Instructional Coaching for Tech-Enhanced Approaches in Mathematics (iCoachTEAM)

Contents

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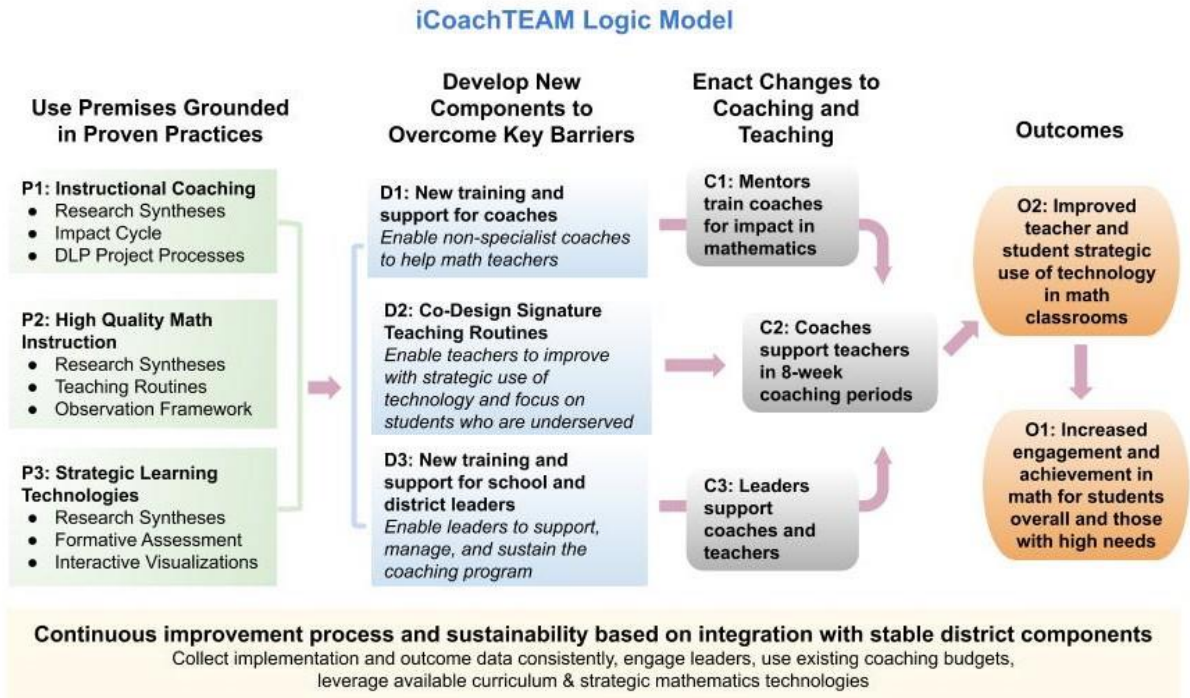
Digital Promise Global (DPG, a nonprofit) and its partners propose an Early-phase project addressing *AP1: Demonstrates a Rationale* and *AP2: Field-Initiated Innovations–STEM and CS*. The proposed 5-year project, *Instructional Coaching for Tech-Enhanced Approaches in Mathematics (iCoachTEAM)*, will develop and evaluate a school-based, one-to-one teacher coaching program to raise the quality of middle school mathematics instruction provided to students with high needs. We define "high-need students" as students whose test scores are a year or more behind grade level, as well as students who identify as Black, Latinx, or low-income (i.e., among groups underrepresented in STEM); we use the term "underserved" to refer to these groups.

Our design builds on established research-backed premises in three major areas (see Logic Model below): (P1) Instructional coaching is an effective means to improve teacher practice and student achievement (Kraft et al., 2018). (P2) Observational frameworks concisely operationalize what "high quality mathematics instruction" looks like (Charalambous & Praetorious, 2018). (P3) Strategic use of technology is an underutilized resource (Baker, 2018) with demonstrated potential to increase mathematics learning for students who are underserved (Roschelle et al., 2017). Development activities for iCoachTEAM will tackle three barriers: D1 will overcome the shortage of coaches with math expertise; we will develop training and support to enable non-specialist coaches (e.g., generalists or technology coaches) to support math teachers. D2 will make "high quality mathematics instruction" addressable as a coaching goal by specifying strategic uses of technology in teaching mathematics that focus on students in underserved groups and can be tackled in 8-week coaching periods. D3 will address the need for school and district administrators to support, manage, sustain, and continuously improve a coaching program, including vetting meaningful technology use, as integrated into their overall district math strategy. Going beyond general-purpose instructional coaching, the proposed iCoachTEAM program will be (a) specific to mathematics; (b) support non-specialist coaches to work with math teachers; (c) leverage technologies available but underused in a district, (d) embed a focus on students with high needs, and (e) incorporate continuous improvement measures specific to mathematics instructional quality. To date, most coaching programs have been subject-matter neutral. Stronger effects are likely when coaching aligns to expectations for high quality instruction grounded in subject matter, considering the literature identifying subject matter-specificity as a characteristic of effective professional development (PD) (Darling-Hammond et al., 2017; Desimone & Pak, 2017). The iCoachTEAM emphasis will be on how teachers can use powerful learning technologies to *develop the mathematical reasoning* of students who are underserved, including those from groups underrepresented in STEM. Doing so requires incorporating a specific vision of high quality mathematics instruction and countering the tendency to use technology with students who are underserved only for supplementary practice (Bernard et al., 2011; Delgado et al., 2015).

A. Project Design



Our logic model from left to right begins with the established state-of-the-art program features (based on premises P1, P2, P3 described above). The research-based premises translate into proven practices in (P1) Instructional Coaching through both the Impact Cycle and Dynamic Learning Project (DLP) processes (each explained under section A.3.); (P2) High Quality Math Instruction instantiated in clear teaching routines and guided by clear observation frameworks; and (P3) Strategic Learning Technologies supporting formative assessments and interactive visualizations critical to developing students' reasoning in math. The What Works Clearinghouse (WWC) practice guide rated formative assessment and interactive visualization as the only two recommended practices with strong evidence (Woodward et al., 2018) and the underlying rigorous research studies demonstrate the clear benefits to students who are underserved, including students from groups underrepresented in STEM (Roschelle et al., 2010, 2016). These inputs are combined with new developments (D1, D2, D3 described above) that are co-designed with district partners to address the aforementioned barriers. This integrated program design forms the foundation for three processes driving coaching and instructional change: (C1) Our partners, the Instructional Coaching Group (ICG) and Heather Dowd (see section B.3.), train and support coaches to work with math teachers; (C2) Coaches work with teachers to implement strategic technology-rich mathematics routines with their students; (C3) District and school leaders engage with a consistent definition of high quality instruction in mathematics, expectations for coaching activities, strategies to protect coach and teacher time, and data-informed continuous improvement (e.g., refining coach supports or clarifying effective coaching tools).

Beginning with the overarching purpose of the proposed project, Goal 1 is to achieve the target outcome of increasing mathematics engagement and achievement overall and for students who are underserved, including those from groups underrepresented in STEM (O1). Goal 2 improves the quality of mathematics instruction through strategic use of technology (O2). Goal 3 designs and evaluates the role of coaching innovations to enable non-specialist coaches to support mathematics teachers.

The foundation for the sustainability of our design is predicated on two resources already commonplace in many districts. First, districts commonly use Title I and other funding for coaches to support instructional improvement in schools where student scores are low. Nonetheless, our experience with districts nationwide suggests that a system to apply coaches and coaching to improve mathematics outcomes is inconsistent at best and sorely lacking at worst. Second, districts today have technology and available math-specific tools and applications, many of which have a strong research basis supporting their effectiveness. Undoubtedly, using technology well, especially during and after the Coronavirus pandemic, will continue to be core to every district's instructional program. Too often, however, leveraging digital tools is singularly relegated to software programs that emphasize skill-and-drill practice, especially prevalent among students who are underserved, where procedural practice on software tutorial programs often risks exacerbating—rather than ameliorating—disparities in academic achievement (Warschauer & Matuchniak, 2010). Moreover, math teachers in particular remain reluctant to use digital technology; districts buy licenses for mathematics tools which are thereafter rarely used (Topper & Lancaster, 2013). Merely helping teachers of students who are underserved to use technology is not the point; to achieve high quality instruction, teachers need to apply technology to engage those students in more challenging mathematical tasks, to support their efforts to make sense of mathematics, to facilitate their conceptual explanations of mathematics, and to adapt instruction to students' emergent needs. The above-cited work clearly shows how technology can help students in these ways; coaching support will close the gap between what we know works and the support needed to do it by teachers of students who are underserved.

A.1. Goals, Objectives, and Outcomes

Based on our Logic Model, Table 1 lists goals, objectives, and outcomes of the iCoachTEAM program, as well as activities and measures to achieve them.

Table 1. iCoachTEAM Goals, Objectives, and Outcomes

Goal 1: Increase the math engagement and achievement overall and for students from underserved groups	
Activity: Coach training & coaching periods target student learning goals & goal-aligned math routines with tech	
Objectives and Outcomes	**Measure**
1.1. In 2022-23 and thereafter, students overall and those from underserved groups of coached teachers will report **higher math engagement** after their teachers receive coaching than before[a]	Student School Engagement Survey (SSES); student engagement observation rubric
1.2. In 2023-24 and 2024-25, students of coached teachers will demonstrate **higher engagement in math** than students of teachers in the control group[b]	Mathematics Quality Instruction (MQI) observation score
1.3. In 2023-24 and 2024-25, 1-yr impact on **overall student math achievement** will be *0.06 sd* higher for students of coached teachers compared with the students of the control group[b]	State standardized math score in grades 6, 7, and 8
1.4. In 2023-24 and 2024-25, 1-yr impact on **math achievement for students below proficiency** will be *0.10 sd* higher for students of	State standardized math score in grades 6, 7, and 8

coached teachers compared with the students of the control group[b]	
1.5. In 2023-24 and 2024-25, 1-yr impact on **math achievement for low-income, Black, and Latinx students** will be *0.10 sd* higher for students of coached teachers compared with control group students[b]	State standardized math score in grades 6, 7, and 8
Goal 2: Improve teacher and student strategic use of technology in math instruction	
Activity: Coach training and coaching activity with formative assessment & interactive visualizations using tech	
Objectives and Outcomes	**Measure**
2.1. In 2022-23, coached **teachers** will report more frequent **use of technology for formative assessment** compared with their prior instructional practices[a]	Use of technology for formative assessment purposes teacher survey scale
2.2. In 2022-23, coached **teachers** will report more frequent **student use of technology for conceptual understanding** compared with their prior instructional practices[a]	Student use of technology for math learning teacher survey scale; use of technology observation rubric
2.3. In 2023-24 and 2024-25, coached **teachers** will report more frequent **use of technology for formative assessment** purposes by *.10 sd* compared with those in the control group[b]	Use of technology for formative assessment purposes teacher survey scale
2.4. In 2023-24 and 2024-25, **students** of coached teachers will experience more frequent **use of technology for math conceptual understanding** than students of teachers in the control group[b]	Student use of technology for math learning teacher survey scale; use of technology observation rubric
Goal 3: Develop and evaluate the implementation and value of key components of the iCouchTEAM	
Activity: Continuous improvement study	
Objectives and Outcomes	**Measure**
3.1. Beginning in 2021-22 and thereafter, key components of the program are implemented as intended[a]	Teacher, coach, principal bimonthly questionnaire, mentor feedback
3.2. Beginning in 2021-22 and thereafter, teachers report usefulness of key components of the program[a]	Teacher, coach, principal bimonthly questionnaire, mentor feedback
3.3. By end of 2022-23, iCoachTEAM finalizes the components of the program[a]	Completed coaching curriculum and training developed with district partners
[a] Continuous Improvement Study; [b] External Evaluation	

A.2. Needs of the target population

As noted before, the iCoachTEAM program focuses on students with high needs: those whose test scores are a year or more behind grade level or below proficiency, as well as those who identify as Black, Latinx or low-income (i.e., among groups underrepresented in STEM). Mathematics achievement remains inadequate nationally, with persistent inequities across K-12 student subpopulations. Only 41% of 4th graders are proficient in math, dropping to 34% of 8th graders.

Proficiency rates for Black, Latinx, and students experiencing poverty are considerably below the national average (NCES, 2019). Further, as a foundation for all STEM disciplines, low math proficiency limits access to economic opportunity. The failures of the current K-12 education system disproportionately impact students of color. For example, although Black, Latinx, and Native American students comprise 40% of the public high school enrollment and more than 17% of college degree holders, they are just 13% of working scientists and engineers (NSB, 2019).

The challenge of improving mathematics instruction is a top priority in our two design-partner districts. Portland Public Schools (PPS) in Oregon serves around 49,000 students, 65% are Black or Latinx and 21% experience poverty. PPS adopted instructional coaching after noting gaps in math achievement between their more affluent and low-income (Title 1) schools. Although the district has seen benefits from coaching, the program lacks consistency, does not leverage technology, and is not well-aligned to PPS' math goals. Four low-performing Title 1 middle schools (ranging from 53% to 74% eligible for free and reduced-price lunch) in PPS will participate in the proposed project. Octorara Area School District (OASD) serves 2,200 students in rural/suburban Pennsylvania, where 40% of their students experience poverty and approximately 20% are Black or Latinx. Octorara leaders look to this program to enable consistent technology use to drive math instructional quality that focuses on student learning of concepts, not just procedures. Their single middle school will participate. Together, the five participating schools span rural, suburban, and urban teaching environments and two states, guarding against developing a program overly specific to one state's standards. In Years 3 and 4, we will expand to two more districts serving over 50% of students in groups included in our high needs definition, adding 30 schools to be included in the evaluation. (Selection criteria will include funded middle school coaching positions, district goals of math instructional improvement leveraging technology for students from underserved groups, and willingness to participate in the evaluation.)

The problems in both our design-partner districts are widespread in the U.S. The broadest studies note that students experiencing poverty and those from groups underrepresented in STEM are subjected to ineffective "drill and kill" technology use more often, compared with their white or more affluent peers. In contrast, innovative uses of technology leading in positive results are more frequent in affluent schools, many of which serve higher proportions of white students (Warschauer & Matuchniak, 2010; Wenglinsky, 2005). When used strategically in the classroom, technology can increase mathematics learning (Bernard et al., 2011; Delgado et al., 2015). The strategic use of technologies can stimulate student engagement in math, provide feedback that students need in order to learn, give teachers information they need to adapt instruction, and develop advanced mathematical competencies (Gadanidis & Geiger, 2010; Pierce & Stacey, 2010; Roschelle et al., 2016; Suh & Moyer, 2007).

Before teachers can use technology for formative assessment and interactive visualization, however, they need adequate training on how to apply technology and update their pedagogical strategies in the context of technology use (Darling-Hammond et al., 2014). Multiple teacher surveys report that many teachers in the U.S. do not have enough experience or training to use technology in ways that advance student achievement, especially teachers in schools serving students experiencing poverty (PwC, 2018; U.S. Department of Education, 2017). Instructional coaching is a promising form of teacher PD that could help—and this help is urgently needed as schools work in a mix of remote, hybrid, and in-class scenarios.

A.3. Knowledge from research and effective practice

Three areas of research shape our program: coaching, high quality mathematics instruction, and technology for mathematics learning. First, coaching is effective because it is grounded in empirically predictive features of effective teacher PD: collective participation, active learning, coherence, content focus, and sustained duration (Darling-Hammond et al., 2017; Desimone & Pak, 2017). A recent meta-analysis of 60 causal studies of teacher coaching programs shows a strong effect of coaching on teacher instruction and student achievement (Kraft et al., 2018), with effect sizes of 0.49 standard deviations (SD) on instruction and 0.18 SD on achievement. Randomized controlled trials of the New Teacher Center's (NTC's) coaching model found overall positive effects on student achievement in English language arts and mathematics (Young et al., 2017). Studies on a set of major initiatives show clear correlations between coaching and increased student outcomes, as measured through standardized testing (Mangin & Dunsmore, 2015).

With regard to technology, the eMINTS program, which used cognitive coaching to guide teachers in implementing technology in their classrooms, found promising outcomes on teacher levels of technology integration (Brandt et al., 2013). Likewise, an evaluation of the Partners in Learning program showed the potential of peer coaching to support teachers in integrating technology in their classrooms (Barron et al., 2009). Digital Promise recently extended this work in the Dynamic Learning Program (DLP), an instructional coaching program that helps teachers in different content areas use technology to develop students' 21st-century skills. The evaluation of our two-year pilot showed that teachers who worked with coaches felt more confident in their ability to use technology to develop students' 21st-century skills than their colleagues who were not coached. Also, compared to their non-coached peers, more coached teachers reported that their students' technology use had a positive impact on overall student engagement and learning (Bakhshaei et al., 2019). These findings were achieved at scale, serving 2,720 teachers in 165 schools nationwide.

The specific components of iCoachTEAM are built on a teacher-coach-administrator partnership approach: teachers and coaches work closely as co-owners of a goal related to student achievement, and administrators nurture this co-ownership (Knight, 2008). Following this approach, coaches provide individualized teacher support using the Impact Cycle (Knight, 2018), which is associated with increased teacher use of effective pedagogical strategies and increased student engagement (Knight et al., 2018). Building on the Impact Cycle, under iCoachTEAM, coach and teacher will together select a student learning goal and a math routine leveraging technology that would help them reach the goal. That routine and goal become the focus of tailored supports, classroom visits, conferencing, and data review over an 8-week coaching period, after which the coach-teacher pair may select another student learning goal to work on.

Within this coaching model, coaches and teachers will work towards high quality mathematics instruction as operationalized by the Teaching for Robust Understanding (TRU, Schoenfeld et al., 2016) framework, a concise crystallization of a very large body of prior mathematics education research. The five dimensions of TRU are mathematical content, cognitive demand, equitable access to content, student agency, and formative assessment. TRU provides an observational tool that coaches and teachers can use as a lens to examine the quality of lesson plans and instruction and to seek improvements. With training, we believe the last four dimensions can be readily accessible to the partnership of a non-specialist coach and a specialist mathematics teacher. The content dimension can be supported with the additional help of centralized district mathematics leaders, already on the job in our partner districts and most other districts we know; they can help coaches and teachers to select among available technology and curriculum resources that are best suited to a goal and address common challenges teachers encounter.

In particular, districts often have two types of abundant technology resources, currently underutilized despite strong research. (1) Tools for practice and formative feedback can provide students with immediate hints and—importantly—can enable teachers to quickly determine in the moment which students need support, which mathematics tasks are most challenging, and what common wrong answers and solutions are cropping up. With coaching, a teacher can learn to use this information to adapt to student needs. (2) Tools for interactive visualization and conceptual understanding can enable students to make connections, for example, between the value of a variable in an equation and the slope of a line in a graph. This is important because research has established that making correct connections among related representations of mathematical objects is the essence of conceptual understanding (Fries et al., 2020; Hiebert & Carpenter, 1992). With coaching, a teacher can learn to launch conceptual activities with student explorations of relationships in computer-based visualization tools—and to harness the patterns that students observe to make broader and deeper connections.

iCoachTEAM development will integrate the above research. That is, in D1, coach training will prepare coaches for the Impact Cycle, introduce them to the TRU framework as a way to describe and observe high quality math instruction, and to inform them about research-based mathematics technologies and aligned curriculum materials that the district already owns. In D2, teachers will experience coach support in 8-week coaching periods as they use technology to implement new technology-rich instructional routines to improve their math instruction. Above we described two example routines, one for adaption to student needs and another for launching conceptual activities. Additional routines will be added through co-design. In D3, district and school leaders will learn the program concepts above and how they can effectively support, manage, and sustain coaching for teachers of students from underserved groups. For many school and district leaders (who are rarely math experts), this program will also help them to understand how to support high quality mathematics instruction for students from underserved groups, in addition to supporting teacher-coach collaboration, reinforcing the non-evaluative and collaborative nature of the coach-teacher relationship, and protecting time for coaches to coach and for teachers to be coached (Bakhshaei et al., 2019). Table 2 details iCoachTEAM program components.

Table 2. iCoachTEAM Program Components

Program Component	Description
Coaching activity	● 8-week coaching periods, offered 4 times/year ● 1:1 coaching using the Impact Cycle ● Conference and observation weekly with each teacher ● Defined student learning goal achieved through technology-enhanced math instruction routines aligned with the TRU framework
Supports for coaches	● 5-day Summer Institute to build relationships among coach and school and district administrators, learn the coaching model and components, and clarify each partner's roles and responsibilities ● 2-day Midyear Institute to celebrate bright spots, reflect on continuous improvement data, and share lessons learned across districts and schools ● Mentorship providing access to experts with outside perspectives and sustained, personalized support to coaches through monthly meetings and ad hoc ● Ongoing PD that includes book study on coaching skills and in response to coaches' needs, including math instruction and technology skills ● Tools, resources, and strategies aligned with common teacher challenges
School and district leader supports	● Summer orientation, Midyear reflection, and Year-end reflection and planning for next year ● Mentorship through quarterly and ad hoc meetings ● Trimester review of continuous improvement data

B. Resources and Management Plan

B.1. Management plan

Table 3. Key Project Activities, Milestones, and Timeline

Activity	Milestone	Timeframe	Responsibility
PHASE I: Program Launch (January - February 2021)			
Partner kick-off	• Review goals, objectives, roles, major activities, timeline, initial work plan	01/21	DPG, HD, ICG, PPS, OASD
Grant launch	• Budget, performance measures, and management plan approval by U.S. Dept. of Education	01-02/21	DPG
Human subjects approval	• IRB and U.S. Dept. of Education approvals	01-02/21	DPG, SRI
Match identification	• Reporting system for district in-kind match • Confirmation of philanthropic match commitment	01/21-completion	DPG

PHASE II: Development (February 2021 - June 2022)			
Codesign coaching training and mentorship	• Codesign summer workshop held with 5 codesign schools and district partners • Detailed Summer Institute content developed • Definition and development of mentoring and support activities • Codesign Midyear Institute with 5 codesign schools and district partners	02-08/21	DPG, HD, ICP, PPS, OASD
Continuous improvement system development	• Detailed data collection plan • Instruments developed	02-08/21	DPG
Prototype trial	• Implementation of coaching activity as intended • Coach use of Impact Cycle integrated with TRU • Implementation of mentoring and ongoing supports for coaches as intended • Implementation of Midyear institute as intended	09/21-06/22	DPG, HD, PPS, OASD
Continuous improvement data collection and reporting	• Bimonthly teacher, coach, and principal questionnaires • Fall and spring student, teacher, and coach survey; annual school administrator survey • Fall and spring teacher, coach, school / district administrator interviews; classroom observations • Trimester reports and reflection meetings for each codesign school and district	09-11/21; 12/21-02/22; 03-05/22	DPG
Program review and refinement	• Redesign workshop with 5 codesign school and district partners • Revised Summer Institute training and coaching supports and tools	06/22	DPG, HD, ICG, PPS, OASD
Recruitment for 3rd partner district (District A)	• Signed MOU with District A for pilot and full implementation participation, including evaluation	09/21-05/22	DPG
PHASE III: Piloting (July 2022 - June 2023)			
Piloting launch	• Summer Institute for 5 codesign schools plus 2 schools from District A	07/22	DPG, HD, ICG, PPS, OASD, District A
Pilot implementation	• Implementation of coaching activity as intended • Coach use of Impact Cycle integrated with TRU • Implementation of Midyear Institute and coaching support as intended	09/22-06/23	DPG, HD, PPS, OASD, District A
Continuous improvement data collection and reporting	• Bimonthly teacher, coach, and principal questionnaires • Fall and spring student, teacher and coach survey; annual school administrator survey • Fall and spring teacher, coach, school / district administrator interviews; classroom observations • Trimester reports for participating school & district • Trimester reflection meetings with all participating schools and districts	09-11/22; 12/22-02/23; 03-05/23	DPG

Recruitment for 4th partner district (District B) meeting selection criteria	• Signed MOU with District B for full implementation participation, including evaluation	09/22-05/23	DPG
PHASE IV: Full Implementation (July 2023 - June 2024 & July 2024 - June 2025)			
Randomization	• Eligible middle schools in 3 partner districts randomized into treatment and control (OASD not in evaluation due to small size)	06/23	SRI
Full implementation launch	• Summer Institute conducted for treatment schools in 4 partner districts	07=08/23; 07=08/24	DPG, HD, ICG, PPS, OASD, Districts A & B
Evaluation data collection	• Baseline teaching and coaching rosters collected, teacher observations, teacher and coach surveys • Outcome teacher observations, student achievement and district administrative data • Teacher, coach, school and district administrator interviews at end of implementation (2025)	08-10/23; 08-10/24; 04-05/25	SRI
Implementation of full coaching program	• Implementation of coaching activity as intended • Coach use of Impact Cycle integrated with TRU • Implementation of Midyear Institute and coaching support as intended	09/23-06/24; 09/23-06/25	DPG, HD, ICG, PPS, OASD, Districts A & B
Continuous improvement data collection and reporting	• Teacher, coach, school and district administrator interviews on early implementation (spring 2024) • Bimonthly teacher, coach, and principal questionnaires; fall and spring student survey • Trimester reports and reflection meetings for each participating school and district	09-11, 12-02, 03-05 both years	DPG
District scale up	• Summer Institute conducted for all middle schools in 4 partner districts	07-08/25	DPG, HD, ICG, PPS, OASD, Districts A & B
PHASE V: Dissemination and Evaluation Analysis and Reporting			
Dissemination of program development and continuous improvement findings	• League of Innovative Schools seminars • Conference presentations [e.g., AERA, NCTM, NCSM, ISTE] • Digital Promise platforms and newsletters	10/22- 12/25	DPG
Evaluation	• Implementation fidelity analysis • Interim memo first-year student outcomes • Final report with teacher and student outcomes submitted for WWC review	08/24; 8/25; 01/25; 12/25	SRI
Note: DPG - Digital Promise Global, HD - Heather Dowd, ICG - Instructional Coaching Group, Districts A and B to be recruited			

B.2. Costs

Improving the effectiveness of coaching has a multiplicative effect, as one full-time released coach can work with 25 teachers intensively through the school year, who then serve approximately 80 students each at the middle school level. The upfront development cost for the program is largely fixed and with limited adaptations for new district contexts, scale up to additional schools and districts can drive down the average per-pupil development cost. For example, [redacted] for program development (the proposed Y1-Y2 budget), amortized over an estimated 25,200 students during the life of this grant (including student cohorts moving up each year into the middle school grades being served and the students of the control teachers being trained after the evaluation period), yields an average development cost of approximately [redacted]/student. Expansion to an additional two districts of similar size as Districts A and B (i.e., another 30 middle schools serving an estimated 16,800 students for a total of 40,500 students) would bring the average development cost down to [redacted]/student in one year.

Program support costs associated with the mentor coaches, coach training, district administrator support, and continuous improvement activities (estimated as the proposed Years 3-5 budget less evaluation costs including incentives for evaluation activities) total [redacted] or [redacted]/student for an estimated 24,267 students served during those years (including student cohorts moving up each year into the middle school grades being served and the students of the control teachers being trained after the evaluation period).

B.3. Key project personnel

We have assembled a team with deep expertise and experience across the many facets of the proposed project: math instruction, technology coaching, teacher professional learning and practice, rigorous quantitative and qualitative research methods, partnership development, and project leadership. *Digital Promise Global:* **Mahsa Bakhshaei, Ph.D.,** Senior Research Scientist and proposed Project Director, was PI of the DLP evaluation, studying the implementation and impact of this technology coaching program in 165 schools across 10 states. **Viki Young, Ph.D.**, Senior Research Director, directs United2Read, an EIR expansion grant and was co-PI of the evaluations of NTC's Investing in Innovation (i3) Validation and Scale Up grants, studying the implementation and impact of NTC's coaching model for new teachers. **Jeremy Roschelle, Ph.D.**, Executive Director, Learning Sciences Research (LSR), has an extensive career investigating mathematics learning with technology, tackling development and innovation as well as efficacy. **Heather Dowd, M.S./M.Ed.,** is an experienced instructional coach, former high school math teacher, and learning designer. With DLP, she mentored coaches and principals, and led the design and facilitation of coaching institutes. *Instructional Coaching Group:* **Jim Knight, Ph.D.**, Senior Partner, has over two decades studying and developing instructional coaching, leads the Intensive Instructional Coaching Institutes and the Teaching Learning Coaching annual conference, and has presented to over 100,000 coaches and other educators globally. *District partners:* **Elena Tachau, Ed.D.**, Director of Curriculum and Instruction, OASD, is an experienced instructional coach and elementary and secondary building principal with over 27 years in public education. **Christopher Shultz**, **Ed.D.**, K-12 Technology Integration Specialist, OASD, taught for over 15 years in K-8 regular and special education, is a Google Certified Coach and Trainer, and leads challenge-based coaching activities in the district. **Patrice Woods, Ed.S/M.S.**, Director of Mathematics, Portland Public Schools, leads the district's K-12 mathematics program, overseeing strategies to achieve equitable student outcomes, and is a National Board-certified mathematics teacher for adolescents. *SRI International:* **Deepa Patel, MPP** and **Rebecca Schmidt, Ph.D.**, Senior Researchers, will serve as co-PIs of the external evaluation. Schmidt was co-PI on the Evaluation of NTC's i3 Validation and Scale-Up grants and Patel was project director of the Evaluation of NTC's i3 Scale-Up grant.

Table 4. Key Project Personnel and Roles

Name, Title, and Organization	Project Role
Masha Bakhshaei, Ph.D., Senior Researcher, Digital Promise	Project Director/Co-PI, oversee program development and implementation quality, timeline, budget, and staffing; conduct continuous improvement research
Viki Young, Ph.D., Senior Research Director, Digital Promise	Research Director/Co-PI, continuous improvement research design and implementation; program design and implementation, oversee evaluation
Jeremy Rochelle, Ph.D., Exec. Dir., LSR, Digital Promise	Math education and instructional technology use expert; math instructional practice and coaching practice design
Jim Knight, Ph.D., Senior Partner, Instructional Coaching Group	Expert advisor on coaching program design (coach learning curriculum, supports, and activities); coach trainer
Heather Dowd, M.S./M.Ed., Professional Development Expert	Lead coach curriculum and support developer; lead mentor coach/ coach trainer
Patrice Woods, Ed.S./M.S., Director of Mathematics, Portland Public Schools	Portland Public Schools project lead; district context expert; coach learning curriculum and supports design
Elena Tachau, Ed.D., Director of Curriculum and Instruction, Octorara Area School District	Octorara Area School District project lead; district context expert; coach learning curriculum and supports design
Chris Shultz, Ed.D., K-12 Technology Integration Specialist, Octorara Area School District	Octorara Area School District coaching program director; coach learning curriculum and supports design
Rebecca Schmidt, Ph.D., and Deepa Patel, SRI International	Co-Principal Investigators, external evaluation design, implementation, and quality

B.4. Feedback and continuous improvement plan

Across its many projects, Digital Promise engages in robust continuous improvement research to understand how the program works in practice, identify facilitating factors, address constraints to implementation, and assess progress towards interim and longer-term outcomes. Our continuous improvement systems cycle back to make mid-course corrections and monitor ongoing implementation and progress towards outcomes. During the Development and Pilot phases of the proposed project, continuous improvement data will be instrumental in refining program components and preparing for full implementation in additional districts. Ongoing, this data collection will help develop a rich description of implementation for each component of our logic model that will help us identify conditions necessary for the program's success, sustainability, and eventually replicability.

Our continuous improvement system will feature low-burden quantitative bimonthly teacher, coach, and principal questionnaires that target key implementation fidelity indicators and a rotating set of instructional practice and student engagement outcomes. We will enrich our understanding of implementation with in-depth qualitative data collection, including teacher, coach, and school/district administrator interviews and classroom observations. In development and pilot schools, we will interview each coach and school leader and a sample of three teachers per school, with observations of the interviewed teachers' classrooms, plus district administrators leading mathematics and professional learning. Through fall and spring site visits during the Development and Pilot phases, we will use a purposive sampling strategy for teacher interviews, with sampling criteria tied to key improvement questions, e.g., how are the math routines that teachers are learning and implementing through the coaching periods engaging students. To measure progress on coach development and teacher practice, we will administer fall and spring student, teacher, and coach surveys, along with annual school administrator surveys to understand program sustainability. We will use the quantitative and qualitative data together to address necessary program development and implementation refinements guided by the logic model, for example, revising the coach training curriculum based on goals and challenges that coaches and teachers identify, adjusting the ongoing coach supports to better focus on their problems of practice, refining district and school leader PD to create supportive conditions for coaching, and adding specific technology tools aimed at student conceptual understanding in math based on teacher progress with coaching. We will maintain our continuous improvement system throughout the grant period.

B.5. Dissemination plan

We will leverage Digital Promise's dedicated research communications team to disseminate research produced through this project. In addition to leading the organization's promotion and diffusion of research knowledge, this team has experience producing innovative research communications outputs, including interactive data visualizations and actionable video series, to build awareness of relevant findings from education research.

To share key findings with the field, we will submit to peer-reviewed journals related to math learning and instruction (e.g., *Journal of Mathematics Teacher Education*, *Educational Studies in Mathematics*, *Journal of Instructional Research*). Additionally, we will propose conference presentations and symposia at events for math researchers and practitioners (e.g., American Educational Research Association, National Council of Teachers of Mathematics, National Council of Supervisors of Mathematics). We will also share findings with Digital Promise's League of Innovative Schools, a national network of district leaders from 114 districts, through sessions at their semi-annual convening and biweekly newsletter.

To more widely disseminate learnings, we will publish publicly available reports, including careful documentation of implementation contexts and transparency in methods and analysis. Additionally, we will disseminate accessible blog posts and infographics about the work to highlight actionable and applicable findings. We will leverage the Digital Promise website and its numerous dissemination platforms, which provide a flexible interface for publishing content including reports and resources and receives over 22,000 monthly users. For wider reach, we will consider media outreach to outlets including: *EdWeek*, *Hechinger Report*, *Ed Tech Times*, and *THE* Journal. Finally, SRI will submit the evaluation report for WWC review.

C. Project Evaluation

SRI International (SRI) will conduct an independent evaluation of Digital Promise's iCoachTEAM program. The evaluation will assess the extent to which the core components of iCoachTEAM are implemented as intended and measure the impact of iCoachTEAM on teachers and students. The proposed evaluation features a cluster-randomized controlled trial (RCT) designed **to meet What Works Clearinghouse (WWC) standards without reservations**. Schools assigned to the treatment group will receive iCoachTEAM in school years 2023–24 and 2024–25. Schools assigned to the status quo will serve as control. Digital Promise researchers will study program implementation during the Development phase to support continuous improvement as the iCoachTEAM model develops. Beginning in Year 3, SRI will evaluate the implementation and impact of the 2-year implementation of iCoachTEAM in 30 schools. SRI will draw on findings from both the efficacy and implementation studies to document strategies for replicating the intervention after the grant period.

The evaluation will address the following questions: <u>**Main impact**</u>: Does iCoachTEAM result in: (RQ1) improved teacher instructional practice after two years of coaching, as measured by the Mathematical Quality of Instruction (MQI) observation rubric? (RQ2) improved student achievement on state standardized tests in math after two years of coaching? (RQ3) improved student achievement in math after one year of coaching? <u>**Moderation:**</u> (RQ4) Does the impact differ for students who are below proficiency in math, low-income, Black, and/or Latinx? <u>**Mediation**</u>: (RQ5) Do teacher practice outcomes mediate the relationship between iCoachTEAM and student outcomes? <u>**Treatment-on-the-treated effects**</u>: (RQ6) What is the impact of iCoachTEAM on student and teacher outcomes when teachers receive the full treatment (two coaching periods)? <u>**Implementation**</u>: (RQ7) To what extent were the core components of iCoachTEAM implemented as intended? (RQ8) What contextual factors impede or enhance implementation? (RQ9) How do implementation and outcomes vary by site and what guidance does that provide for replicating iCoachTEAM in other settings?

C.1. Addressing What Works Clearinghouse evidence standards without reservations

The evaluation will use a cluster-randomized controlled trial, designed to meet WWC group design standards without reservations for the teacher outcomes and student outcomes after two years (RQ1 and RQ2).

During the year of the Development phase, Digital Promise will recruit 30 middle schools across 3 sites (Portland Public Schools and two additional sites, Districts A and B) to participate in the RCT. SRI will randomly assign schools to treatment or control in summer 2023. Schools will be blocked on site and school poverty level; within these blocks, each school will have a 50 percent chance of assignment to treatment.

All proposed teacher and student outcome measures meet group design standards under the WWC Teacher Excellence Review Protocol, version 4.0.

Student outcomes. Table 5 shows the students who will be included in the analytic samples. The analytic sample for two-year impacts on students (RQ2) will include students in grades 6 and 7 in fall 2023 and will examine their outcomes in grades 7 and 8 in spring 2025 (the green cells). SRI will limit the sample to students present in study schools in the fall of 2023, shortly after randomization, to ensure the analytic sample does not include late-joiner students. By excluding late joiners and examining students in their original randomized condition, the analysis is eligible to meet WWC standards *without* reservations.

For one-year impacts on students (RQ3), the sample will include students in all blue cells. This is a combined sample of students in grades 6 through 8 in 2023–24 (one-year student cohort

A) and students in grades 6 through 8 in 2024–25 who joined the study schools for the first time in 2024–25 (one-year student cohort B). Because students can join the sample in 2024–25, after randomization, this analysis will be eligible to meet WWC standards *with* reservations.

Table 5. Grade Progression for Student Samples in Impact Analyses

Student Cohort	2023–24	2024–25
Two-year student cohort	Grade 6	Grade 7
	Grade 7	Grade 8
One-year student cohort A	Grade 6	
	Grade 7	
	Grade 8	
One-year student cohort B		Grade 6
		Grade 7
		Grade 8
Note: Grey cells indicate that the student does not appear in the study schools with a study teacher		

Teacher outcomes. To ensure that the analytic sample of teachers does not include joiners, SRI will collect rosters of teachers prior to randomization. SRI will also collaborate with Digital Promise on recruitment and data collection strategies to minimize overall and differential attrition of teachers (e.g., clear communication, financial incentives, and local district partners to support data collection) (Roschelle et al., 2014). In its previous studies of the impact of coaching programs (Laguarda et al., 2020; Young et al., 2017), SRI achieved teacher and student attrition rates within boundaries set by the WWC.

C.2. Key components, mediators, outcomes, and implementation

The proposed evaluation is designed to measure implementation of the project's key components, mediators, and outcomes as depicted in the iCoachTEAM Logic Model (see Section A). A prerequisite to interpreting findings about the impact of a program is establishing whether the key components of the program were implemented with fidelity (RQ7). SRI will collaborate with Digital Promise to specify meaningful and measurable indicators of key program components and thresholds for high, medium, and low implementation fidelity for each (see Exhibit I-1.1 in Appendix I for draft indicators aligned to select program components). Data sources for measures of implementation fidelity include data on coaching activity collected by Digital Promise, and annual teacher and coach surveys administered to both treatment and control teachers and coaches in the spring of each year of the study. Differences between treatment and control on key survey measures will allow the study to assess the extent to which teachers' experience of coaching with the iCoachTEAM program differs from teachers' experience of coaching under the status quo. See Appendix I-1 for detail on data sources, samples, and analysis.

SRI will conduct site visits to treatment and control schools in the final year of the study (winter 2025) to examine the contextual factors that impede or enhance iCoachTEAM implementation (RQ8) and the way in which the iCoachTEAM model is implemented and sustained in the different site contexts (RQ9). Site visits will provide information about the project components crucial to building teachers' knowledge and competencies in using technology in mathematics instruction, particularly to support students traditionally underrepresented in STEM and those who are one or more grade levels below proficiency in math. During these site visits, researchers will focus on collecting information about local contextual factors important to replication and document ways in which the iCoachTeam model was adapted to local contexts. SRI will visit a purposeful sample of nine schools, representing a range of local contexts. SRI will sample six treatment schools with a mix of high and low fidelity of implementation, based on spring 2024 analysis. SRI will also sample three control schools (one in each of the three sites) to examine coaching under the status quo. Within each school, SRI will interview the principal, coach, and two math teachers who received coaching. SRI will interview one district leader in each site (e.g., those responsible for coaching, professional development, and curriculum and instruction). See Appendix I-2 for a description of qualitative research methods.

Formative Reporting to Digital Promise and Partner Sites. Digital Promise plans to collect data for continuous improvement throughout the grant period to make real-time adjustments to the iCoachTEAM model. SRI will provide systematic data about implementation fidelity across the study sites as well as data to inform future replication and sustainability of the iCoachTEAM model. SRI will analyze and report implementation fidelity measures for sites participating in the intervention in each year of the two-year RCT. This reporting will support Digital Promise in understanding the extent to which implementation differs by site and will inform efforts to make program refinements, and to codify and replicate the model beyond the grant period. Findings from the qualitative analysis in 2025 will be used to interpret and explain implementation fidelity and provide Digital Promise with important data to inform future replication of the iCoachTEAM model.

C.3. Valid and reliable performance data on relevant outcomes

All math teachers assigned to grades 6 through 8 in study schools will be included in the impact analysis. All outcome data will be collected identically across sites for both treatment and control conditions.

Impacts on teachers. Two-year impacts on teacher practice (RQ1) will be collected by trained observers on the study team using the MQI observation instrument. The MQI is recognized as an eligible teacher outcome in WWC's Teacher Excellence review protocol and is found to be predictive of student achievement (Kane and Staiger, 2012) (see Appendix I-3). *Sample:* SRI will observe math instruction in 168 classrooms in grades 6 through 8 in fall 2023 (baseline) and spring 2025 (outcome). *Analysis:* SRI will posit a two-level hierarchical model with teacher and school levels and with the treatment effect estimated at the school level. We will pool data across sites to conduct the impact analysis (see Appendix I-5). *Power:* The minimum detectable effect size (MDES) for MQI teacher outcomes is 0.48, assuming an initial sample of 168 teachers with 20 percent attrition, for an average of 4.5 teachers per school in 30 middle schools included in the final analysis (with half in treatment, see Appendix I-5 for additional assumptions).

Impacts on students. To assess students' achievement in mathematics, SRI will collect annual student-level test scores on state assessments in 2023–24 and 2024–25 for all students in grades 6 through 8 (see Appendix I-4). *Analysis:* For the two-year impacts on students (RQ2), student achievement in spring 2023 will serve as baseline. The analysis will posit a two-level hierarchical model with student and school levels, with the iCoachTEAM impacts estimated at the school level. For the one-year impacts (RQ3), student prior year achievement from spring 2023 (student cohort A) or spring 2024 (for student cohort B) will serve as baseline. The analysis will posit a three-level hierarchical model with student, teacher, and school levels. Additional models will add interaction terms to examine the potential differential impact of the iCoachTEAM program on different students and schools (RQ4, see Appendix I-5 for detail). *Power:* The MDES is 0.19 for the two-year impact on math achievement, assuming 480 students per school in 30 schools (with half in treatment). The MDES is 0.20 for the one-year impact on math achievement, assuming 80 students per teacher, and 7 teachers per school in 30 schools across sites (with half in treatment), see Appendix I-5 for additional assumptions).

Mediation analysis: SRI hypothesizes that teacher classroom practices mediate the effect of the iCoachTEAM program on student outcomes. If the study detects a statistically significant impact of the iCoachTEAM program on student outcomes, SRI will estimate such a mediation effect (RQ5). To do so, SRI will adopt the mediation conceptualization and analytic framework of Pituch, Murphy, and Tate (2010), which will test whether the mediation path from the intervention to each of the teacher outcomes and further to the student outcomes is statistically significant.

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