A Coordinated, Cross-Institutional Career and Technical Education Cybersecurity Pathway

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Co-PIs: Steven Bean (The Digital Nest), Gerlinde Brady (Cabrillo College), and Julie Edwards (Pajaro Valley Unified School District)

This Medium Project in the PreK-14 pathways strand extends a collaboration between four organizations: Pajaro Valley Unified School District, the Digital NEST, Cabrillo College, and Education, Training, Research (ETR). The goal is to strengthen, connect, and expand existing efforts to increase the number of Latinx students who enter and stay on a path to computer information systems (CIS) that connect to community college and the workforce. The project was funded on October 1, 2018 and will address the following research questions:

1. What systems-level factors need to be in place and what processes will best create them?
2. What kind of preparation and supports do teachers need to guide Latinx youth in the pathway?
3. What features are necessary to motivate and support students to enter, persist, and complete the pathway?

The Activities include:
- A Design-Based Research-Practice Partnership (RPP) that builds the pathway, ensures the capacity of educators to support it, and creates policies to institutionalize it,
- High school activities that engage students and serve as on-ramps to the CIS pathway,
- Articulated high school to college classes,
- Student support services to build college readiness and success, and
- Data collection and analysis to monitor student movement along the pathway and institutional change, and to guide continuous refinement.

Key Outcomes so far include:
- A collaboration of high school teachers, a counselor, and the CTE Coordinator worked with college faculty to develop the pathway, including alignment of the school district’s new signature CTE Pathways initiative with the college’s CIS program.
- Built the high school classrooms with all new state-of-the-art equipment, modeled after the Community College classrooms
- Dedicated CTE college counselor hired
- Recruited 130 students into 6 sections of CS classes across two high schools.
- Collected and summarized interview and survey data from students in on-ramp classes
- Presentation accepted at the National Initiative for Cybersecurity Education conference
Adapt, Implement and Research at Nebraska: A Statewide Implementation Study of a Researcher-Practitioner Partnership for K-8 Computer Science Education

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This project (a.k.a. AIR@NE), a K-8 strand large project, examines the adaptation of a validated K-8 Computer Science (CS) curriculum in diverse school districts statewide in Nebraska. Our Research-Practitioner Partnership is primarily between the University of Nebraska-Lincoln (UNL) and the Lincoln Public Schools (LPS) with participants from other diverse districts across Nebraska. The overall purpose of the project is to broaden CS participation by adapting and implementing the successful model of LPS’ K-8 CS curriculum, instruction, and professional development in diverse districts across Nebraska with high concentrations of African Americans, Hispanic Americans, and Native Americans, as well as rural areas and high-poverty schools, all within the framework of a Networked Improvement Community (NIC). Our primary goal is to (a) study and document how different districts adopt the curriculum and broaden participation in CS and (b) assess the effectiveness of the CS curriculum and resources.

Specific Aims. The specific aims of AIR@NE are to (1) Adapt and implement the articulated LPS CS curriculum and learning progression models and assessment metrics; (2) Customize LPS’ current professional development model for each participating district; (3) Create a teacher virtual network support model for ongoing logistical and content support; (4) Adapt, develop, and validate teacher and student instruments of knowledge of CS and self-efficacy in CS skills; and (5) Conduct the project as part of a research-focused NIC, grounded in design-based research.

Expected Outcomes. We will adapt and implement the LPS K-8 CS curriculum and resources in K-8 schools across Nebraska, leading to a broadening of high school participation in CS, and a widening of the CS student pipeline to post-secondary education and to underrepresented groups including female, minority and students from low income backgrounds. There will be a comprehensive system of courses, learning communities, and support mechanisms for teacher PD. This will produce a community core, strengthened by various stakeholders. Our coordination efforts will result in more teachers getting trained in K-8 CS. A hierarchy of networks will allow teachers in different districts to use the most accessible medium or platform while sharing resources and experiences with others external to their districts. This project will further validate and revise the research instruments and ultimately provide critical tools for CS education and research. Finally, the project will result in rural, high-minority, and Native American case studies incorporating both the qualitative and quantitative implementation data.

Progress to Date. Across Year 1, we engaged in three major activities. First, we successfully recruited first cohort, with 29 teachers (original plan was 28). We have also put in place an online application process and a review process. Second, we developed two courses—Introduction to Computer Science 1 for Teachers (CSCE 805T) and Computer Science Pedagogy for Teachers (TEAC 851L)—with daily lesson plans, activities, assignments, and final projects. We delivered these courses in June 2019. Third, we adapted and developed teacher and student instruments measuring CS knowledge, self-efficacy, attitudes and practice. The teacher instruments were delivered prior and post courses to document the effectiveness of the summer courses. There was a significant increase in teacher knowledge of CS as assessed by two previously validated instruments (computational thinking t(28) = 3.58, p < .01; CS concepts t(28) = 5.78, p < .001). There were also significant increases in terms of teacher confidence in teaching computer science (t(3) = 4.49, p < .001). Pre-post testing on changes in attitudes toward CS (i.e. “computer science is enjoyable and stimulating to me”) did not show significant increases (t(23) = 1.29, p = .21). Furthermore, we also developed student attitudinal instruments for use beginning fall 2019. In addition, a classroom observation instrument was developed and pilot-tested during the micro-teaching sessions during the pedagogy course.
A Researcher-Practitioner Partnership to Design, Implement, Assess, and Scale Integrated CS Curricula in K-5 Classrooms (CS4All_Springfield)

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Institutional Lead: Paul Foster, Springfield (MA) PS
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Evaluator: Jeff Xavier, Sage-Fox Consulting

Overview

Our RPP is focused on developing integrated computer science and computational thinking instructional modules for Kindergarten through 5th grade that will be implemented across all K-5 classrooms. Our goals are to:

1. Through DBIR, and relying on dyads of teachers working in grade-level professional learning communities (PLCs), develop equity-based CS/CT lesson plans for full scale diffusion in all K-5 classrooms in Springfield

2. Implement tightly-coupled research and evaluation projects to guide the piloting and implementation strategy for CS lessons.

3. Leverage design team teachers to serve as CS/CT instructional coaches and support their colleagues in the full-scale implementation of design-based lessons.

4. By the end of the four years, all SPS K-5 teachers enact design-based, integrated CS/CT lessons in their own classrooms.

In this iterative design-based implementation research process, teachers work together in grade level professional learning communities to develop CS modules that can be integrated into other content areas. The modules are then piloted and refined iteratively three times. In the year following lesson development, classroom teachers in the relevant grade levels are given PD on teaching CS and implement the modules in their classrooms across the district. Three research projects inform this project including: 1) investigation of the characteristics of the PLCs and teacher dyads that produce high quality lessons; 2) examination of teacher and student learning of computational thinking as a result of participating in CS/CT lessons; and, 3) inquiry into the impact of characteristics of schools and teacher/school incentives and disincentives on wide-scale implementation of CS/CT lessons.

Proposal Snapshot

Size: Large
Strand: PK-8
Focus: Design-Based Implementation Research

Springfield Public Schools (MA)
25,400 students PK-12
89.8% students of color
76.7% economically disadvantaged
17.3% English Learners
23.5% students with disabilities

Highlights from Year One

- RPP organizational structure and working relationships established and refined;
- Integrated CS/CT lessons developed for K and 3rd Grade classrooms;
- More than 50 K/3 teachers received professional development on delivering CS lessons with a strong focus on issues of equity in teaching CS; and,
- Researchers and practitioners collaborated in design and delivery of an equity-focused professional development for year-two design team teachers.

Relationships among Lesson Design Process and Research

Assessing Teaching & Learning

Designing, Refining & Implementing Curricula

Identifying Barriers to Equity & Inclusion

Evaluating the RPP In Place

Supporting PLCs, Collaboration & Innovation
Accelerating Women’s Success and Mastery in Computer Science (AWSM in CS)
Carol Fletcher (PI) and Joshua Childs (Co-PI)
University of Texas at Austin

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Accelerating Women’s Success and Mastery in Computer Science (AWSM in CS)

The Accelerating Women’s Success and Mastery in Computer Science project (AWSM in CS) is a Research Practitioner Partnership funded by the National Science Foundation (award #1837602). AWSM in CS is a medium sized funded proposal focused at the high school level. AWM in CS will focus on engaging researchers and practitioners involved in a Networked Improvement Community (NIC) to engage in a root cause analysis to examine the primary drivers within the context of recruitment, instruction, and school/community culture and policy as it relates to females in computer science. The 23 high-school practitioners are implementing a three-year plan-do-study-act cycle (PDSA) and will iterate on research-based interventions that may impact female representation in computing courses. As part of the NIC, participants will engage in a week-long summer institute, webinars that focus on PDSA cycles, a semester-long course on improving recruitment and retention in computer science, and an online platform that will allow every member of the NIC to engage with one another. Virtual and in-person professional development will also support NIC participants through network building experiences.

For outcomes, our project is focused on female enrollment and completion of CS courses, AP test taking and performance, and subsequent CS course enrollment (after initial course enrollment) will be measured. We are also interested in examining qualitatively the role of the NIC to address teachers’ and students’ needs. With the help of NCWIT, we engaged in a week-long equity focused training for our practitioners in June 2019. During this training, participants learned about the state of computer science as it relates to women and girls, strategies to recruit and engage girls in computer science, and how the tools improvement science could assist in the overall goals of the project. Starting in Fall 2019, we will hold twice monthly calls that will see NIC participants share their PDSA cycles, provide feedback and ask questions to one another, and learn from one another as the school year progresses.
Addressing Issues of Equity and Engagement in CS through a Research Practice Partnership: The CS Teaching and Learning Collaboratory

Connecting CS Educators for Equity and Engagement

Award #187305

Cindy Blitz, Ph.D. (PI), Center for Effective School Practices (CESP), Graduate School of Education, Rutgers
Fran Trees, DPS and Thu Nguyen, Ph.D. (Co-PIs), Department of Computer Science, Rutgers
Teresa Duncan, Ph.D. (Co-PI), Deacon Hill Research Associates

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Proposal Size Proposal Strand RPP Type Practitioner Audience
Medium High School Research Alliance, PLC Teachers, Guidance Counselors, Admins

/*Project Description, Goals, and Progress/*

Building upon an existing research practitioner partnership (RPP) and an initial NSF grant (Award #1738737), this project creates a space for collaboration and action for CS educators from K12 and higher education, education researchers, and community partners through an RPP in order to increase capacity in equity-focused, rigorous, evidence-based, engaging CS teaching and learning while working together as authentic partners to supplement what is already in place and to assess initiatives’ impact and fit for different populations and situations.

This is accomplished through numerous and ongoing activities including annual summer institutes, RPP meetings, consistent and ongoing collaboration opportunities and access to curated resources, virtual provision of PD with tailored differentiated support as well as through the use of project data to inform decisions regarding potential modifications and enhancements to all components of the RPP and the project itself.

Our project goals are to (a) develop and deliver high-quality CS PD for teachers that enhances their ability to deliver instruction that is responsive to their students’ abilities, motivation, and cultural backgrounds; (b) invest in building the capacity of school and district leaders to plan, implement, manage, and evaluate programs and policies that can support rigor and equity in CS education; and (c) engage in research and community-building activities that can improve the performance, effectiveness, and sustainability of the RPP as well as expand the size and diversity of its membership. By working in collaboration with a network of teachers and administrators who serve these students, the team tailors activities and pedagogy of content to address the different needs and experiences of students, providing them with opportunities for rigorous and engaging CS instruction.

Short- and long-term outcomes of interest are at the RPP-level (or team-level), teacher-level, school/district-level, and, ultimately, at the student level and include mutual trust, knowledge sharing, active participation, increased pedagogical content knowledge and CS self-efficacy and confidence, the addition of rigorous and equity-driven CS coursework, among others.

The project team has presented their work at the RESPECT 2019 and SIGCSE conferences, have participated in relevant webinars, and have been involved in the CS for All and CS for All Teachers communities, among others. The entire CS-TLC team looks forward to continuing our work within the RPP, across RPPs and among our colleagues more widely as well as welcoming a second cohort to our team!
Broadening participation in computer science through music, dance, and coding across learning spaces

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This CSforAll:RPP Medium project in the PreK-8 strand is a partnership between Northwestern University, Georgia Institute of Technology, the Evanston/Skokie School District 65, and the Evanston Public Library System. This proposal builds on an existing partnership to develop a shared platform that supports computational learning across a network of schools, community centers, libraries, and homes (DRL-1824551). This platform, called Evanston Learns in-school, out-of-school, and online (EL3) was used to support a month-long coding campaign that resulted in 79% of 3rd-8th Graders registered and using the platform. However, while we have both technology and community infrastructures in place to support creative computational thinking experiences for young learners, we lack documented examples of how to curate and structure learning activities across settings in ways that keeps youth engaged in longer-term projects, that demonstrate both the personal and professional value of coding, and that demonstrate computation as a means to achieve creative and personally fulfilling goals.

This proposal has expanded and integrated two successful existing learning platforms that we developed through prior NSF support that combine music and coding: TunePad (DRL-1612644) and EarSketch (DRL-1417835). Using these platforms, we are developing a continuum of music-themed CS learning opportunities deployed through the EL3 platform and designed to work between and across a variety of school and out-of-school spaces. The proposal will address the following research questions:

- How can music as a cultural form of literacy engage youth across learning environments?
- How can music+coding learning experiences interact with youth’s identity-related needs and motivations? Does it lead to broader participation in foundational computer science experiences?
- How we can design authentic ways for youth to document and share their learning experiences to serve identity formation, community building, and career preparation?

Keywords: Music, coding, dance, learning ecosystems, computer science education, informal learning

Young people’s creative experiences with CS can have a critical impact on their academic and career trajectories. This project is contributing to a conceptual framework to promote computational literacy between and across a range of learning settings to engage a diverse audience. The proposal will (a) explore ways to make coding relevant across spaces where youth spend their time; (b) develop new approaches for youth to document their learning outside of the classroom; and (c) create shared physical and online spaces for students to spectate, play, and develop their use of coding to create artifacts that have meaning in their home communities.
Two Year Project Goals

Develop a deep sequence of training and curriculum that involves five experiences for Secondary Education Mathematics Pre-Service Teachers (SEMA PSTs). All experiences will align with state and national (future) CS and (existing) Mathematics standards.

Pilot training experiences over two years across two cohorts of students with extensive evaluation and analysis of the emerging best practices that support sustainability and scalability.

Project Description

Through a combined inter-disciplinary effort from the College of Education’s Secondary Education Mathematics Teacher Education Program (SEMA TEP) and the College of Engineering’s Computer Science (CS) department, the University of Alabama (UA) has developed a curriculum design model that prepares SEMA teacher candidates to teach Advanced Placement (AP) Computer Science Principles (AP CSP). The project explored a two-course sequence and associated activities that form a pathway for increasing the pool of future educators who are prepared to teach the AP CSP course without deep pre-existing content knowledge.

Community Impact

We have established a continued community of practice for the graduates of our pathway during their first few years of teaching to help them remain aware of opportunities from the Alabama K-12 CS Education community.

By using the RPP Model we have connected our students with veteran AP CSP teachers in the community to not only participate in class room observations, but to work side-by-side on preparing for Alabama CS certification expectations. This collaboration led to several of Alabama’s first CS Praxis certified teachers including Alabama’s first minority Secondary Education teachers to be certified.

Key Lessons Learned

Additional CS pre-service curricula needs to address the current alignment with Digital Learning and Computer Science (DLCS) standards within the state and at the national level.

We feel that the two course sequence and additional experiences fully prepares teacher candidates to teach an AP CSP course, however, additional coursework may be needed to add this level of preparedness to teacher candidate portfolios in preparing them to teach more advance CS education courses.

Outcomes and Next Steps

During the two year project we have prepared SEMA students who are now in the classroom and successfully teaching AP CSP after graduation. We have impacted the number of certified CS teachers in Alabama.

To build off this success, we are looking to grow the program into a state-wide offering that will allow teacher candidates and current in-service teachers to participate both in person and online. We hope to gain further collaboration with the College of Education, additional funding resources to incentivize SEMA students into taking on additional coursework, and find a more permanent home for the pre-service program.

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<th>Program Status</th>
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<th>Teaching CSP?</th>
<th>Still Interested in teaching CSP?</th>
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<td>Anticipated third cohort</td>
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Project Title: Building State Capacity for K-12 Computer Science Leadership National Conference
Award Number: 1733938
PD/PI Name: James F Stanton, Principal Investigator
Lynn Goldsmith, Co-Principal Investigator
Recipient Organization: Education Development Center, Inc.
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The $97,543 EAGER Grant was awarded under the provisions of Solicitation NSF 17-535, STEM + Computing Partnerships (STEM+C) to support a National Conference, co-funded by Google, to enhance state policies advancing implementation of K-12 computer science (CS) education.

The Conference was designed to convene a common grouping of practitioners from each of ten states leading the development of K-12 CS education policy. The Practitioner group consisted of: CS teacher leader, superintendent CS leader, business leader CS advocate, education equity leader, legislative education leader, education commissioner/designate, K-12 CS statewide education coalition leader, K-12 CS education higher education leader and Governor’s education advisor. Additionally, national leaders in the K–12 computer science movement (NSF, Code.org, Google, CSforAll, Microsoft, Education Commission of the States [ECS], CSTA, and ECEP Alliance) were invited to attend the conference.

The Conference goals were to:

1. Convene ten states that are at the forefront of building capacity for strategic state approaches to:
   a. Identifying and engaging both statewide elected leaders and business leaders.
   b. Building or engaging with education coalitions.
   c. Framing a broad-based equity agenda in order to scale CS education in a manner that complements the state’s grassroots/tactical accomplishments in the areas of K–12 CS.

2. Gather information on existing best practices and specific resources developed by each state, which can advance other states’ efforts to strengthen their strategic agendas

3. Provide each state with the opportunity to develop action plans based on the pre-conference materials and the panel presentations in each of four key topic areas: statewide elected leader engagement, business leader engagement, coalition development or engagement, and equity.

The Conference was organized to help attending state leaders reinforce their progress, share and solve persistent problems, and develop a draft action plan of steps to take on returning home. The state membership structure proved to have had several benefits. A critical mass of leaders within each state were able to meet as a group over two days, discuss, build trust, problem-solve, and develop some initial actions plans to take back home. Attendees indicated that this broadly representative group brought new information to the table and helped them identify key parties who were not currently part of their leadership group. State leaders left the Summit with a stronger commitment and greater buy-in to their coalition’s work around an agenda and action plan.

In reflecting on the Conference itself, the feedback from the attendees, and the responses of state leaders during follow-up interviews, it seems clear that equity was both the most complex and challenging issue in terms of getting state traction addressed during the two days.
BRIGHT-CS RPP: Building Student Retention through Individuated Guided coHort Training in Computer Science Researcher Practitioner Partnership  
Award # 1837344

Principal Investigator: Ryoko Yamaguchi  
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Institution: University of North Carolina Greensboro  
Proposal Size: Small  
Proposal Strand: PreK-8  
RPP Type: Networked Improvement Community

Goals and Objectives
The Principal Investigator and core members of the team are developing a computer science learning ecosystem for middle school black girls, called BRIGHT-CS, that includes summer and afterschool programming. While we have implicit support from schools in our ecosystem, we found an exigent need to explicitly engage teachers and school leaders to further create and support an inclusive environment where Black girls can thrive during school hours. The RPP includes school and teacher leaders, such as a middle school administrator, science teacher, English teacher, guidance counselor, ESOL teacher, and school-based equity coordinator.

The BRIGHT-CS RPP is a two-year planning grant to identify barriers and future work in the areas of structural, instructional, and curricular improvements in middle schools to promote more Black girls to gain interest and experience in computer science (See Figure 1 Conceptual Framework, School-level Outputs). As a networked improvement community, our goal is to design and test out inclusive classroom and school practices.

Description of the Project (Activities and Outcomes)
To engage teachers in creating an inclusive school environment, the RPP’s activities include:

** Equity audit.** The RPP looks at school and classroom data (e.g., assessment data, parent and student interviews, teacher interviews) to identify and discuss structural, instructional, and curricular barriers that Black girls face in their school.

** RPP design and action plan.** The RPP identifies specific barriers at their schools, and develops a common theory of action for what it will take to increase Black girls’ educational opportunity and learning, particularly in STEM+CS. The theory of action is translated into a design and action plan focused on what educators can do (as opposed to what students can do) to improve inclusive practices in their classroom and school, culminating in an action plan with data collection instruments.

** RPP pilot and plan.** The RPP designs and tests a small pilot of inclusive practices to address structural, instructional, and curricular barriers. Based on the results of the pilot, the RPP will plan for follow-on activities, collaborations, and dissemination. The plan will also include future work and expansion.

Progress to Date
During the 2018-19 school year, schools staff were recruited and the RPP met three times, completed an equity audit, and completed parts of the RPP logic model. In the 2019-20 school year, we will be completing the logic model and piloting small-scale improvement practices.
Making K-12 computing education accessible to students with disabilities

AccessCSforAll is a Research-Practitioner Partnership that includes Code.org and schools nationwide, including those that serve students who are deaf, are blind, or have learning disabilities. Together they are creating and testing the effectiveness of an accessible version of Computer Science Principles. AccessCSforAll also partners with the College Board to ensure that they are ready to fully accommodate students with disabilities in their testing.

AccessCSforAll Resources

- Development of Accessible Tools and Materials—refining tools to increase accessibility, creating accessible curricula, and developing online and offline accessible programming technologies.
- Professional Development—opportunities and workshops for teachers of accessible AP Computer Science Principles to students with disabilities.
- Searchable Knowledge Base—offering and updating promising practices, questions and answers, and case studies.
- Resources—sharing publications, guidelines, proceedings, and videos on accessibility and tools for educators of K-12 students with disabilities.

Individual Support

Ask us questions about how to include students with disabilities in computing. Email AccessCSforAll@uw.edu or call 509-328-9331.
CS THROUGH CE
Broadening Participation and Building Pathways in Computer Science Through Concurrent Enrollment (CE)

GOALS
- CSP is offered in 40 high schools for college credit through CE programs in urban CT and rural MN
- CSP-CE is taught in high schools by qualified teachers using inclusive teaching practices
- CSP-CE classrooms more closely reflect school demographics than other CS courses
- Research provides evidence to support a robust model to bring CSP-through-CE to a national scale as a means for BPC

RESEARCH QUESTIONS
Guiding Question: Is CE an effective model for broadening participation in computing?
RQ1: What are the supports and barriers to implementing and sustaining computer science principles (Mobile CSP) as a CE course?
RQ2: Does a CE implementation of Computer Science Principles broaden participation?

ACTIVITIES
IMPLEMENT CSP AS CONCURRENT ENROLLMENT
- Adapt CSP curriculum for college credit
- Recruit high schools to offer CSP as CE
- Recruit and prepare high school teachers for CE

TEACHER PROFESSIONAL DEVELOPMENT
- Adapt professional development to meet CE standards
- Enhance inclusive teaching practices in PD
- Provide summer workshops & school year support
- College faculty mentor teachers
- Engage school counselors in equity-focused recruitment

RESEARCH
- Establish an RPP to address shared problem of practice
- Study the implementation of CSP-through-CE, including supports and barriers
- Examine CSP-through-CE’s potential for broadening participation

PROGRESS
Year 1 (Oct 2018 - Sept 2019):
- Curriculum - CSP tasks adapted for CE
- PD - trained 14 teachers in CT and MN at CE sites
- Equity - established CSP framework w/inclusive excellence, added discussion and practice of microaggressions, RPP book study of White Fragility
- Research - initial interviews and document collection completed and analysis begun
- Partnership - established team values, roles, & decision-making procedures; continuous improvement on partnership dimensions

RPP TYPE
Design-Based Implementation Research/Network Improvement Community

RPP PARTNERS
This medium-sized, preK-14 pathways RPP includes researchers at Elms College and the National Center for Computer Science Education (College of St. Scholastica). Practitioner audience includes CE programs at Capital Community College and Southwest Minnesota State University, partnering secondary schools/teachers, and Mobile CSP master teachers James Veseski (CT) and Ryan Lindsay (MN).

PRINCIPAL INVESTIGATORS
- Karen Binkhorst, CCC
- Renee Fall, NCCSE
- Seth Freeman, CCC
- Beryl Hoffman, Elms
- Dan Kaiser, SMSU
- Shushuang Man, SMSU
- Kourosh Mortezapour, SMSU
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CAFÉCS is an established Research-Practitioner Partnership between the Chicago Public Schools (CPS) and local universities that places the accent on equity in computer science (CS) education in CPS. CAFÉCS aims to ensure that all CPS students have access to inclusive, high-quality, introductory computer science education in high school. The CAFÉCS RPP has several collaborative structures that center on an ongoing problem-solving cycle around our problems of practice (PoP). The leadership team meets weekly for general project planning and management, the broader team including all OCS and research staff meets monthly for a deep dive on a shared topic of interest, and we hold quarterly planning and evaluation retreats.

Supporting implementation of the computer science graduation policy.

**PoP:** CPS students did not have access to a high-quality high school computer science course.

**Outcomes:** Since the rollout of Exploring Computer Science (ECS) and the establishment of the CS graduation requirement, more than 45,000 students have taken ECS and 181 teachers have taught the course at CPS. Adjusting for school-level factors, student learning outcomes are equivalent across race and gender.

![Number of ECS Students](chart1.png)

### Developing a hybrid ECS course to reach unique student populations.

**PoP:** students and teachers in credit recovery, detention center schools, homebound students, and students in nonstandard classroom situations need different curriculum supports.

**Outcomes:** The first semester of ECS has been adapted to a credit recovery context; a pilot starts in fall 2019.

### Developing a coaching model focusing on inclusive pedagogy.

**PoP:** instructors need support for inclusive teaching practices such as journaling and think-pair-share.

**Outcomes:** we have developed a coaching model to support new ECS teachers which is integrated into the ECS professional development program and systems of accountability and support for CPS CS teachers.

### Validating and implementing assessments for computer science students.

**PoP:** students with prior CS experience need a consistent way to place into intermediate/advanced CS courses, and schools need to schedule students into courses where they have the best chance of success.

**Outcomes:** We have developed and validated a placement exam to assess whether students are entering high school with experience equivalent to the ECS course. We have transitioned the standard ECS course assessment from paper to an online version so that feedback can be shared more efficiently with schools.

### Formalizing a sustainable Exploring Computer Science facilitator development model.

**PoP:** The ECS teacher pool has grown beyond any individual person or group’s acquaintance, and a more structured process was needed to recruit and prepare facilitators for the ECS course.

**Outcomes:** We have collaborated with the ECS developers and the Chicago ECS facilitator team to establish a recruitment, application, and onboarding process for new facilitators, growing our facilitator pool from 9 to 12.

CAFÉCS is always looking to the future of computer science education in Chicago

We are continually adapting and improving our work to meet the needs of CS students and educators in CPS: a library of sample lessons by master teachers to use for PD, coaching, and CS teaching methods classes; analysis of the success of our students and teachers with AP CS Principles; building opportunities for students to participate in dual credit and dual enrollment CS courses at local universities, and whatever comes next....
Collaborative Research: CS4SF: A Scalable Model for Preparing High School Teachers to Provide Rigorous, Inclusive Computer Science Instruction
San Francisco State University: Hao Yue (PI), Ilmi Yoon (Co-PI), Patricia Donohue (Co-PI), Eric Hsu (Co-PI)
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In this medium-class, high school-strand project, San Francisco State University (SFSU) and San Francisco Unified School District (SFUSD) partner to address two major needs in computer science (CS) education: a lack of qualified CS teachers at the high school level and a lack of diversity among high school students who take CS courses. Evidence shows that when teachers create an inclusive learning environment, all students have the opportunity, motivation, and ability to learn traditionally intimidating subjects. Thus, the goal of this design-based implementation research practitioner partnership (RPP) is to create and validate a transferable, scalable model for preparing high school teachers to create an inclusive learning environment that engages and challenges female students and students from underrepresented groups (URGs), and to provide teachers a support system as they do so. To achieve this goal, the RPP will institute CS4SF, a program that encompasses three activities aimed at creating a CS educational community committed to inclusion and excellence (See Fig. 1). First, a 1-week summer professional development (PD) course held at SFSU will immerse high school teachers in CS knowledge and evidence-based, inclusive pedagogical strategies. The PD course consists of Inclusive Pedagogy sessions where teachers learn culturally relevant, student-centered pedagogy that encourages a growth mindset and increases student confidence, Content Launch sessions that feature case-based CS problem-solving exercises and small-group discussions, Hands-on sessions in which teachers are divided into teams to work on CS projects, and Reflection sessions for teachers to discuss what they learn. Second, a Community of Practice (COP) will meet monthly to provide teachers with their own inclusive learning community, offering support throughout the year and the opportunity to regularly interact with SFSU CS professors. Third, teaching assistants (TAs)—selected from the most talented CS undergraduates at SFSU—to assist teachers and students for 4 to 5 hours a week by helping teachers with technical questions on CS content, providing one-on-one support to students, etc. The TAs also feedback their observations on the classrooms back to the RPP, which is valuable information for the RPP to better identify teachers’ need and develop the summer PD course for the coming year.

Over the course of this project, the RPP aims to reach 100 teachers, 72 TAs, and 5,000+ high school students with this evidence-based wraparound solution. The outcomes of this project can be used more broadly by the educational community to develop inclusive environments that support learning for all students. Moreover, CS4SF is modular and scalable, so RPPs nationwide can use this model to improve the rigor of their CS courses and increase the proportion of female and URG students who take advantage of them.

Figure 1. Diagram shows how CS4SF’s three components work together to prepare and support high school CS teachers.
Overview

This medium-sized proposal addresses issues of equitable access to computationally rich experiences in middle grades (Pre-K8 strand) by establishing a Research-Practice Partnership (RPP) between two universities and two middle schools with high populations of underrepresented groups. Using design-based implementation research (DBIR), the project aims to further develop conceptual, theoretical, and applied frameworks for integrating computer science (CS) and computational thinking (CT) to build student interest and capacity in these disciplines. This project is informed by a STEM ecosystem model which posits that effective CS/CT learning is the product of the entire connected academic enterprise, including school leadership, teacher and student resources, available learning opportunities, along with prior experiences, encouragement, and training. The ecosystem model will serve as a guiding lens for stakeholders (e.g., teachers, administrators, parents) and researchers as they collaborate to develop strategies that broaden the participation of underrepresented populations in CS/CT academic activities and prepare them for success along such a trajectory.

Progress to Date

During year one of the project, RPP work at both schools centered around trust and relationship building as university team members worked with school leaders and teachers to identify areas of need and devise supports to address those needs. At both middle schools, CS researchers worked collaboratively with classroom teachers to co-develop CS/CT-infused curricular modules as a direct response to a common challenge of finding appropriately aligned material for this new area of study. Another common focus of year one RPP work was to identify teachers at both schools to lead school-wide CT/CS integration efforts. University team members engaged these teachers in extended professional development (PD) workshops during the summer that focused on the integration of block-based programming in core content areas. The PD was project-based and allowed each teacher to design their own CS/CT infused lessons that will be implemented in their classrooms this year. This school year these lead teachers will also provide PD experiences for their colleagues with support from university staff.

Research to date at both schools has yielded some important findings with regards to our primary investigative questions about barriers and opportunities for developing a CS/CT-focused STEM ecosystem that provides opportunities for all students to pursue future opportunities in computationally-intensive areas of study. While efforts in year one focused on building the necessary critical relationships for teachers and school administration to see us as valuable resources and partners for growing their ecosystem, year two work will extend our focus on establishing community and parent buy-in. The RPP team is currently working to plan family code nights that will actively engage parents and other community members in the ecosystem. Additionally, we are working with teachers to help develop their capacity to design and develop culturally-responsive computing curricula that will create inclusive CS/CT learning experiences for all students.
Proposal Size: Medium
Proposal Strand: Research practice partnership focusing on the recruitment and support of CS teachers of color while continuing to serve students historically underrepresented in computing
RPP Type: Networked Improvement Community
Practitioner Audience: Teach For America staff and teachers

Goals and objectives for the project: Through this award, we seek to develop a networked improvement community (NIC) that centers the experiences of teachers of color and their students while interrogating issues teachers consider central to broadening participation efforts. The project’s goals are to:

- Establish a NIC comprised of Teach For America (TFA) staff, Exploring Computer Science (ECS) staff, and teachers of color from TFA’s network that constantly evolves to address problems of practice related to broadening participation in computing for teachers and students.
- Develop and share strategies that lead to increases in the number of Computer Science (CS) teachers from TFA’s network that identify as people of color.
- Identify necessary supports that help CS teachers introduce and expand CS learning opportunities for underrepresented students in high-need schools.
- Identify strategies that CS teachers can use to create equitable CS learning environments.

Brief description of the project, including activities and outcomes: We recruited and established the first NIC cohort, comprised of 9 TFA staff who are regional liaisons for CS education across the TFA network. This NIC is focused on recruiting teachers of color across TFA to consider teaching CS. We also conducted a root cause analysis and developed a yearly plan with TFA staff who are regional CS liaisons to interrogate issues around recruiting teachers of color to consider teaching CS. We met monthly as a NIC to develop the infrastructure necessary to recruit teachers of color across TFA to teach CS. Additionally, we reached out to 410 teachers across the TFA network via email, in-person contact, or phone; had 13 TFA teachers apply to become ECS Fellows; and ultimately recruited 6 of those teachers to become ECS Fellows and attend the ECS 2019 summer professional development in Golden, CO in July 2019.

Progress to date: To build our body of knowledge about supporting teachers of color in CS, we have gathered our first round of data collection with this group of ECS Fellows. Specifically, we have conducted week-long observations of their participation in PD, have collected pre- and post-PD surveys, and conducted in 4 interviews to learn more about these teachers and their anticipated opportunities and challenges of teaching CS. For a comparison group, we also interviewed 3 TFA ECS Fellows from the prior cohort. This data is currently being analyzed and the results will inform our subsequent recruiting and support programs. We secured IRB approval from the University of Oregon for this research.
Hybrid Professional Development to Enhance Teachers’ Use of Bootstrap
(Collaborative award numbers 1738598, 1738606, 1829544)

Team: Kathi Fisler, Emmanuel Schanzer and Jen Poole (Brown University/Bootstrap),
K. Ann Renninger (Swarthmore),
Steve Weimar and Annie Fetter (21PSTEM),
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The Oklahoma State Dept of Education wants to find ways to satisfy their new K-12 standards by integrating content into existing courses. Bootstrap specializes in such integration, offering curricular modules for Algebra, Data Science, Physics, and Social Studies. The 21PSTEM PIs (formerly The Math Forum) specialize in online professional development and community building around mathematics education. PI Renninger studies the multi-phase development of interest in the context of teacher and student learning.

We are developing and studying a hybrid professional-development model to help 8th/9th grade mathematics teachers integrate computer science into their courses. Features include:

- An initial online component that engages teachers in activities and discussions about multiple conceptions of mathematical functions. Our prior experience in Bootstrap shows that math teachers have often settled into a narrow conception of functions that does not naturally extend to using them in computational contexts.
- A 3-day in-person professional development workshop in which teachers learn about activities and pedagogies that align mathematics and computing via programming. The activities build up to larger projects such as writing a videogame (using algebraic functions) or analyzing a dataset.
- Follow-up online study groups and support activities to help teachers plan their scope and sequence and adapt materials to their students and classes.

Outcomes and Findings to Date

- A version of the Oklahoma 8th grade mathematics framework (pre-algebra) that integrates Bootstrap-based computing content throughout the year. The augmented framework is mapped to Oklahoma’s state CS standards.
- A new version of Bootstrap’s pre-existing curricular materials that enables teachers to mix and match individual lessons rather than target our preconceived projects.
- Interviews and surveys show that teachers broaden their conception of functions across the combined professional development components.
- Confirmation that existing formal models (from psychology) of the stages of interest development also apply in this project. This lets us draw on results and practices from other projects on fostering interest development differently for teachers in each stage.

As Oklahoma’s math and CS standards are similar to those in other states, we expect that our approach and findings should apply in other districts and states.
Collaborative Research:
IDENTIFYING PARTICIPATION BARRIERS TO COMPUTER SCIENCE EDUCATION IN RURAL MISSISSIPPI

Shelly Hollis, Mississippi State University (shelly.hollis@rcu.msstate.edu)
Marcus Golden, Mississippi Valley State University (marcus.golden@mvsu.edu)

Project Description

The small strand, K-14 project, Collaborative Research: Identifying Participation Barriers to Computer Science Education in Rural Mississippi, project will seek to accomplish three goals within the two year timeframe of this proposal:

1. Establish a researcher-practitioner partnership with teachers, administrators, and counselors from five districts
2. Identify and understand barriers to CS education, perceptions about CS as an area of study, and stereotypes associated with those interested in CS subjects in high poverty, rural areas of Mississippi
3. Increase the number of African American K-12 teachers in the Delta who are interested in teaching CS and provide professional development to prepare them to offer a course the following year

Student Survey Results

People who do CS need to be very smart.
- Disagree: 44%
- Agree: 38%
- Neutral: 18%

Students who are good at math & science are much more likely to succeed in learning CS.
- Disagree: 57%
- Agree: 24%
- Neutral: 19%

People who do computer science make things that help improve people’s lives.
- Disagree: 53%
- Agree: 20%
- Neutral: 27%

Most people who work in computer science have good paying jobs.
- Disagree: 68%
- Agree: 14%
- Neutral: 18%

Computer science can be used in a lot of different types of jobs.
- Disagree: 74%
- Agree: 17%
- Neutral: 9%

We conducted a perceptions survey with 144 students in 4 of the five districts and hosted coding activity events with elementary, middle, and high school students as well as community coding event in the Greenville School District. We had very positive reactions to the coding activities with some students even asking to stay or come back for additional time. We also held focus groups with students, teachers, administrators, and counselors in 4 of the 5 districts. The two biggest barriers to computer science education identified in focus groups with administrators, counselors, and teachers was lack of priority due to testing pressure and low interest due to lack of exposure.
CS for Oregon is a project to reboot high school CS education in the State & broaden student participation in CS courses.

“[CS for Oregon is] not only providing PD, but quality PD; you are not only offering a curriculum, but an inquiry-based, culturally relevant one. You are not only offering a project, but building it with principals, teachers & policymakers.” Cecilia Martinez PhD

Establishing Exploring Computer Science Courses

In 2018-19, we recruited 22 teachers from 16 school districts to participate in our ECS PD. In 2019-20, 16 teachers from 11 school districts joined. ECS is being offered in 28 schools across Oregon that are geographically, racially, & socio-economically diverse. Teachers who returned for a 2nd year of PD reported that CS course enrollment increased by as much as 300%.

“The school gets awards, [so] everybody thinks they are doing the right thing; they feel good about what they do. [Reading the case study in Stuck in the Shallow End] reminded me of the blind spot we can have where we are achieving for ourselves. In my class, [the students were] all white, 25% girls. I was lucky to recognize that I was doing it wrong. I found ECS and now my demographics are changing.” - Returning ECS teacher who teaches in a majority Hispanic school

Informing State Policy on CS

In 2019, we engaged with the ECEP alliance. We also built a coalition of educators, policymakers, & state legislators to examine systemic issues in equitable CS education.

CS for Oregon is a medium-size, high school strand project between PIs: James Hook (PSU), Jill Hubbard (OSU-Cascades), and Joanna Goode (U of O)
**Project Description**

The University of California—Irvine is partnering on a small-sized PreK-8 grant with the Orange County Department of Education (OCDE) and Santa Ana Unified School District (SAUSD) to form a collaborative network of university and K-12 researchers and practitioners with the aim of promoting computational thinking for students in grades 3-5. The intention is to build connections to a broader literacy curriculum as reflected in the Common Core State Standards, to the language and discourse needed to ensure academic success, and to the learners’ peers, community, families and culture needed to make learning relational and meaningful. The work will be situated in Santa Ana schools, where the majority of students are low-income (91%), Hispanic/Latinx (96%), English learners (60%, higher in elementary grades). The project will use the principles of Design-Based Implementation Research, designing interventions to implement, study and refine in collaboration with UCI, OCDE, and SAUSD.

**Goals:**

1. Investigate current practices regarding the teaching and learning of computational thinking in grades 3-5 in the districts and nationally, and their potential for successful engagement of diverse learners;
2. Develop pilot instructional materials, with a focus on integration with California’s CCSS, specifically English Language Arts, in a way that best meets the needs of the predominantly low-income/Hispanic/Latinx/English learners;
3. Iteratively pilot and evaluate these instructional materials so as to further develop them for broader implementation and assessment;
4. Establish a successful Researcher Practitioner Partnership that can be further developed and sustained, serving as a model for other RPPs in support of Computer Science for All.

**Activities:**

- Piloted materials and instructional units for grades 3-5;
- Gathered data to inform the implementation process, measuring the extent to which the materials engage learners on the emotional, behavioral, and cognitive levels as well as the suitability of the materials for promoting computational thinking among the targeted learners;
- Refined the curriculum to better meet the learning and socioemotional needs of diverse learners;
- Established a Researcher Practitioner Partnership in support of Computer Science for All.

CONECTAR was awarded the next medium-sized PreK-8 grant titled Collaborative Network of Grades 3-5 Educators for Computational Thinking for English Learners. The goal of this project is to scale up the project to 40 new fourth-grade teachers with scale up to the rest of the District planned for an eventual stage 3 of the project. This project will involve refinement of our professional development approach to better prepare and support a broader group of teachers, and development of ways to document and learn from what will likely be more varied classroom implementation. As before, the project will be continued through Design-Based Implementation Research, with the university and school district partners working together to iteratively refine the curriculum, professional development, and assessment tools as the project develops and expands into additional classrooms. In the third year of the grant, we will examine the effectiveness of the curriculum for developing computational thinking and literacy skills among diverse students. UCI and SAUSD will be the formal partners in the next round of the RPP, with OCDE continuing to support the project as a collaborator.
The project has a local objective, motivated by the immediate challenges and opportunities in the state of South Carolina to make computing accessible to a diverse audience—and a larger objective, motivated by a need to understand what preparation is necessary and what impediments must be overcome to effectively deliver culturally responsive computing education to students.

CONSTITUENTS

- Computer science and education researchers from Clemson University
- Teacher practitioners and the director for eLearning and Integration at the Anderson Five Career Campus (soon to become the Anderson Institute of Technology), which will offer computing courses to students at high schools in School Districts 3, 4, and 5.
- Teacher practitioners and the CATE coordinator of the Pickens County School District.
- The South Carolina’s Coalition for Mathematics and Science (SCCMS), an organization which facilitates contacts and information exchange with SC school districts across the state.

IMPACT

- The project has facilitated the professional development of 37 ECS teachers (using the ECS team) and 18 AP CSP teachers (using UTeach Institute) in two cohorts. Most of these supported teachers are from underserved districts.
- The teachers were trained by the ECS team and the UTeach Institute. Computer Science “pathways” in South Carolina may include one or both of ECS and AP CSP courses.
- In response to SC CS educator needs, the project team is creating a modified ECS professional development offering (for summer 2020) that accommodates unique challenges and contextual issues in SC K-12 schools.

OUR GOALS

Pedagogical Content Knowledge for CS
- Teachers will generally be more confident with CS pedagogy related to prior teaching experience.
- There will be specific computer science topics teachers will feel especially uneasy teaching.
- Instructional contrasts will illuminate areas of PCK-CS that are most important to focus on in professional development.

Inclusive, Culturally Responsive Computing
- Teachers will initially have differential expectations for students’ success in Computer Science.
- A focus on broadening participation such that teachers’ final attitudes are more inclusive than their initial attitudes.
- With teachers required reflective about their privilege and constraints-they must be connected to students in non-traditional ways prizing diversity as an asset to innovation.

Ongoing Professional Development Support Models
- Different ongoing professional development models will provide different levels of support.
- Models that are most effective are shown by teachers’ responses to individual professional development support model.
- Distinctive aspects of PCK-CS will highlight teachers’ challenges in implementing CS instruction and incorporating computational thinking.

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Computer Science for Mississippi
NETWORK IMPROVEMENT COMMUNITY
Growing Teacher Competency and Capacity

Mississippi State University • Research and Curriculum Unit • rcu.msstate.edu
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Proposal Size: Medium
Proposal Strand: High School Strand—Medium
RPP Type: Networked Improvement Community
Practitioner Audience: Exploring Computer Science (ECS) teachers in Mississippi

Goal One
Identify, develop, and deliver additional CS content training for high school teachers who are delivering the ECS curriculum as part of the ongoing CS state pilot.

Activities
The CS4MS NIC: Growing Teacher Competency and Capacity project will scale up the existing CS state pilot with the collaborative effort of the NIC to identify, develop, and deliver the additional CS content training fundamental to enhancing teacher confidence, effectiveness, and student achievement.

Outcomes
Current ECS teachers are working on the following resources:
- Two- to three-minute videos on various ECS topics
- Online modules for each ECS unit
- Supplemental face-to-face training sessions for each ECS unit

Goal Two
Work with the Mississippi State University College of Education and Department of Computer Science and Engineering, and the Mississippi Department of Education to develop appropriate licensure and endorsement pathways for CS teachers.

Activities
By creating multiple pathways for licensure and endorsement, Mississippi will be positioned to quickly scale up the number of qualified teachers, thereby moving closer to the state goals of placing a qualified CS teacher in all K-12 schools by 2023-2024 and reaching every student with CS opportunities.

Outcomes
The following two endorsements were approved by the Mississippi State Board of Education during Summer 2019.

Grades K-8 Computer Science Endorsement
12 hours of coursework to include the following:
- Digital Tools for 21st Century Teaching and Learning
- Graphics and Web Design
- Introduction to Computer Science Education
- Advance Information Processing

Grades 7-12 Computer Science Endorsement
20 hours of coursework to include the following:
- Introduction to Computer Programming
- Intermediate Computer Programming
- Data Structures and Algorithms
- Discrete Math
- Introduction to Computer Science Education

Description
With direction provided by the Computer Science for Mississippi (CS4MS) Network Improvement Committee (NIC), this project will guide the development of quality supplemental professional development for ECS teachers and create the licensure needed to enable different pathways to becoming a computer science (CS) teacher.
CSforCLE: A Researcher Practitioner Partnership focused on Understanding Equity & Access in a CS for All Implementation  www.CSforCLE.org
Cleveland State University & Cleveland Metropolitan School District
Nigamanth Sridhar, n.sridhar1@csuohio.edu
Debbie Jackson, d.jackson1@csuohio.edu

Mission: To create equity and opportunity where all Scholars engage with and explore Computer Science.

Vision:
• A robust, unified network of educational, industry and non-profit partners dedicated to supporting Computer Science learning across Cleveland Metropolitan School District (CMSD).
• Computer Science and Computational Thinking curricula are threaded throughout all grades with every CMSD scholar graduating with an advanced course in computer science.
• Established CS pathways leading to post-secondary programs and careers in every CMSD school.
• CS becomes a core content area in CMSD.

RPP Organization
• Bi-weekly meeting of the CSforCLE working group, usually at a CMSD facility
• Quarterly meeting of the CSforCLE leadership group
• Another RPP already exists between CMSD and CSU’s Center for Urban Education, which facilitates data sharing
• Grad student co-advised by CSU & CMSD

Working Group
Chelsey Cook – CMSD Principal
Terika Webb – CMSD IT Dept.
Debbie Jackson – CSU Education
Nigamanth Sridhar – CSU CS
Jeremy Shorr – TIES (Ecosystem)
Casey McCullough – TEALS support
Grady Burrows – BioEnterprise

Research Group
Brian Harper – CSU Ed Research
Karla Hamlen – CSU Ed Research
Tendai Ushendibaba – CSU Grad Student
Jason Smith – CMSD Research & Eval
Lisa Bievenue – Project Evaluator

Advisory Group
Karen Thompson – CMSD Curriculum
Helen Williams – Cleveland Foundation
Shawn Braxton – CMSD IT Department

2019-20 Goals
• Continue teacher PD to include more teachers
• Develop and mentor more teacher leaders
• Enhance Community of Practice
• Work with TEALS to place volunteers in new CMSD schools

Teacher Leaders
Briana Guevara – CMSD High School
Carolyn Petite – Chagrin Falls HS

Funding Partners
National Science Foundation
The Cleveland Foundation

Problem of Practice: Teacher Credentialing
• Ohio requires teachers to pass Ohio Assessment Exam (OAE) to obtain supplementary licensure.
• CSforCLE offered test preparation workshop for teachers in collaboration with UTeachCS.
• 18 teachers participated in test prep workshop during summer 2019.
• 100% OAE passage rate amongst teachers enrolled in CSforCLE PD.

Overview and Goals

The University of Hawaii in collaboration with the Hawaii Department of Education will conduct a 3-year large study aimed at improving state-level initiatives to address diversity in computer science education.

- October 2017 to August 2020
- STEM+C Award # 1738824, large proposal targeted at public high schools in Hawaii
- Partnership with Hawaii Department of Education – train 60 teachers across 30 public high schools in Hawaii
- AP CSP Curriculum by UTeach
- Research-Practitioner Partnership (RPP)
- Networked Improvement Communities (NIC)
- Focus on equity, distance education and diversity of teachers and students
- Identify and remediate barriers to participation among diverse students
- Enhance career pathways for students

Current Activities

Increase awareness and interest of AP CSP among school administrators, parents, students and high school teachers in Hawaii.

Progress

Cohort 1 – 17 Teachers, 11 schools
Cohort 2 (current) – 17 Teachers, 13 schools, 10 new schools
Cohort 3 (June 2020) – Target is 24 teachers, 10 new schools

Contacts

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Web Site: maui.hawaii.edu/csp4hi
Developing board games and learning materials to support 5th grade students' connected learning around computational thinking and coding

NSF Grant # 1837224
PI: Victor Lee, Stanford University & Utah State University
Co-PIs Jody Clarke-Midura & Mimi Recker, Utah State University

This PreK-8 Small Research-Practice Partnership involves Design-Based Implementation Research to develop new curriculum that is jointly enacted in classrooms and school libraries with teachers and school library/media specialists with whom our partner district had been scheduling computer science instruction. The goal of the project is to test out a model of unplugged-to-plugged computing education based on enacting rules in board games and then modifying code of digital instantiations of those same board games. Our hope is to increase interest in computing, particularly with girls. To date, we have designed and implemented a unit with three classrooms and one school library. We are in the process of refining our unit and preparing for implementation in three additional classrooms and a new school library.

For more information, email vrlee@stanford.edu
Digital Promise Global in partnership with the League of Innovative Schools has put together a three-year collaborative Research Practitioner Partnership (RPP) proposal to design, investigate and improve inclusive computing pathways for PreK-12 students via a medium project in the PreK-12 pathways strand.

Most states have enacted computer science (CS) mandates and most districts have started to integrate CS and computational thinking (CT) into their curriculum. But districts face significant obstacles both in terms of infrastructure and feedback measures that result in low participation of underrepresented students. Building on its ongoing, long-term relationships with the 114 districts in 34 states serving over 3 million students, the League of Innovative Schools has launched this medium-sized RPP to design coherent curricular progressions for CS and CT with an intentional emphasis on access and equity.

In the project—entitled “CT Pathways”, for short—researchers join with three “Core” districts from the League of Innovative Schools of a range of population and demographics: Iowa City Schools (IA), Indian Prairie School District (IL), and Talladega County Schools (AL).

Within each of these “Core” districts to focus on districts’ Hispanic and African American students, Title 1 schools, and more generally their girls and low-income students. These students need intentionally designed pathways and supports to increase consistent, cumulative, and competency-based participation in CT and CS. Our RPP will address three research questions, each with a deliberate focus on access and equity: How to define the purpose (“the why”) and structure (“the how”) of an equitable CS/CT pathway? How to support teachers to overcome barriers and grow competencies necessary to implement an equitable pathway? How to make targeted improvements to access and equity by collecting and analyzing data in periodic, rapid cycles?

To date (entering year #2 on 10/1/19), there have been a number of key accomplishments. These include:

- The coordination of each Core District taking a comprehensive inventory of existing district resources, including instructional capacity, curricular materials, and existing administrative protocols—and from this inventory, recognizing opportunities and gaps within their own PreK-12 offerings
- The articulation of the essential Why? behind a PreK-12 computing pathway, leveraging the CSforAll’s SCRIPT tool and including multiple stakeholder across each of the three Core districts
- The construction of a PreK-12 competency map, breaking down the individual competencies (i.e., algorithmic thinking, computational modeling) and how these compare to how other organizations (i.e., CSTA, CSforAll, Code.org); the goal is for participating districts to grasp the range and breadth of how CT has been defined under a range of competencies and articulate among themselves what competencies are crucial for their own students.
- The development of a Summer Challenge Institute (July 2019) with 5 additional League districts featuring an early version of the CT Pathways Toolkit, which includes a series of activities and measures to articulate the why?, what?, and how? of designing meaningful preK-12 computing pathways.
- The co-development (with three Core districts) of a three-year research blueprint, specifying the measures to be developed over the course of the grant and how they will be integrated into a quarterly feedback loop for the three Core districts.
EDC and NYCDOE are engaged in a design research partnership to study and enhance the implementation of Advanced Placement (AP) Computer Science Principles (CSP) courses in low-performing NYC high schools. This large RPP builds on the prior Beauty and Joy of Computing in New York City (BJC4NYC) NSF-funded project (grant no. 1441075), in which EDC and the University of California Berkeley created, tested, and refined Beauty and Joy of Computing (BJC), a high school AP CSP course. NYCDOE recruited and trained over 100 BJC teachers from a demographically representative set of NYC high schools, and feedback from NYC teachers informed curriculum revisions.

Our goal is to broaden participation in computer science by scaling and sustaining implementation of AP CSP, with particular attention to implementation in low-performing schools. Designing and testing targeted supports that assist low-performing NYC schools, including curriculum adaptations, differentiation of professional development, and school-level supports, will achieve this aim.

Project activities include the recruitment of a cohort of high schools offering AP CSP and the iterative refinement of teacher and school supports with attention to the needs of low-performing schools.

Project outcomes for participating schools will be:

- Increased enrollment, attendance, and attitudes toward computer science, especially for female, black and Latinx students underrepresented in computing
- Greater percentage of female, black, and Latinx students taking & passing the AP CSP exam
- Increased teacher knowledge, confidence, and curriculum use
- Improved long-term school planning & CS culture

To date, we hosted a Computer Science for All RPP development workshop, convened the advisory board, recruited teachers and schools, and designed PD and supports. Results of this RPP will be of use to practitioners and contribute better knowledge of teacher and school supports needed for implementation of rigorous computer science courses.
**Project Title:**  *Expanding Pathways in Computer Science across South Dakota*

**Principal Investigators**

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**Partners**

- Black Hills State University
- South Dakota School of Mines and Technology
- Technology and Innovation in Education
- High schools, districts, and teachers across South Dakota

**Evaluator**

Inverness Research Associates

**Project Attributes:**

- Size: Medium
- RPP-type: Discipline-based Implementation Research

**Overview**

A project team comprised of faculty and staff from Black Hills State University, Technology and Innovation in Education, and the South Dakota School of Mines and Technology is supporting South Dakota schools in adding *Exploring Computer Science* (ECS) to the high school curriculum. A pilot effort from 2014 through 2017 built significant capacity within 22 South Dakota schools and generated strong support among teachers and students. In 2017, NSF awarded a new grant to bring additional South Dakota schools onboard, especially those serving American Indian and rural communities. The project team has spent the first two years of the new award establishing and supporting two new cohorts of teachers and schools, bringing the total number of South Dakota teachers to 48 and schools to 38. The newly involved teachers are engaged as research partners as they're learning to implement the new curriculum within their classrooms.

**Research Questions**

1. To what degree does the project's suite of professional development components – together with the ECS curriculum itself – build teacher confidence and competence in teaching computer science?
2. To what degree does participation in the ECS course influence student beliefs and attitudes about computer science?

**NSF Awards**

- CS for All: Researcher-Practitioner Partnerships (award #: CNS-1738855)
- STEM - Computing Partnerships (award #: DRL-1441080)
Description:

The College of Education and the Department of Computer Science of the University of Puerto Rico at Rio Piedras partnered with Department of Education (PRDE), and key NSF-funded projects to tackle the lack of computer science education (CSE) in Puerto Rico. The main goal of this project is to establish the building blocks for a strong and well-integrated Research-Practitioner Partnership (RPP) that will foster the integration of CSE in the public schools of Puerto Rico.

Goals:

(1) Establish an RPP that will foster CSE in public school system of PR.

(2) Build and study a rapid-response support system for a cultural-linguistic equivalence of ECS curriculum in Spanish.

(3) Pilot the implementation of ECS Curriculum in Spanish in at least two high schools in PR with a high population of Hispanics, Hispanic women, and economically disadvantaged students.

What are ECS4PR’s contributions to CSE in Puerto Rico?

- Establishment of a CSE RPP in PR (AIPE 30+ active members)
- Translation of ECS Curriculum to Spanish
- Development, Translation and/or Adaptation of different learning materials and research instruments (e.g., RPP Diagnostic Rubric, ECS PD Questionnaire, ECS PD Content Assessment, ECS Observation Protocol, ECS Unit Assessments & Scoring Rubrics)
- Collection, analysis and presentation of research data
- Creation of a support system that is scalable for ECS PD + ECS Curriculum implementation in PR
- Comparison and revision of our Spanish 6.2 version of ECS with its newest version (v 9.0)
- Official ECS Course ID in PRDE enrollment system (CCOM 132-3108)
- First group of certified Puerto Rican ECS PD Facilitators, who led the 2018 and 2019 summer PDs in Spanish
- Dissemination of ECS4PR project findings and experiences in local and national conferences by PRDE Teachers (6 conferences)
- Offer ECS Follow Up Meetings
i2i is a CS4All project that focuses on the Prek - 8 strand small project for 18 months. The major goals of the project are to:

1. Establish a partnership among K-8 educators, representatives from computer science business in Maine, school administrators, and educational researchers to collaboratively generate and explore (both during this grant period and when additional funding becomes available) research questions related to supporting rural computer science learning progressions.
2. Build a network of rural districts committed to integrating computer science into their K-8 curriculum and school culture.
3. Facilitate a co-design process to identify where and how computer science can integrate into the Next Generation Science Standards and math Common Core standards while addressing the unique needs and interests of rural schools and communities.
4. Facilitate a co-design process to identify the professional development structure for scalable computer science learning progressions that will address the needs and interests of rural schools and communities.

In the past 6 months we have recruited 12 Teachers, 5 Tech Integrators, 6 administrators, and 6 business partners from three, geographically and socio-economically diverse regions. In choosing our school districts, we looked for a diversity in size as well as geographic location, to give the partnership a stronger sense of how to impact the range of educators and students across the state. School districts ranged in size from one elementary school with 550 students to a district with nine, elementary schools and a total population of 970, K-8 students. These schools include several island schools, representing the geographic isolation that is faced by much of this rural state.

Together, with our project partners, we have come gathered at three, separate, events to begin the co-design process. These events include a launch and a site visit to one of our partnering school districts in the spring of 2019, and a three-day retreat in the summer of 2019. The entirety of this project is to build relationships, trust, and understanding among rural educators, educators, and the local business community to enable the development of professional development for K-8 educators focused on integrating computer science into existing math and science standards and curricula.

The professional development of i2i so far has focused on 3 core outcomes - building relationships, developing a common vocabulary and understanding of what CS and CT is, and identifying the problems of practice related to achieving the goal of K-8 CS integration. As we work toward building relationships we are identifying the resources and areas of expertise across our evolving community, and understanding the context of each district and educator’s classroom/school. Developing a common understanding of CS and CT is where we spent the greatest amount of time, as we built off of existing literature and case studies in a scaffolded manner slowly adding more and more complexity and nuance as the community progressed. Many components of the PD have brought together the business leaders and educators - specifically when the group is working toward understanding what CS and CT actually is and the role of CS and CT in rural Maine businesses. We look forward to two more school site visits as well as a culminating symposium to include lawmakers, partners, businesses, and educational leaders.

MMSA Maine Mathematics and Science Alliance • www.mmsa.org • ph: 207.626.3230
The Integrating the Computer Science for All Initiative in Three Rural Eastern North Carolina School Districts (iCS4All)

PI: Matthew Militello
Co-PIs: Robert Martin Reardon, David Frye, Ronnie W. Smith

East Carolina University
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iCS4All ($999,751; PreK-8) builds on the trust and relationships engendered by an existing Research Practitioner Partnership (RPP; school-university-community collaborative research) to establish a collegial learning environment in which teachers will devise instructional material and engage with professional development to facilitate the integration of computational thinking into their middle school (Grade 8) music and visual arts classes.

iCS4All initiates an additional collaboration between two universities—East Carolina University (ECU) and the William & Ida Friday Institute for Educational Innovation at North Carolina State University (FI). An additional collaborative strength of iCS4All is that it harnesses the expertise of faculty within two colleges within East Carolina University: College of Education (Department of Educational Leadership) and College of Engineering and Technology (Department of Computer Science).

iCS4All focuses the synergy from the collaborative partners on the effective integration of computer science and computational thinking into students’ classes in three rural districts (Duplin County Schools, Jones County Public Schools, and Sampson County Schools) in eastern North Carolina, while also leveraging the skills and dispositions of the students’ parents and caregivers.

**Objectives**
(a) prepare and academically equip principals to lead iCS4All,

(b) prepare and academically equip teachers to integrate computer science and computational thinking into their subject content,

(c) engage students in understanding the salience of computer science and computational thinking to their lives and careers, and

(d) engage parents and caregivers in validating and sustaining iCS4All.

**Activities & Outcomes**
(a) monthly “moderation meetings” of teachers and iCS4All faculty,
(b) collaborative creation of “curricular activity system” guide book for music and visual arts teachers,
(c) tri-county “community learning exchange” for principals, teachers, parents, and students,
(d) student self-assessment & Q methodology study of student learning outcomes
(e) professional development for principals and teachers,
(f) planned “artist-in-residency” week incorporating input from ECU Music, Art, & Data Science faculty

**Active Involvement:** Spring 2018, Spring 2019
[Fall 2019 involvement curtailed due to extensive flooding from Hurricane Florence. Artist-is-residency focuses on translation of weather data into music and visual arts]
Next Door to Silicon Valley:  
A Researcher-Practitioner Partnership to Address Disparities in Access and  
Expectations for Computer Science Education

**PI:** Jill Denner (jill.denner@etr.org); ETR (Education, Training, Research)  
**Co-PIs:** Mary Anne Robb & Julia Hodges (Santa Cruz City Schools)

This project represents a small proposal in the PreK-8 strand and ran from September 2017-August 2019. The goal was to leverage existing efforts to integrate computer science (CS) and computational thinking (CT) into classrooms in a way that promotes a cohesive pathway from elementary to middle school and reaches all students. The intended practitioner audience is other medium sized school districts. The primary Research Question was: *How do we reduce the disparity in students’ access to quality opportunities to learn CS/CT and ongoing support to persist in CS?*

**Activities**
- Create a district-wide CS Committee
- Provide professional development and support for CS leaders
- Build buy-in across the school district and families to support and sustain CS education
- Collect and analyze data to inform next steps
- Create an equity-focused districtwide vision for CS education
- Coordinate a county-wide Administrators training to demystify CS
- Develop our design-based implementation Research-Practice Partnership

**Outcomes**
- RPP developed from an early to a medium phase; increased capacity to generate and use research
- CS integrated into 5th grade science, and middle school science and reading time
- Districtwide survey data from students, families, and teachers/staff used to inform the addition of CS Education in 5-year technology plan
- Results presented at four inter/national conferences (SIGCSE, AERA, RESPECT, Hawaiian International Conference on Education)
- New 3-year CS for All-RPP grant starting September 2019: “Computing for the Social Good: A Research-Practice Partnership to Increase Equity among Students and Parents”
- Submission of two related grants on family engagement: Spencer Foundation and NSF ITEST
Overview: This High School Strand, Small, Research proposal aims to explore outcomes of a novel AP Computer Science Principles teacher training program in which teachers complete the Beauty and Joy of Computing (BJC) and receive intense instructional support from undergraduate Computer Science majors. By leveraging a long-term relationship between the Atlanta University Center, consisting of Morehouse College, Spelman College, and Clark Atlanta University, and Atlanta Public Schools (APS), in-service high school teachers will be trained and supported to teach AP Computer Science Principles. APS predominantly serves and employs African American and other minority students and teachers. Likewise, the Historically Black Colleges and Universities (HBCUs) of the Atlanta University Center primarily serve minority undergraduate students. Through this unique model, minority high school teachers will receive BJC professional development and support from minority undergraduate CS students to teach their majority-minority AP CSP classes. In turn, minority APS students will receive rigorous CS instruction made relevant and contextualized within their culture.

Intellectual Merit: The intellectual merit of this project is to elucidate the effects of in-person undergraduate mentors during training and implementation and further validate the BJC curriculum within minority populations. The relationship between the Atlanta University Center and APS will yield well-trained AP CSP teachers who will be supported by mentors during their first year of implementation. We will examine the outcomes of these mentor/mentee relationships, interesting because the mentors will, more than likely, be younger than their mentees. We anticipate changes in teachers? CS content knowledge, understanding of careers in computing, and teaching confidence. Likewise, we expect changes in undergraduate students? ability to mentor, levels of civic engagement, and CS content knowledge.

Broader Impacts: The broader impact of this project is the development of a scalable model partnership between HBCUs and minority-serving school districts to have an impact on broadening participation in computer education. In doing so, partner schools receive the benefits of: (i) increased feelings of belongingness among high school students (ii) support from local content experts, and (iii) sustaining a relationship with a local HBCU. Likewise, participating HBCUs receive the benefits of: (i) recruiting from these underserved schools (ii) retaining their existing CS undergraduates through meaningful programs, and (iii) sustaining a relationship with the local school districts.
CodePlay: Personalized Computational Thinking in Grades 3-8
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CodePlay is a Medium-sized Design and Development proposal in the K-8 Strand from the Research-Practitioner Partnership (RPP) between Braintree Public Schools (BPS) and EdGE at TERC. The shared purpose of this RPP is to build a strong foundation for the teaching and learning of Computational Thinking (CT) in upper elementary and middle schools throughout BPS, and in doing so, to inform a scalable and generalizable model of personalized CT education for a broad audience of diverse learners in grades 3-8.

The RPP consists of 5 educational researchers and developers from our non-profit organization, three STEM K-12 curriculum directors from the school district, and a growing group of 15-30 teachers across the district. Through PD workshops, small working group sessions, classroom design-based implementation research, and frequent video conferencing; the RPP has developed a suite of CT materials and teaching strategies to improve STEM learning for a broad range of diverse learners. For the past two years, interactions between researchers and educators included:

- Quarterly day-long meetings with the entire RPP
- Monthly meetings (in person or on Zoom) with small working groups
- Classroom visits and observations (about 10 during year 2)
- Video conference interviews (at least 1 per year per participant)
- Logs kept by classroom teachers.

To date we have

- Co-designed a series of CT activities with teachers in grades 3-8, including a prototype of a differentiated CT/Math interactive called NumberFactory
- Designed a CT learning progression for grades 3-8
- Collected district-wide student CT skills, attitudes, and activity data and teacher CT instructional practices data for two years.
- Conducted cohort analysis of student data. Found significant improvements across cohorts in student CT skills, attitudes, and activities among students with at least one RPP teacher.
Our Project

Our medium project is designed for PreK-8 teachers and employs design-based implementation (DBIR) research. The ultimate goal of this work is to provide a school division and educators across the state and nation with a usable, comprehensive, effective, and appealing model of PD to support CS integration, particularly computational thinking (CT) and programming, in K-5 instruction for all learners, with an emphasis on supporting students with high incidence disabilities.

Through exhaustive refinement, this model should sustain an approach that fully supports teachers in this type of instruction. Further, through this work we seek to provide enhanced partnerships between local, government, and state agencies through a collaborative DBIR approach.

Our Objectives for this research practitioner partnership are:

1. To determine the challenges faced by teachers in inclusive classrooms when integrating CS into instruction for students with diverse needs, including those with high-incidence disabilities.
2. To determine a developmentally appropriate progression for integrating the Virginia CS Standards of Learning into math, science, and literacy instruction, particularly for students with disabilities.
3. To develop videos and other universally designed instructional materials to support K-5 teachers in inclusive classrooms in integrating the Virginia CS Standards of Learning into their math, science, and literacy instruction, with an emphasis on supporting students with disabilities.
4. To build upon and refine an existing model of professional development aimed at supporting K-5 teachers in inclusive classrooms in integrating the Virginia CS Standards of Learning into their math, science, and literacy instruction.
5. To examine the effectiveness of the professional development for supporting K-5 general education and special education teachers in inclusive classrooms in integrating the Virginia CS Standards of Learning into their math, science, and literacy instruction.
6. To identify effective support methods and adaptations for teaching CS to K-5 students with high-incidence disabilities, incorporating the principles of Universal Design for Learning.
7. To develop theory about how elementary grade teachers develop competencies for integrating CS into their content area instruction.

Our Progress

To date we have developed our first cohort of teacher participants, have conducted our first summer institute in which teachers learn about computer science, and have developed all of the assessment instruments needed to measure our progress. Our first cohort of teachers will participate in a range of professional development activities throughout the 2019-2020 school year. We will use feedback and data from these activities to revise our model of professional development for the following year.
REAL-CS and Exploring Computer Science

REAL-CS (Researching Equity, Access, and Learning in Computer Science Computer Science Education) at the University of Oregon: Scaling and Sustainability in High School Computer Science


The Exploring Computer Science CSforAll Grant & Project

The Exploring Computer Science (ECS) CSforAll grant is for a large, high school research alliance RPP. ECS is a high school introduction to the world of computer science and problem solving. It is a K-12/University national program (curriculum and professional development) committed to democratizing computer science knowledge by increasing learning opportunities at the high school level for all students, with a specific focus on access for traditionally underrepresented students. It aligns with many CS education standards.

The ECS Program

Founded in 2008, ECS is an introductory year-long high school computer science course focused on foundational computer science concepts and computational practices. Units cover topics including human-computer interaction, problem-solving, web design, programming, data analysis, and robotics. This past year, ECS added two supplemental units: artificial intelligence and electronic textiles.

ECS includes a two-year professional development (PD) model. The three strands of our PD are inquiry, equity, and CS concepts. PD is designed around research findings that describe characteristics of effective STEM PD. Discussions on equity and belief systems are shaped by research outlined in Stuck in the Shallow End (MIT 2008; Updated version 2017).

Over 55,000 students participated in ECS courses nationwide in 2018–19 with an additional 6,000 expected in 2019–20. In 2016, 2017, and 2019 ECS collaborated with other PD programs to create CSPdWeek, a one-week residential PD program at Colorado School of Mines that allows ECS teachers from areas not served by regional hubs to participate in ECS’s PD as well as build a CS teaching community.

Key Activities & Outcomes

1. FACILITATOR SUPPORT
ECS provides support for PD facilitators across the country by convening an annual weekend workshop, covering new research findings and sharing ideas about PD scenarios.

2. ECS PD SUPPORT
The ECS teacher PD program is a two-year model: two week-long summer institutes and online or face-to-face quarterly PDs throughout the year. ECS supports regional projects as they plan for and implement local PD.

3. RESEARCH-PRACTICE CYCLE
ECS follows a generative approach to learning from, linking to, and informing problems of practice in computer science teacher education. Research that emerges from REAL-CS informs curricular materials and the design and structure of professional development programs.
Researching Equity, Access, and Learning in CS Education (REAL-CS)
Elevating Student’s Voices: Engagement, Identity, and Agency in CS Classrooms (Strand 3)

Team Leadership: Jane Margolis (PI), Jean J. Ryoo (Co-PI and Director of Research)
Key RPP Partners: Alicia Morris (LAUSD teacher), LAUSD ITI Dept and CS teachers, Shelly Hollis (Mississippi State Univ.), Mississippi CS teachers (UCLA NSF grant #1743336)

REAL-CS is a 5-year collaborative grant between UCLA and the University of Oregon, consisting of three strands of work: Strand 1 focuses on the national expansion and support of Exploring Computer Science (ECS) led by Joanna Goode and Gail Chapman, U. of Oregon (see CNS-1743195). Strand 2 focuses on CS for California, building the capacity of teachers, administrators, and policymakers for broadening participation in computing, through ACCESS and SCALE-CA led by Julie Flapan, UCLA. Strand 3 seeks to elevate the voices, perspectives, and experiences of minoritized youth in CS who are taking ECS and AP Computer Science Principles courses, led by Jean Ryoo, UCLA.

In Strand 3, we seek to learn from students’ directly about what impacts their engagement, agency, and identity with computing. During the 2018-19 school year, we collaborated with Los Angeles Unified School District (LAUSD) teachers and ITI Department to collect the following data sources: weekly classroom observations of 4 focal classrooms, in-depth interviews with focal students, student artifacts, videos/photos, and pre-/post-surveys across all LAUSD. This 2019-20 school year, we are working with Shelly Hollis at Mississippi State University and teachers in the Mississippi Delta to learn from the experiences and perspectives of high school students living in rural areas of the Deep South. Researchers native to the region have also joined our team to support data collection/analysis that are socio-culturally and historically-situated.

Our project is guided by the following principles:

Centering Student Voice:
Our research amplifies student voices about their own educational and CS learning experiences. We focus on student identity (how do students see themselves as CS learners; do they feel that they belong in the world of CS), agency (do students see computer science as a vehicle for doing things that matter to them), and engagement (what/how are they learning). We observe classrooms through a sociocultural lens that recognizes interactions between teachers and students, students and students, and takes into account the entire school context, as well as the sociopolitical environment students are living in.

Documenting Inequity as well as Efforts to Challenge these Inequities:
We document the ways that youth are being disenfranchised through structural inequality, institutional norms, racism, sexism, classism. Our research also seeks to document how students and educators actively counter experiences of inequity in CS classrooms.

Systemic and Intersectional Analysis:
Our systemic and intersectional analysis examines structural inequalities, belief systems, policies, and learning. We recognize the pervasive presence and intersectionality of mutually-constructing systems of race, class, sexuality, gender, and immigration status oppression that impact students’ CS learning experiences. We respond to these findings by advocating for and helping to build pathways for change across structural, cultural, and systemic levels, in support of the students and educators we have the privilege of working with.

For more information, please see: http://csequityproject.org/real-cs
A Systemic Approach to Challenge Inequality in Computer Science Education

CLASSROOM

Building Capacity for Educators

"Summer of CS" professional learning for teachers, counselors and administrators prototype to be replicated regionally.

COUNTY/DISTRICT/SCHOOL

Supporting Leadership for Sustainable Implementation

CS Equity Implementation Guide for Administrators and accompanying workshop

CAPITOL

Informing Policymakers for Systemic Reform

Provide evidence-based research to inform policy and amplify voices of CSforCA, a multi-stakeholder coalition.

Research - Practice - Partnership

Network Improvement Community

Five early-adopter local education agencies will mentor and share lessons learned with five additional districts to scale equitable CS across CA.

Plan-Do-Study-Act

Ongoing Plan-Do-Study-Act (PDSA) cycles of iterative continuous improvement of the Administrator Equity Guide and Workshop through survey and interview data.

Research and Evaluation

Evaluation team from American Institute of Research will facilitate a formative evaluation of the NIC while our UCLA research team will conduct research on the equity implications for CS education reform at the classroom, district and state levels.

For more information, contact
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ScratchEncore: Equity via a Flexible, Culturally-Relevant Advanced Scratch Curriculum for Upper Elementary Diverse Students and Teachers
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A medium K-8 project to develop and test an intermediate, culturally relevant computer science curriculum through a Design-Based Implementation Research RPP.

Research Question: “How can we create advanced elementary Computer Science instructional materials that value advancing equity equally with student learning outcomes?”

Research-Based Development Results
- Theme development through participatory design sessions with curriculum stakeholders
  - Participatory design activities allowed students to reflect, project, and apply identities
  - Participants developed culturally relevant theme ideas in five Spheres of Influence: home/family, school, peers, media, and interests
- Design of the Teacher Accessibility, Equity, and Computing Content (TEC) Rubric for evaluating computing curricula
  - When teachers use the TEC rubric, they are attuned both to the curriculum’s instructional design and treatment of issues of equity and cultural diversity

Preliminary Findings on Curriculum Use
- Downloaded 142 times in 2018-2019 school year by individuals from 6 continents including 29 states in the United States
- Pilot teachers believed Scratch Encore was successful in their classrooms (4.29/5 average rating) and was engaging to their students (4.38 / 5 average rating)
- Teachers specifically noted the Ofrenda, Transportation, and Soccer modules as culturally relevant to their students
- In the Events module modify project students:
  - Added or changed a costume (79.64%)
  - Changed the backdrop (4.92%)
  - Added or used sounds (31.32%)
- In the Events module create project students:
  - Used required blocks (60-90%)
  - Used the say block from Module 1 (>80%)
  - Used size manipulation blocks (>25%),
  - Used blocks not formally introduced in the curriculum (≈75%)

Curriculum Design
- 15 modules, 3 themes
- 2-4 lessons / module
- Use → Modify → Create pedagogy
- TIPP&SEE, a new learning strategy to navigate example projects through discovery learning
- Culturally-Relevant Design
- Aligned to CSTA Standards

Year 3 Study Strands: Modules 1-6

Year 3 Pilot Modules 7-15
This project leveraged an existing Research Practitioner Partnership (RPP) to help build the knowledge base needed to infuse high quality, engaging CS curriculum and instructional practices into K-12 classrooms across diverse and geographically dispersed school districts in New Jersey and Pennsylvania.

The overarching goal of this project was to increase the number of school districts in the region with the capacity to deliver rigorous engaging CS education for all of their students, and to strengthen and broaden the CS program in districts/schools already possessing this capacity.

The mechanism through which we set out to accomplish our goals was a research practitioner partnership (RPP), the Computer Science Teaching and Learning Collaboratory (CS-TLC), which functions as a Research Alliance and has key components of a Professional Learning Community.

Founded on insights generated by the science of team science, CS-TLC serves as a collaborative supported structure that promotes and supports key mechanisms and processes of effective collaborations, including open and honest communication; free exchange of perspectives and ideas; structured opportunities to collectively review, interpret, and reflect on experiences and data; and meetings that are outcome-oriented.

Additionally, of central focus, is the pressing issue of social justice and how best to prepare teachers and administrators to provide equity in the provision of rigorous and engaging CS classes in their schools and classrooms.

The three specific project goals include (1) Capacity-Building (2) PD Delivery and Support; and (3) Iterative Feedback (through a process evaluation and the use of data to inform decisions regarding potential modifications and enhancements to all program components).

Activities completed include, among others, an extensive needs assessment of participating districts, high schools, and teachers along with the development and implementation of a CS Summer Institute for teachers and administrators in July/August 2018. We have built upon this work and further developed and refined our approach for our related grant (Award # 1837305).

This current grant concludes this fall and we believe that the diverse makeup of the organizations participating in CS-TLC is a notable strength and that the cultivated group dynamic has proven to be conducive for the exchange of information and practical strategies as well as for acquiring content pedagogical knowledge that enhances classroom delivery and improves teacher self-efficacy. The CS-TLC team was awarded a Public Choice Award in the 2019 STEM for All Video Showcase for the CS Teaching and Learning Collaboratory video.
The University of Northern Iowa Partnership for CS Teacher Preparation is funded from 2018-2020 by an NSF small proposal grant in the high school strand of the CSforAll program. The group is a research-practitioner partnership (RPP) aiming to facilitate computer science (CS) teacher professional development (PD) across Iowa. The partnership currently includes research faculty at The University of Northern Iowa and a cohort of 29 teacher practitioners from 25 school districts, most located within an hour and a half of Cedar Falls, Iowa. While approximately one third of the practitioners were teaching computer science at the start of the partnership, 100% of them are teaching a computer science course in their school district during the current school year.

The PD program includes a sequence of five courses developed and led by a PD design team of faculty members at the University of Northern Iowa. The PD design team meets weekly during the school year and multiple times a week during the summer. The delivered PD includes online and face-to-face interactions between course instructors and participating practitioners. Most of the teachers enrolled in this program are completing this coursework as a step towards earning a state CS endorsement, an achievement that has recently become available for teachers in Iowa. The cohort began coursework during the summer of 2018 with an Intro to Programming course, followed by a Teaching and Learning Programming course during the 2018-2019 school year, followed by a Foundational Concepts course during the summer of 2019. Teachers are currently enrolled in a Data Structures and Algorithms course for the 2019-2020 school year and will complete the PD sequence with Methods of Computer Science in summer 2020.

In addition to the provided PD, the partnership has begun formal data collection and analysis of the attitudes and competencies exhibited by the CS students of the 29 practitioners. To date this has included a pre-course attitudinal survey. There are further plans for post-course surveys and the application of a standardized programming benchmark. Additional research is being conducted within the classes taught by the practitioners to evaluate and enhance the PD being delivered to the teachers and to examine appeal and impact in underrepresented groups in CS.
RPPforCS is a large NSF-funded project adapting the RPP approach to build the capacity of CSforAll: RPP evaluators and researchers to study, understand, and report on CSforALL: RPP efforts and to establish a participant-driven, multi-site research agenda for the CSforAll RPP program. Partnerships are highly diverse in terms of size, context, research area and strength of working relationships. This project is engaging PIs, researchers and evaluators to collaboratively develop a shared data set to capture participation data across projects, co-define an RPP research agenda to advance the field of CT/CS educational knowledge, and use the CSforAll infrastructure for collaboration, learning and dissemination.

The RPPforCS Team

Alan Peterfreund, PI  
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Stacey Sexton  
Stephanie Wortel-London  
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Our Research Questions

1. What are the RPP-specific activities and partnership characteristics that shape the extent to which/ways in which RPPs meet their goals for quality CS education?
2. How do different RPPs define and design around different indicators of healthy RPPs and how do they evolve over time?
3. How do RPPs measure their effectiveness at affecting CS education and broadening participation?
4. What is the influence of RPPforCS on the grant-funded community and broader CS education community)?

Our Progress So Far

Connected Community of Practice

Teams have had the opportunity to share findings at forums, panels at conferences, and poster sessions.

The RPPforCS website was relaunched with enhanced features in December 2018. Project profiles, links to key personnel, community activities, and other resources are now included on the website.

We’ve convened annual community gatherings in partnership with RESPECT (2018, 2019, 2020).

Research

A large amount of data regarding implementation, practice, and other topics have been collected from projects in a variety of formats, such as abstracts, proposals, interviews, and surveys.

Projects have been engaged through resources such as Theme Studies (a synthesis of project thinking around core components of CS education and RPP efforts) and Research-Practice Briefs (practitioner-focused documents highlighting how members of the RPPforCS community are addressing issues of practice), which were then shared with the RPPforCS community. A searchable project database was also created to allow projects to find each other based on a number of different categories.

Co-sponsored a workshop with CSEdresearch.org at ICER (2019) on Assessment in CS education.

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To learn more, please scan the QR Code or visit: www.CSforall.org/projects_and_programs/rppforcs/
UTeach and NYC: A Design Research Partnership to Expand and Improve High School Computer Science Education for Underrepresented Urban Youth
Award # 1837687

Kimberly Hughes - Principal Investigator
Anthony Petrosino - Co-Principal Investigator

The University of Texas at Austin and Southern Methodist University

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Proposal Size: medium
Proposal Strand: high school

RPP Type: Design-Based Implementation Research (DBIR)

Practitioner Audience: public school administrators, classroom teachers, researchers, curriculum developers, and professional learning and support specialists

Goals and Objectives: Improving Black and Latino/a student participation, learning, and engagement in Computer Science by addressing the following three research questions:

1) What organizational conditions, processes, and supports are associated with improved participation by Black and Latino/a students in CS?
2) What kinds of project-based instructional strategies, materials, and interventions are associated with improved student learning in UTeach CS Principles among Black and Latino/a students?
3) What kinds of non-cognitive approaches are associated with improved engagement and motivation by Black and Latino/a students in UTeach CS Principles?

Description: During this project, we are working in collaboration with the NYC DOE CSforAll initiative and NYC classroom teachers to study the implementation of UTeach CS Principles curriculum. We will study how the enacted curriculum, project-based instructional practices, and teacher approaches and routines do or do not effectively engage students. Together, we will identify patterns of reduced student engagement and learning and then design and implement interventions that enable and support teachers to effectively engage Black and Latino/a students in CS. This process of iterative design and testing will allow for productive adaptations to the written curriculum based on the effects of the teacher-enacted curriculum on student engagement and learning. We expect to augment the current curriculum with new activities and teacher routines that will better differentiate student learning, as well as introduce improvements to teacher professional development and implementation support.

Progress to date: During the planning year, UT researchers and staff worked alongside NYC DOE staff and NYC classroom teachers to create a project charter that identifies key activities and actions that will lead to increased student engagement, interest, and achievement in the AP CS Principles course. Research activities and instruments were finalized and eight NYC teachers attended summer training on the UTeach CS Principles curriculum. Based on input from NYC teachers, the student introduction to the UTeach CS Principles course was enhanced with activities designed to address issues of student identity and self-efficacy in CS. This new content is being implemented for the first time this fall.