

Project Summary

Computer Science in Secondary Schools (CS3): Studying Context, Enactment and Impact

In this **Full Design and Development-Implementation** project, **Computer Science in Secondary Schools (CS3): Studying Context, Enactment and Impact**, SRI International (SRI) will systematically investigate how implementation of *Exploring Computer Science* (ECS) impacts secondary students' computational thinking practices. They will partner with ECS developers and teachers, the nonprofit Code.org, and other stakeholders in computer science (CS) and CS education to study ECS enactment, teacher practice and student impacts in diverse education contexts. ECS was developed under NSF funding as a pre-Advanced Placement (AP) course that develops students' computational thinking practices and prepares them for future engagement in CS education and careers. ECS has begun to scale rapidly in response to demand from states, the CS industry, and CS education leaders. Further scaling and successful implementations could meet the pressing national need for effective ways to engage diverse students in computer science careers.

However, scaling and sustainability of ECS has been impeded by limited evidence of how much students learn and how implementation impacts the depth of student learning. Ongoing small-scale studies of ECS are building an evidence-based argument for its efficacy, but the lack of common student learning measures and a framework for examining inquiry-based curriculum enactment, teacher practice, and student learning limits insights from these studies. A more systematic understanding of how enactment affects student learning is critical to maximizing ECS' impact on students' computational thinking skills and the CS pipeline. Since 2011, SRI has been partnering with the ECS team and participating schools to develop assessments that measure the computational thinking knowledge and skills targeted by ECS. Given the opportunities for rapid expansion of ECS, now is the critical time to establish technically sound measures of student learning, to measure impacts of ECS on students' computational thinking skills, and to investigate the key factors that lead to successful implementation of ECS in secondary schools.

Intellectual Merit. SRI will leverage existing partnerships and assessments, Code.org's ECS scaling initiative, and SRI's expertise in evaluating inquiry-based instruction to understand context-specific relationships between ECS instruction and student learning. They will investigate implementation by focusing measurement efforts on the key issues surrounding curriculum enactment, teacher practice, and their impacts on student learning. Learning measures will be based on results from NSF-funded developments and analysis of student work while measures of implementation will be drawn from studies in inquiry-oriented science classrooms. The project will use multiple methods to measure student learning, curriculum implementation, teaching quality, professional development, and contextual and background variables. From this data, the team will conduct an HLM analysis to determine which factors impact student learning. The project will be guided by an advisory board with exceptional expertise and breadth of experience in assessment and computer science education.

Broader Impact. The nation's educational infrastructure struggles to meet the CS industry's increasingly high demand for computational thinking skills. Also, females, African Americans, and Hispanics are woefully underrepresented in the CS workforce. This shortage is reflected in the AP CS pool, where the numbers of these underrepresented groups are well out of proportion with those seen in the AP population in science and mathematics. The founding goals of ECS are to broaden the participation of underrepresented students in precollege CS by focusing on urban schools where students face significant barriers to taking AP CS as a first computing class, and to help these students learn critical computational thinking skills. Preliminary evidence from development sites indicates that ECS has real potential to achieve its goal. This study will partner SRI with ECS developers, teachers, and other experts to systematically investigate ECS implementation and impact at a larger scale. The project will focus on identifying conditions for successful implementation of inquiry-based CS curriculum materials across multiple schools and districts representing varied contexts. The findings will contribute to the CS education field and assist policy-makers concerned with scaling up of CS curricular reform and strengthening the pipeline to CS careers.