

Board 64: Work in Progress: Update on the Impact of Secure and Upgrade Computer Science in Classrooms through an Ecosystem with Scalability & Sustainability (SUCCESS)

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Abstract: This Work in Progress Paper provides an update on the Secure and Upgrade Computer Science in Classrooms through an Ecosystem with Scalability & Sustainability (SUCCESS) project, an NSF-funded (#2031355) Computer Science (CS) educational Research-Practice Partnership (RPP) whose shared goal is to provide high quality CS educational opportunities to all middle school students in a rural area. SUCCESS brings together people, programs, knowledge, and resources to provide CS education and career counseling to students in these middle schools. RPPs are a novel method that uses research in local educational contexts to increase access to CS in areas that typically lack necessary resources. The SUCCESS RPP is creating a CS course sequence that satisfies a West Virginia (WV) middle school career exploration requirement and supports districts in implementing CS education in their schools, thereby expanding CS opportunities for rural students. Core RPP members are West Virginia University (WVU) Center for Excellence in STEM Education (CE-STEM), West Virginia University Beckley campus (WVU-B), the Raleigh County School District, the West Virginia Department of Education, and Code.org.

The SUCCESS RPP partnership first convened at a summer 2021 workshop, where middle school-level “design teams” including teachers, principals and counselors were formed. These teams worked with district and university SUCCESS senior personnel to modify the most widely used CS curriculum in the world (Code.org) and understand how the RPP would use data obtained from partners and students of participating teachers. Data collected are used to provide and iteratively improve culturally responsive development (PD) and other supports to additional state districts in summer 2022 and 2023. In this paper, we provide an update of the impact of the project to date on numbers of teachers, counselors, and principals, and the number/percent of students who have taken the adapted CS course for each participating school, as well as challenges and how project personnel adapted the project to address these challenges. The RPP approach and our results can benefit anyone working to increase access to high-quality CS education at the K-12 levels.

Background: Senate Bill 267 charged the WV Department of Education with creating a plan to make CS available to all K-12 students. Bill 267 makes WV one of the first states to require all students be exposed to a variety of CS experiences throughout their K-12 career. In addition, in 2017, the state Board of Education mandated College and Career Readiness Standards for Student Success for grades K-12 to prepare students for seamless and successful entry into college or career. This requires that students develop a full understanding of the career opportunities available, obtain the education necessary to be successful in their chosen pathway, and a plan to attain their goals throughout their education (known in the state as the Personalized Education Plan, or PEP). Thus, these standards are based on 16 Career Clusters, or groups of occupations and industries based on commonalities identified by empirical evidence. Input was also obtained from local workforce and post-secondary leaders, the Board of Education, and teachers. [1] *Virtually every career in all clusters, regardless of education level, requires CS.*

Prior to 2021, some of the state’s districts had made a CS course available in some high schools but many schools lacked teachers with the experience necessary to teach the class, and the situation was even more dire at the middle school level. For example, there was no common CS curriculum. There had also been a lack of administrative support for having teachers attend CS PD. In addition, counselors had not encouraged students entering high schools offering the CS course to take it.

To meet CS goals in the state, an RPP approach was implemented. RPPs are collaborative, long-term partnerships whose goal is to improve persistent problems of practice in education in a local context. In the RPP model, research is incorporated into decision-making processes, and the problems addressed are meaningful to practitioners in schools and districts. [2] RPP partners often include school districts, state administration, businesses and other organizations, and university faculty. These partners collaborate to iteratively define and refine common goals, research questions, metrics, and implementation. RPPs are

effective because they bring local practitioners, counselors, and principals into the research process, thus research questions are more relevant to them and the results from RPP research are more likely to be implemented in real-world contexts. [3] The progress of the RPP is evaluated by an independent source who attends all meetings, workshops, etc., and provides input that partners use to improve the project.

The problems of practice addressed by the RPP are also important nationally: by 2022, only 27 states had policies giving all high school students access to CS courses, and only 12 had policies to offer CS access to all K-12 students. [4] Schools in urban and rural areas are less likely to offer CS than those in suburban areas, contributing to the access divide and disparities in CS participation and achievement by socioeconomic status, race, and gender. [5] Over 20% of public-school students in the US attend schools in rural districts. [6] Integration of CS into the K-12 curriculum remains elusive for many rural districts because they lack educators with CS expertise and the confidence to teach CS. [7] Rural schools face other challenges to implementing CS, including lack of principal and counselor awareness of the importance of CS to all careers, and community ambivalence about subjects that could lead students to seek careers outside of the community. [8]

Teaching and career counseling for rural students requires unique understanding of these challenges and local characteristics that shape community life and family dynamics. This RPP is working with these uniquely qualified teachers and counselors to increase their knowledge of CS and awareness of the importance of CS to virtually every career at every level of education and provide the necessary support for their success in the form of resources, opportunities, and much needed place-based innovations. [8]

While 86% of the state's population completes 12th grade, only 21% complete a Bachelor's degree and the percentage of the state's population living below the poverty level is among the highest in the nation at 15.8%. [9] Graduating high school with CS & coding skills could greatly change the socioeconomic outlook for these students. There are currently 814 open computing jobs in the state; the average salary for all jobs here is \$42,370 while the average salary for a computing occupation in the state is significantly higher at \$75,109. [10] Yet these jobs are out of reach for most: in 2020, only about 250 of the state's students graduated with a degree in CS and only 405 high school students took an Advanced Placement CS exam in 2020. Teacher preparation programs in the state have not produced any CS graduates since 2018. Thus, the benefits of providing CS PD and curriculum support [11] to K-12 teachers has potentially far-reaching effects for students as well as the state's economy. Local barriers to students' CS participation align with the findings from the CS literature:

- Some counselors and teachers were unaware of the importance of CS education [12]
- Teachers were not equipped with CS content knowledge [13]
- Counselors lacked awareness of CS job prospects necessary to advise students [8]
- Principals didn't actively support initiatives to increase CS participation because they didn't understand the importance of CS [14]

Activities: The SUCCESS RPP addresses these challenges by leveraging its partnerships to customize the Code.org middle school curriculum for local rural contexts and prepares and supports middle school teachers to deliver the curriculum, and counselors and principals to support CS education through knowledge of its importance to careers using data-driven decisions to continuously improve. RPP activities, a summary of related progress to date, and future plans include:

- **Providing a Professional Learning Community (PLC)** The PLC has been rapidly established through workshops, meetings, video chats, and follow up visits with RPP senior personnel and WVUIT students. It continues to evolve as new teachers, counselors, and principals are onboarded and as the project expands to additional districts.
- **Adapting the Code.org curriculum** In the 2021-2022 academic year, the curriculum was adapted to include locally-relevant activities by 11 teachers and with input from 5 counselors and the Director of Technology in Raleigh County and CS content experts from WVU Beckley. The revised curriculum

has been implemented in CS classes in 5 of the district's middle schools to date. This core group continues to obtain input and revise and will continue to do so as needed for the duration of the project.

- **Providing Middle School Teacher CS PD to Additional Districts** The same core group of teachers is creating PD based on the adapted lessons for 2 new teachers, counselors, and one principal in at least two additional districts in 2023. Teachers will also complete Code.org's CS Discoveries for Middle School training. The same process will be followed for 2023 – 2024 PD offerings.
- **Providing Counselor and Principal Workshops for Additional Districts** The initial workshop with participating RPP counselors and principals was held in person in summer 2021. Since then, additional meetings, in person and virtual, have occurred, and input has been collected for revising future workshops, which will occur regularly both in person and virtually for the duration of the project. Last fall, the counselors worked with Director of Technology to have all middle school students complete the STEM Career Interest Survey [15]. Counselors will discuss students' responses to help them make the connection between their potential career options and course choices for the upcoming year.
- **Creating a Video Library featuring CS and STEM Careers with Local Professionals** Two Career Fairs occurred in Spring 2022 for students and their families. These fairs feature local professionals discussing how they use CS in their careers, specific skills and apps, and classes students should take to prepare for similar careers in the state. Fairs are recorded and are available to anyone via district website. The goal is to feature local STEM professionals that will represent each of the 16 career clusters by the end of the project. Career fair dates are set for Spring 2023.
- **Providing Technical Support** Technical support is coordinated and provided by the District's Director of Technology. A former principal and life-long CS learner, the Director of Technology is integral to the project, as she has a unique understanding of the district's technology, its challenges, and how to best address its needs. Undergraduate CS students from the WVU IT program, trained in Code.org's curriculum, have also been providing in-class and virtual support and all will continue to do so.
- **Studying the Impact of the Implementation** on the district teachers, counselors, principals, and their students. The PI, a social sciences researcher, is conducting RPP research and has been working with senior personnel, RPP teachers, counselors, and the Director of Technology to collect survey responses, notes from meetings, interviews, etc. and then provide partners with summaries of results which are then used to improve the project since summer 2021.
- **Providing Data Collected to State, District and Other Partners**, and the broader community through a dedicated website, research publications, recommendations, and as additional teacher materials from Code.org. Anonymous data collected from teachers, counselors, principals, and students has been analyzed and shared with partners and the external evaluator and used to iteratively improve the project implementation, which is a continuous process for the duration of the project. Last fall, for example, data collected indicated that several changes had to be made to the curricular materials to accommodate different course lengths, and teacher training had to be provided at the last minute due to school staffing changes. As a result, a new onboarding plan has been adopted.

The RPP research study is funded by NSF to increase student interest and therefore enrollment in CS courses and majors by supporting teachers, counselors, and principals in providing high-quality CS instruction to their students. Prior to the implementation of the SUCCCESS RPP, none of the Raleigh County district's schools offered CS courses. Table 1 provides the number of teachers, counselors, and principals in the district who have participated in the RPP to date. Table 2 provides the number of students receiving CS instruction and counseling by grade and school in the district in the 2021-2022 school year as well as estimates for the number who will be similarly impacted by the end of the current academic year.

Number of Teachers, Counselors, & Principals* in the RPP since 2021-2022.

Academic Year	Teachers	Counselors	Assistant Principals	Principals	Total # District Partners Impacted

					by School
2021-2022	13	5	1	5	23
2022-2023	11	6	1	7	22

* The district superintendent also met with SUCCESS partners.

Number of Students Who Have Had CS Instruction and Counseling since 2021-2022.

Middle School	Total Enrollment 2021-2022	Students in CS 2021-2022	Enrollment 2022-2023	Projected Students in CS 2022-2023	Total # Students Impacted to Date
Beckley Stratton	649	560 (86%)	674	585 (86%)	1145
Independence	469	459 (98%)	477	467 (98%)	926
Park	372	48 (13%)	395	131 (33%)	179
Shady Spring	586	526 (90%)	577	568 (98%)	1094
Trap Hill	387	240 (62%)	376	229 (61%)	469
Column Total (Percent)	2460	1833 (75%)	2499	2116 (85%)	3813

During the final RPP meeting of the 2021-2022 academic year, the entire group shared data on the number of classes offered in each middle school and the number students in each, along with total enrollment, to determine what percent of students at each school had received CS education in the RPP's first year. In three of the five schools, over 85% of students had taken the CS course! The smallest school lost one of its RPP teachers early in the year, but 62% of their students still took the course. Only one school had not implemented course due to scheduling problems and consequently only 13% of their students received CS education. To remedy that situation, Park's counselors worked with principals during the summer 2022 workshop to add CS courses into the schedule in the 2022-2023 academic year; this will increase the number of students impacted this year to more closely match other district schools.

Summary: During the last year and half, data obtained indicates that SUCCESS RPP has been very effective in supporting teachers in overcoming challenges and implementing the adapted Code.org CS curriculum in their classes and that they know that their voices are valued in the work of the RPP. Teachers have taken the initiative in bringing CS to their students, and knowing that involving parents is so important for their students, teachers from two schools even submitted proposals last fall to provide an evening event for students and their families in spring. The events will increase the awareness of CS career opportunities to parents/community members by showcasing the connections between CS and the 16 career clusters and how they will allow students to say in their home state. Both events will broadcast the district's commitment to strengthening CS education. One event will be a collaboration with the business community that would develop a local database of the 16 career clusters, with emphasis on CS, focusing on how CS can make it possible for students to obtain well-paying careers while staying in their home state.

Providing counselors with necessary supports proved to be more challenging in year one, however, those challenges resulted in improvements to counselor resources and support this year. For example, there

were difficulties organizing career fairs in a timely manner and securing speakers for in-person events last year. This year, career events are already planned and will increase family participation. In addition, the Director of Technology noted early in the 2022-23 academic year that counselors had to spend so much time focusing on scheduling students' courses that they had little time to gather information from students about careers they were interested or well-suited for and which courses students they should take to reach their career goals. This is extremely important as rural students from this state are much more likely to have to take remedial courses at the university level than their non-rural peers, and are more likely not to graduate as a result. To remedy this problem, all students are now completing the STEM Career Interest Survey [15], which includes items about interest in science engineering, technology, and math and has been modified for counselors to include CS. Counselors will use students' responses to guide them to specific career options and required courses.

SUCCESS RPP has made substantial progress in establishing and maintaining an RPP to bring CS education to Raleigh County middle schools, despite preexisting challenges discussed earlier as well as new challenges, including technology distribution, scheduling and staff changes. Data from teachers, counselors, and students has been used to improve curricular materials, classroom practices, and plan the next PD offering in 2023. Through these future PD offerings, SUCCESS RPP will help more districts in the state make CS available to all students as outlined in Senate Bill 267, making this one of the first U.S. states to require all students be exposed to a variety of CS experiences throughout their K-12 careers.

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