The Role of Researcher-Practitioner Partnerships in CS4All: Lessons from the Field

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CCS CONCEPTS

• **Social and professional topics → K-12 education**; *Computational thinking*; *Accreditation*; *Model curricula*; *Student assessment*;

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1 SUMMARY

Researcher Practitioner Partnerships (RPP) are "long-term, mutualistic collaborations between practitioners and researchers that are intentionally organized to investigate problems of practice and solutions for improving district [and school] outcomes." [1] As highlighted in NSF solicitation NSF 17-525, RPPs are critical for the success of CS For All initiatives aimed at providing all K–12 students access to CS education.

The panelists represent three examples of mature RPPs that have successfully implemented CS4All programs in three states working with school districts with different characteristics and at different scales. The projects share similar approaches to the goal of increasing equity in CS education by providing all high school students access to a rigorous and relevant CS course. All projects chose to focus on the Exploring Computer Science (ECS) Curriculum and Professional Development. While the specifics of the implementation vary, the projects encountered similar challenges especially when transitioning from a pilot stage to igniting systemic change across the region. Challenges vary in importance and scale across a wide range of issues including: teacher capacity building, fidelity of implementation, leadership structure and buy-in, personnel turnover and continuity of funding. The open ended commitment of RPPs to work together on the specific problems that the educational partners face and grounding solutions on rigorous research has allowed these projects to flourish.

The discussion will focus on how the programs were able to organically build an RPP and leverage it to deploy, scale and sustain their initiatives. The panel will share obstacles, successes and lessons learned from each implementation. Nascent and more established partnerships will benefit from learning how these three RPPs overcame challenges so that they can leverage those lessons to accelerate their own implementation.

2 DON YANEK — CAFÉCS

The Chicago Alliance For Equity in Computer Science (CAFÉCS) RPP started 8 years ago as an informal alliance between a Chicago Public School (CPS) high school CS teacher (Yanek), a CPS administrator (Wilkerson), and three university computer scientists (Dettori, Greenberg, and Reed). As the group sought to become better grounded in educational research practice, they added an educational researcher (McGee). The goal was to provide quality access to ECS to all high school students in CPS. With its 167 high schools, CPS is the third largest urban school district in the country. CPS 110,000 students includes: 47% Hispanic, 38% African American, and 80% economically disadvantaged students.

CAFÉCS has grown significantly since starting with a pilot cohort of 11 teachers. With the support of multiple public and private grants (NSF: CNS-1138417, 1543217, 1542971, 1738691, 1738776, DRL-1640215), the alliance has developed 15 ECS facilitators who have provided ECS PD to over 250 CPS teachers. In the alliance's first 5 years, ECS has been taught in 40 CPS high schools to over 13,000 students reflecting the diversity of CPS student body. In addition, 44% of the students are female. Currently, ECS is being taught in 63 schools to over 11,000 students by over 150 teachers. A Principals PD program and a peer coaching program have also been established. The alliance has contributed to the literature on the impact of the ECS course on students' attitudes towards CS [2], students' choices about future CS coursework [5], and students' development of computational thinking practices [6]. A proud moment for this alliance came when Mayor Emanuel felt confident enough in the direction of the alliance to launch the K–12 CS for All initiative (CS4All) in 2013. Two years later, the members of the alliance stood together in support as the Chicago School Board approved the institution of CS as a graduation requirement for all CPS high school students starting with the 2020 graduating class. It would have been easy to declare victory and disband the alliance,

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but it soon became clear that as much work as went into laying the groundwork for enacting the graduation policy, even more work would go into ensuring high quality implementation of the policy.

The need to reach every high school within the four year timeline dictated by the graduation requirement highlighted existing hurdles and uncovered new ones. Challenges revolve around teacher capacity building, improving and diversifying the support for novice teachers, ensuring fidelity of implementation, measuring impact on student learning, cultivating buy-in from school leadership and facilitating institutional changes within CPS to progressively transition ownership of logistics.

3 HELEN HU — UTAH ECS INITIATIVE

The Utah Exploring Computer Science Initiative grew out of discussions of the Utah Computer Science Teachers Association (CSTA) chapter on how to respond when 9th and 10th graders were not being allowed to take CS classes. The Utah State Specialist for Computer Science (Lyman), three university computer scientists (Hu, McCarthy and Heiner), and high school computer science teacher-leaders (Reitz-Larsen) collaborated to introduce a one-semester version of ECS to fulfill an existing Utah high school graduation requirement. NSF award CNS-1240977 supported four years of ECS summer workshops for over 200 Utah teachers [3, 4]. ECS workshops are now supported by a combination of funding from the Utah State Board of Education (USBE), the Utah STEM Action Center, and a Code.org state partnership.

The partnership between the USBE and university CS researchers has been key to the explosive adoption of ECS in the state. ECS has served as one of two options for the statewide high school Computer Technology graduation requirement set by the USBE. Similarly, Utah teachers were quick to sign up for ECS workshops because the summer workshops and the follow-up PD were requirements for earning an ECS endorsement as well as a more advanced CS endorsement for in-service teachers.

One of the challenge of the partnership has been reaching all students in Utah. ECS students were only 37% female in 2015–16. The lack of gender equity reflects a preconception by guidance counselors, parents, teachers and even students that female students may not benefit from ECS as much as male students. The partnership also struggled to break into the most rural school districts, where administrators were less enthusiastic about teaching students programming skills that would cause students to leave the community. Many rural teachers were already teaching seven or more different courses each semester and were not eager to add a new course to their teaching load. We are slowly making progress in both these areas by leveraging other STEM projects and state legislative funding in support of CS education through the USBE and the STEM Action Center.

4 DENNIS BRYLOW — PUMP-CS

The PUMP-CS project (Preparing the Upper Midwest / Urban Milwaukee for Principles of Computer Science) grew out of an effort in 2010 to bring together stakeholders from Wisconsin's Department of Public Instruction, high school CS teachers, and several universities, with Brylow representing Marquette's CS faculty. With the shared goal of promoting CS education across the state, the steering group planned the first CS-specific professional development workshops and worked to secure funding from local sponsors, Google CS4HS, and ultimately NSF. With support through NSF awards CNS-1339392 (Marquette University) and CNS-1339179 (University of Wisconsin - La Crosse) beginning in 2013, the PUMP team began rolling out ECS courses in high schools all over the state, including urban, suburban, small town and rural districts. Over three academic years, 62 teachers and over 1,800 students have participated in the project.

The greatest challenge in partnering with school districts has been getting good information into the right hands in each school. Although many affluent suburban districts quickly signed on, reaching socioeconomically disadvantaged students in very urban and very rural schools has proven persistently difficult. Many administrators still do not know what CS is, or assume that they must be teaching it because there are devices or digital literacy courses in the school. At the next tier of familiarity, district decision-makers may realize there is a need for CS, but fear that special equipment costs or the difficulty of hiring and retaining qualified CS teachers will be a prohibitive strain on limited resources. For schools that are ready to staff and run CS courses, the most daunting challenge is choosing a safe pathway through the ever-expanding universe of CS curriculum resources.

The greatest success of the PUMP-CS partnership has been to leverage university and state resources to help curate coherent curriculum choices, to promulgate sensible content standards, and to support our K–12 colleagues in developing reflective communities of professional development at various levels.

With new CS courses planted in seven of the largest Milwaukee Public School (MPS) system high schools by 2016, the PUMP team extended its focus to promoting CS education in every school of our state's largest and most diverse public school district. Continuing NSF support through 2019 is under award CNS-1640217 for Marquette, in collaboration with University of Wisconsin - Milwaukee and MPS. As is the case in many large districts, the central administration often has limited power to directly affect change in individual clusters and schools, and the case for CS education must frequently be made building by building.

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