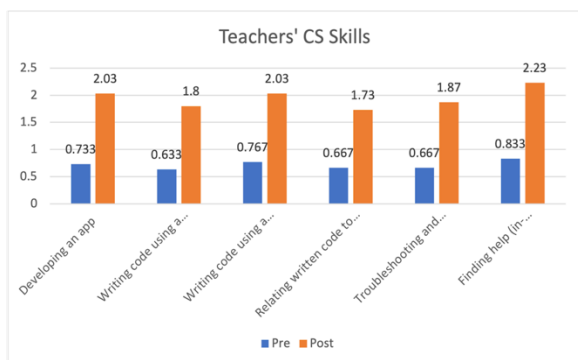


Figure 1. Participants demonstrated a significant shift in their confidence, as a result of their PD participation.

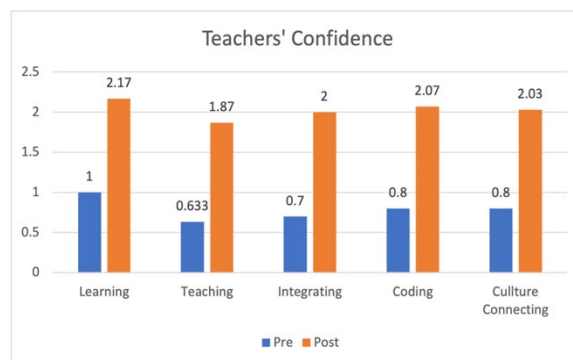


Figure 2. Participant ratings of their perceived degree of confidence in their CS skills

In Figure 1 we are able to see that after the PD experience, teachers have increased their confidence in many categories of CS education including their own capacity for coding and integrating cultural connections. Figure 2 shows that the teachers' perceptions of their own skills have grown significantly as a result of the PD intervention, including their confidence in developing an app through writing and debugging code.

In keeping with a teacher-centered approach, the cohort decides on the location, dates, and times for the in-person workshop. The minimum requirements are 12 hours of PD followed by implementation. The PD uses resources from Code.org's CS Principles curriculum in which we enroll them into our teacher dashboard, where they are our 'students.' We start with Unit 3 for App Development, in which teachers first explore app design elements and then

begin to modify apps, eventually leading them to have a basic, working app by the end of the first day. The subsequent PD time has them design an app that is connected to their content or has cultural or linguistic connections that would be of interest to their students and to develop a lesson plan for how they will bring this app and, in particular, the coding of apps, to their students. The timing of the implementation is decided by the participating teacher. Implementation designs have ranged from having the students use the app the teacher made and then making some modifications with code to a full app-making experience mimicking the PD experience with their students.

A unique and powerful element of the LTC team is the mentors who are undergraduates in CS, engineering, or a related field. These mentors are able to help the lead facilitator during the PD by giving personalized attention to the participants in order to help them make their designed apps come to fruition. The mentors also run support webinars and follow up with the teachers to help them finalize their apps. This personalized approach with enthusiastic, patient and knowledgeable mentors helps the teachers gain the confidence they need to then implement their lessons connected to app-making with their students. When possible, the mentors try to make themselves available to help the teachers during their classes when starting their implementation.

The majority of teachers who have participated in PD have been enthusiastic about the opportunity to implement coding-based material in their schools. The wide array of prior exposure and the subject matter expertise of these participants has influenced how they wish to implement and how competent they feel to do so. The project's PD iterative design process has adapted material and methods for these teachers. In particular, teachers have consistently requested more hands-on activities, an increased time during PD to problem-solve together, and a reduction in the volume of content covered. Teachers reported that participating in group PD helped them realize that they were not alone in feeling challenged by some of the material; they welcomed the opportunity to connect with their peers. Feedback across multiple focus groups and site visits confirms that participant perceptions of the relevance and usefulness of the PD have increased with each iteration.

Conclusion

In conclusion, we feel that this flexible model for PD and approach to CS integration is a valuable contribution to CS education and one that can be replicated in different educational contexts. The support from the mentors is a specialized adaptation, one that might not be available for other settings but is certainly one that is worth developing. Overall, the approach to meeting teacher's needs in learning CS and integrating it into existing content can help to overcome many obstacles to reduce the barriers to expanding access to CS for students in underserved communities.

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