Rural Research-to-Practice Partnerships Integrating Computer Science K-8

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***Abstract*—This report highlights evidence from a research to practice partnership (RPP) designed to examine computer science (CS) integration in rural K-8 schools. The project implements a design approach that encourages collaboration between educators, tech integrators, and administrators. They act as co-researchers in identifying and examining connections between barriers to integration.**

Keywords—computer science, computational thinking, problems of practice

I. INTRODUCTION

Rural communities across the country are hungry for highly engaging learning experiences that integrate computer science (CS) across disciplines as more jobs require CS skills and new computer science standards come into place. However, existing and emerging barriers make integration difficult, particularly in rural Maine, where staffing and resources are already strained.

The Integrate to Innovate (i2i) project has been using a design research framework to co-design a research to practice partnership (RPP) to answer the question: What are the key elements needed to support rural K-8 educators' integration of CS into math and science instruction? This began with identifying barriers, or problems of practice, in integrating CS within a rural Maine setting.

II. METHODS

We have built a rural framework from the design-research models and practices developed in the Middle-school Mathematics and the Institutional Setting of Teaching project [1] to advance providing equitable learning opportunities in computer science to all students. Our model is place-based, generates long term relationships with one or a small number of districts, has a focus on informing research and practice, emphasizes co-design, and fosters collaboration among all members at every stage of the process [2]. We have partnered with 25 current K-8 educators, administrators in three rural Maine districts, along with STEM business partners to ensure the problems of practice identified and potential solutions developed meet the needs of the essential stakeholders.

At a series of on site visits in the schools of the participating rural Maine districts, RPP members were trained by researchers to make classroom observations to document CS integration experiences, including barriers, within the classroom. They later organized in focus groups to analyze the data.

Using a combination of survey data and semi-structured interviews with all RPP participants, we were able to focus on identifying potential problems of practice, followed by applying a social network analysis. We examined network measures of brokerage [3] between the problems of practice and represented these connections in a network graph. Brokerage, here represented as betweenness centrality, is an indicator of how any one practice or barrier might be related to other barriers through their bridging of "structural holes" in a network. Betweenness centrality and the mapping of these connections not just represents the connectivity between barriers but also surfaces underlying practices that could represent opportunities for training and programming. We used Gephi software to store, code, and analyze network analytic data.

III. RESULTS

The following graphs represent both the culmination of data from i2i interviews, survey data, summer retreat artifacts (posters), the summer retreat transcripts, and the connections between problems of practice (PoP) that were tracked during those interviews and events where administration, tech integrators, and teachers were present. A "connection" is produced by either a person mentioning two problems of practice being related or leading to one another (in an interview or focus group transcript), or if they were represented as being related in an artifact. The nodes or points on the graph are sized according to the number of ties connected to that practice (larger = more ties). The thickness of a tie or link is based on the number of ties between those two problems (more links = thicker).

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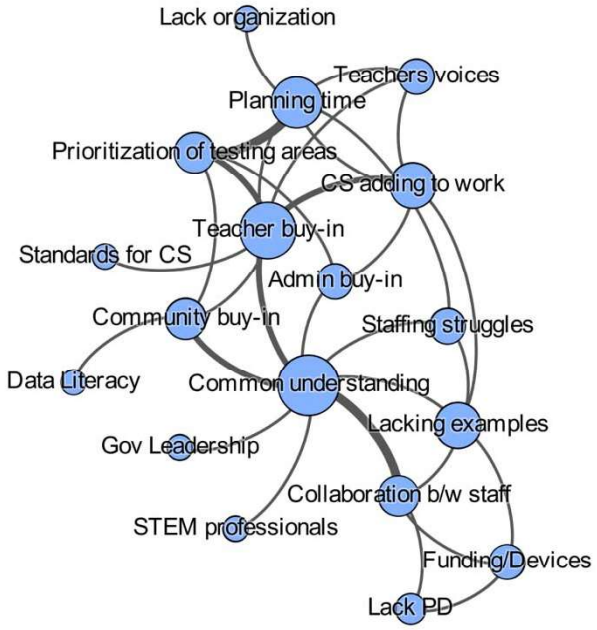

Fig. 1. PoP Network Analysis

TABLE I. Measures of PoP Betweennes Centrality

Label	**Betweenness Centrality**
Common understanding	60.53
Teacher buy-in	33.75
Planning time	20.82
Lacking examples	18.37
Community buy-in	18.01
Collaboration b/w staff	16.47
CS adding to work	12.23
Staffing struggles	7.24
Prioritization of testing areas	4.67

Our top three "problems" in our survey rankings were planning time (lack of), common understanding (lack of), and lacking examples. While common understanding is still important in this graph the other two are not as prominent. "Planning time" is related primarily to testing areas and work management/organization, and "lacking examples" is a subset of more structural barriers related to collaboration between staff, funding, professional development and work/staffing struggles. Other problems that seem more prominent in this graph, that were not previously highly ranked shed light on more specific areas of rural problems: teacher buy-in, CS adding to work, collaboration between teachers and tech integrators, and community buy-in.

IV. Conclusion

At a gathering of the full RPP in late October 2019, participants dug into the data presented here and began formulating initial research questions that would help the RPP better understand the nuance of each problem set and aid in the next steps of designing professional development strategies and integration materials to address them.

Next research steps include investigating how a rural school culture comes to value CS and CT (specifically through common understanding of the CS and CT definitions and buy-in), what the key components of a CS integration support and coaching model would be in order to establish and sustain CS integration in rural K-8 classrooms, and what design principles of instructional materials are needed to design activities aligned with other STEM practices and learning progressions.

In May 2020, i2i will hold a symposium to reach Maine educators, policy-makers, and business leaders to communicate these findings and essential next steps in addressing rural CS integration problems.

Acknowledgment

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