

# Developing Leadership for Improvement: Iterative Cycles as Opportunities for Learning

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## ABSTRACT

Improvement and action-oriented research approaches make iterative testing to learn about systems and adaptive change a central practice. As the need to develop the field's capacity to improve grows, so does the need to develop leaders' capacity for leading and conducting iterative cycles of testing. The present study reveals how EdD candidates learn to investigate and specify problems and aims, develop the capacity to lead, and conduct iterative cycles of testing in schools and school districts. We draw on the implementation of core learning activities in one Educational Leadership Doctoral Program employing improvement science as a signature methodology. Findings suggest shifting candidate orientations, growth in the capacity to engage in iterative cycles for improvement of problem definition and actionable steps, and the ability to garner collegial engagement in improvement and iterative testing. Implications highlight the importance of designing and structuring learning activities beyond those that exist in traditional research methods courses to ensure adequate candidate preparation.

## KEYWORDS

*improvement science, iterative testing, EdD, educational leadership, systems change*

Improvement research and improvement science continue to expand and take hold in teacher preparation (Sandoval & van Es, 2021), teacher professional learning (Lozano, 2017), and EdD programs (Perry et al., 2020). The spread of improvement science into EdD programs has given rise to the adoption of improvement research methodologies and approaches. The increasing use of improvement in education has created a need for field- and capacity-building work where educators are capable of engaging and leading improvement at scale. As the need to develop the field's capacity to improve grows, so too does the need to develop leaders' capacity for leading the work of improvement.

Leading improvement requires the adoption of specific dispositions (Biag & Sherer, 2021), including the take up of disciplined inquiry, a penchant for inquiry and learning, and persistence. These dispositions are reflected in core activities that span across improvement research methodologies. For example, in design-based research, improvement science, continuous improvement, action research, and other research approaches oriented towards improvement, iteration and testing of changes to practices, processes, tools, and systems are central features of improvement research (Barab & Squire, 2004; Bryk et al., 2015;

Hinnant-Crawford, 2020; Langley et al., 2009; Young et al., 2010; Yurkofsky et al., 2020). Across these methodologies, iterative cycles of testing are opportunities for educators responsible for leading improvement to engage in critical reflection where educators fail fast, learn quickly, and develop insight into the systems within which they work.

Iteration is a basic element of engaging and leading improvement that results in system wide change. Yet, while the importance of iteration is understood in these approaches, iteration itself is often ascribed to a formalized process that occurs after the establishment of a well-defined problem space and a well-scoped aim. In improvement science, the use of Plan-Do-Study-Act (PDSA) cycles are an example of a formalized process for iteration (Bryk et al., 2015). Once a specific area for improvement is identified, PDSAs are used to articulate well-specified changes that can then be tested and refined at small scales. Iteration is not limited to engagement to a formal routine, like the PDSA. Instead, iteration is the foundation of critical reflection, disciplined inquiry, and persistence. These are essential dispositions required of leaders working to support innovation and change.



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In this study, we build on the notion of iteration as a process that permeates every step of improvement research to illustrate the dialogical nature of problem articulation, scoping, and iteration to achieve change at scale. The aims of our study are twofold. First, we seek to contribute to the field's practice and understanding by examining how educational leaders learn to investigate and specify problems and aims through iteration. Secondly, this study showcases specific learning activities used by faculty to support doctoral candidates in that process. Although improvement literature articulates "well-specified" (Bryk et al., 2015, p. 144) aims and theories of action as a central feature of improvement, how improvement leaders reach highly specified theories of action, how they learn to specify these theories, and how instructors or facilitators teach leaders to engage in these processes of inquiry is vague. We view our study as a contribution to this literature by highlighting what "well-specified" (Bryk et al., 2015, p. 144) means and looks like in the context of preparing leaders to take up problems of practice in the dissertation in practice and how emerging improvement leaders learn to specify their aims and theories of action through guided activities in their coursework or consultations with course instructors.

We present two cases of doctoral students, Kerry and Nicole, both in the second year of a three-year doctoral program, to illustrate how educational doctorate programs can support their candidates as they learn to use improvement tools in service of their dissertations in practice. Our goal is to highlight how Kerry and Nicole engaged in iteration over a series of course activities and, through these activities, shifted in their views of improvement and use of improvement tools over the course of a semester. We highlight the core learning activities that faculty facilitated to inform student orientations towards improvement science and its use in dissertation research. Faculty had an explicit goal of providing candidates with the experience of engaging in iterative testing and building of evidence. Kerry, Nicole, and the faculty teaching the course continuously challenged assumptions through iteration, testing, and continued scoping of the problem. These two cases illuminate how the work of scoping unfolds through iteration, better positioning students to engage in research design that creates a throughline from problem to aim and that leads to productive iterative cycles of testing change ideas.

We begin with a brief description of the educational leadership doctoral program and the course from which we draw these two cases. We describe the core learning activities in detail to illustrate the process faculty anticipated candidates to move through as they refined their research projects. As faculty in the program, we also offer descriptions of our positionalities relative to the EdD program, the course, and the two candidates. We then present the cases, offering rich detail into each student's problem and their disposition towards improvement. We then engage in a discussion about these cases, describing candidates' initial orientations to improvement work to situate the extent to which the learning activities helped candidates refine their understanding and scope of their dissertation research.

## PROGRAM AND COURSE CONTEXT

The doctoral program was founded in 2007 and is currently in its 16th year. With an express focus on the preparation of educational leaders, the program has evolved now offering two concentration tracks: P12 and Community College. In this three-year

program, candidates take many of their courses during the first two years. Students matriculate in courses during fall, spring, and summer terms, including continuous research-to-practice seminars where candidates work closely with a faculty member to scope and craft dissertation proposal work in preparation for the third year of the program which is dedicated to their dissertation research. Beginning in 2019, the program recognized the need for redesign to more closely reflect the Carnegie Project on the Education Doctorate (CPED) framework and initiated a formal process of revisioning involving faculty in both concentrations. Revisioning processes included drafting new mission and vision statements, conferring with the EdD. advisory board to discuss the knowledge and skills program graduates required to be successful educational leaders in the field, the development of new program competencies, and a steady shift towards the adoption of dissertations in practice.

P12 faculty took up course revisions beginning with the research methods courses by adjusting target learning outcomes in the existing course sequence. For example, while all candidates completed an introduction to research methods course in the spring of their first year, revisioning meant that the introduction to research methods course would now include quantitative and qualitative learning modules where previously learning was limited to qualitative or quantitative methods. Similarly, students also complete an advanced research methods course in the spring term of their second year. Previously, students would select into the advanced course based on their anticipated research design, but this often was premature and did not always adequately support candidates.

The shift to dissertations in practice required P12 faculty to analyze their current course sequence and identify gaps where program learning goals could be strengthened. The primary gap noted occurred between the two spring terms. In the first spring term, candidates were immersed in learning about research methodology, research methods, and actively engaged in reflexive activities that prompted them to write about their positionalities in relation to their identified problems of practice, including their personal and professional identities. In the second spring term, candidates were expected to finalize their research designs in preparation for their dissertation research and write that section of their proposals. In practice, this meant that candidates had a two-semester gap where they might, or might not, make applied connections to the research methods they might use in their dissertation work. The Forecasting and Addressing Instructional Needs (FAAIN) course, as an applied methods course, was meant to fill this gap; however, the course had not been explicitly treated or taught as such. Upon reflection about this gap, instructors decided to redesign the FAAIN course to center the applied research component and thus support students' engagement with improvement science methodologies.

The authors entered this problem space at different junctures of the revisioning process. We describe our respective roles in this space in turn. Lozano has been part of the education leadership doctoral program revisioning process since 2019. As part of this process, Lozano worked on the redesign of the P12 research methods course sequence and previously taught the Intro to Research Methods course. Lozano co-teaches Forecasting and Addressing Instructional Needs with Garcia and co-led department-wide professional learning sessions focused on improvement science and dissertations in practice with Sandoval. Garcia has been instrumental in the redesign of Forecasting and Addressing Instructional Needs and co-teaches with Lozano. Garcia comes to the course with experience as a practitioner of improvement science

within school systems and organizational approaches. Sandoval teaches the Advanced Methods course in the research methods course series for P12 students. Sandoval brings a breadth of experience leading Networked Improvement Community efforts. Sandoval led P12 learning-focused conversations on dissertations in practice, targeting the alignment of methods and data analysis.

In this paper, we draw on coursework completed in the redesigned FAAIN, a required course for all doctoral candidates enrolled in the fall semester of their second year. The purpose of the course from which we take these two cases had the goal of providing candidates with the opportunity to refine and revise their understandings of the problems of practice they aim to take up in their dissertations. To make the purpose of the course clear, the course learning goals and objectives were organized into practice and research categories. Figure 1 indicates how these learning goals appeared in the course syllabus.

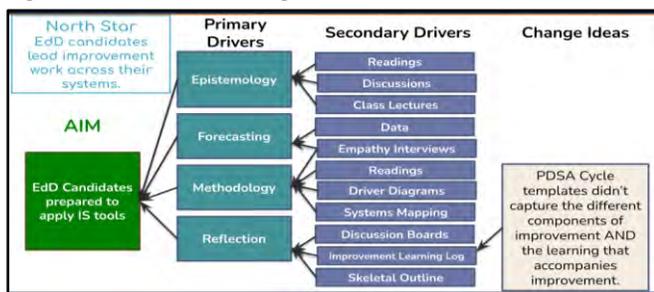
Figure 1. Course Learning Goals and Objectives

STUDENT LEARNING GOALS AND RELATED OBJECTIVES	
Students will advance their knowledge, skills, and dispositions in alignment with the EdD Leadership Competencies. At the completion of this course, students will be able to apply their learning in practice and in their research as follows:	
<b>Practice</b>	<ol style="list-style-type: none"> <li>Engage in an improvement project to effect change for the group/system/process they identified in their "forecasting"</li> <li>Gain in-depth understanding of improvement science principles and tools to guide organizational development and planning that is inclusive of all stakeholders/educational partners (especially minoritized communities)</li> <li>Apply tools and strategies to advocate for equity and speak truth to power</li> </ol>
<b>Research</b>	<ol style="list-style-type: none"> <li>Gain a richer understanding of theory and methodology in crafting and answering research questions</li> <li>Develop practices of documentation and analysis to:               <ol style="list-style-type: none"> <li>study processes and systems</li> <li>capture and reflect on your learning</li> <li>justify next steps</li> </ol> </li> </ol>

## Course Learning Activities

The course instructors carefully designed the instructional arcs to coincide with the candidates' anticipated learning trajectory as they refined dissertation projects. In Figure 2, the primary drivers indicate the core learnings that are reflective of the instructional arcs of the course, whereas the secondary drivers reflect the course components that instructors believed were integral to supporting candidate preparation and application of improvement science tools in service of candidates' dissertation work.

Figure 2. Course Driver Diagram



As part of the course, there were two core learning activities designed to support candidates to bridge their understanding: 1) the improvement work learning log (see Appendix A) and 2) two workshoping protocols (see Appendix B) conducted in small

breakout groups during two separate synchronous class meetings (Week 4 and Week 9). Each core learning activity is described.

### Workshop Protocol 1

Candidates were expected to attend the Week 4 class with a working driver diagram draft to share with their peers. During this meeting, we introduced the protocol that was designed to provide candidates with a structure for presenting their driver diagrams and talking through their ideas with peers in small groups. Our goal was to provide candidates with a scaffolded feedback opportunity to support driver diagram draft revisions.

### Improvement Work Learning Log

At the end of the Week 4 class meeting, faculty introduced the learning log to support candidates in documenting learning as part of the improvement research process. The logs included three learning reflection entries, each with distinct prompts. The first entry, Driver Diagram, prompted candidates to reflect on the degree to which their systems were reflected in their driver diagrams, to consider improvements that were needed, and directed candidates to share their driver diagrams with colleagues to solicit input and feedback. The second and third entries were focused on testing and building evidence through iteration. These entries, titled Learning Cycle 1 and Learning Cycle 2 respectively, included reflection questions that prompted students to plan testing of a change idea anchored in their theory of action, reflect on what they hoped the test would help them learn, make predictions about how the test would unfold, collect evidence on the execution of the test, and reflect on what happened when they completed the test. These prompts are closely aligned with the organization of PDSA cycles central to improvement science approaches (Bryk et al., 2015).

### Workshop Protocol 2

Candidates were provided with a second structured workshoping opportunity during Week 9. The protocol included the following steps. In small groups, students numbered off and decided who would present first. Then, each student had the chance to share their learning, namely the iterations they had engaged in to stage their improvement project. While the presenter explained their project, the other students listened and captured their reactions and questions in a note-catching matrix that was accessible to all students in the small group. The presenter then responded to the questions and comments made by the others in the group. After each member had a chance to explain their project, the whole group reviewed the questions and takeaways and synthesized the themes that emerged through their collective exchange.

The second workshop protocol was distinct from the first in two ways. First, because we knew that candidates were at different stages in their work projects, we offered two pathways to enter the process of sharing their work and soliciting feedback. It was important to emphasize the importance of learning, honoring where candidates found themselves in this process, and reinforcing the notion that this is real work, and it is messy. To this end, one version offered candidates the opportunity to discuss their revised driver diagrams, this time emphasizing their anticipated plans for conducting a future learning cycle. At the same time, we also found it important to support candidates who had already conducted at least one learning cycle. We offered a second protocol path in support of those candidates that had tried something and were in the stages of



reflecting on their learning and/or planning their next learning cycle. An important difference in this protocol was the inclusion of a note-catching matrix (see Appendix C) that helped students reflect on feedback and questions provided by peers where, again, candidates could document what was being shared as well as questions and feedback that were provided in return. The process of taking notes was intentionally designed to reinforce the importance of documenting learning.

We introduced the first workshopping protocol during our online Week 4 class meeting. Through this activity, our aim was to provide candidates with the opportunity to share their working theories as documented in their driver diagrams in anticipation of engaging with other colleagues at their respective work sites to solicit feedback as part of their improvement work learning log. This first workshopping protocol set candidates up for completing their first improvement work learning log entry and ease them into the subsequent learning log entries. In much the same way, the second workshopping protocol was designed to scaffold students into the continuation of refining their research projects in the service of the dissertation in practice. Our co-constructivist approach to teaching facilitated our ability to be responsive to the learning needs of our candidates. In this way, the development and refinement of these tools and protocols allowed us to meet candidates where they were in the learning process and design learning experiences that could propel them to the next phase of their learning journeys.

## DEVELOPING CAPACITY FOR IMPROVEMENT

We present the cases of Kerry and Nicole, two educational leadership doctoral candidates enrolled in this course, who were learning to use improvement tools to improve mathematics teaching in their respective districts. These cases highlight how they evolved in their understanding of the use of improvement tools as they began to use them: for their dissertation research, the scope of their aims in early stages of work, the learning activities that faculty engaged to shift their individual orientations around these tools to help further scope their projects, the extent to which scoping shifted, and how scoping supported iterative cycles of testing.

### Case Study 1: Kerry

Kerry was a student in her second year of the P12 education doctorate program. Upon entering the class, Kerry, much like her peers, had an identified complex problem of practice that merited attention and fit within the requirements of a dissertation in practice. Yet, the degree to which Kerry had engaged in specific problem analysis and problem definition activities had been limited. Kerry was an experienced educator and was encouraged to draw on these experiences as she continued to explore and define the problem of practice she would take up in her dissertation research. This was something that we as instructors also emphasized in the context of our course and repeated frequently throughout formal instruction opportunities.

During Week 4, when candidates were asked to generate working drafts of their driver diagram in preparation for the first workshopping experience, Kerry joined a small group to share her work. In class, small groups were provided with ample time to workshop their current driver diagrams with each other in breakout groups. At the end of the dedicated group time, the instructors held a whole group debriefing session. Kerry shared some of her insights

and questions about her project. Based on her description, the instructors gathered that the scope of Kerry's project was much too broad, constraining her ability to identify a direction for engaging in iterative cycles of testing that she might want to explore in this course. In this debrief, Kerry identified a specific professional learning approach, lesson study, as her dissertation in practice research. She wondered how she might test and build evidence at a small scale if her dissertation research required her to implement an entirely new approach with a team of teachers over a prolonged period of time. At this point, Kerry surmised lesson study was not a small, testable change that she could engage in inquiry around and that she would need to come up with an entirely new project to meet course assignment requirements.

It was clear that Kerry had identified a complex problem of practice around mathematics teaching and learning, had identified lesson study as a specific solution, and believed that that was her dissertation in practice. Upon reviewing Kerry's driver diagram it was clear that the aim was broad and incomplete (see Appendix D). Kerry's driver diagram listed two goals: 1) increase math teachers' capacity for change as measured by survey/interview data by Fall 2023 and 2) increase participation in professional learning by implementing new practices, improved opinion/attitude of professional learning and/or willingness to continue. The goals listed in the driver diagram were preliminary and not reflective of the kind of problem definition within a specific system or the scoping required to clearly identify a throughline for improvement in a dissertation in practice. Further review revealed that the primary and secondary drivers were also unclear. At this point, Kerry had identified drivers that were reflective of resources (e.g., provide time, provide incentives, require professional learning), people (e.g., district, math department, volunteers, coaches), and actions (e.g., coaches conduct focus groups, group conducts research, etc.) that were beyond her sphere of control. Given her use of specific categories (i.e., resources, people, actions) beyond her immediate local context, it was apparent that Kerry's initial driver diagram captured reasoning that was similar to what might be captured in a causal systems analysis (e.g., Ishikawa or fishbone diagram). Kerry had not moved through a process of flaring where she might brainstorm root causes that might directly contribute to the problem of practice she sought to redress: student mathematics achievement.

At this juncture, it was evident that Kerry needed to consider how the identified problem of practice manifested within her district and work team, investigate how others understood the problem, and determine how feedback loops were used with her team. This would enable her to scope a project that was reflective of her system and aligned with the existing work practices that she could leverage to support improvement.

Kerry emailed her driver diagram to the two course instructors to solicit their feedback. One of the course instructors responded with written feedback, noting:

I see 2 aims in your aim statement. How about choosing one for the class? I think the one about increasing participation in [professional learning] is a good starting point. And I would ask before settling for that one, is that the problem you are trying to solve? How do you know that is the problem? (jot those things down) Now, look at the slides from the class again and ask? What could augment participation? And what is within your sphere of control? Personally, I would not include the district. List all the resources you do have and/or can provide within your role. Perhaps things like: embedded time during regular

PD or time during regular grade level/department meetings; peer observations (are these already common practice); think of things that already exist within the system. Follow the same process for secondary drivers.

These questions aimed at helping Kerry try to scope her theory of improvement. In particular, the instructor's move to ask Kerry to attend to what problems she was attempting to solve and what was within her locus of control were meant to get Kerry to center the needs of her colleagues and students over her commitment to lesson study as a change. The questions also were designed to get Kerry to center activities and meeting spaces she had influence over, rather than large, year-long efforts and initiatives. Kerry took this feedback and constructed a second iteration of her driver diagram based on the instructor's feedback.

During Week 9, Kerry participated in the second workshoping session using the protocol with her peer group. She shared her most recent version of her driver diagram as peers used the note catcher to document the sharing and feedback session. Kerry had refined her goal to the following: improve high school math teachers' attitude and capacity for professional learning. In addition, she had refined her primary drivers to identify similar grain size areas that could potentially be targeted to reach her goal. While Kerry had refined her secondary drivers, these were still too broad in scope as they named people and not necessarily specific norms, structures, or routines clearly related to the primary drivers. Furthermore, Kerry had also expanded the change ideas to include specific components of a more comprehensive professional learning approach that could be leveraged to test and build evidence. For example, Kerry identified things like journal club and unit mapping as specific change ideas. The second workshoping protocol supported Kerry in working with her peers to discuss the scope of her project and also consider additional factors that might be important to her work.

At this point, Kerry had conducted one of the learning cycles which involved surveying math teachers to identify professional learning supports that they were interested in and following up with requests. Kerry had written in her learning log that she had rarely received responses to her offering of support and used this cycle to interrogate why. She noted:

Over the past year, I have told many math teachers to reach out with any kind of request for support. Here are some example phrases I have used in email to teachers:

- "If there is anything else we can help you with over these next couple of weeks, please let us know!"
- "Is there anything I can do to support your teaching from home efforts?"

[...] I am certain that there were basically zero requests for support in response to emails with any of these phrases.

Kerry recognized that her open-ended offering of support was a possible issue after having read Beswick's (2014) study on soliciting the professional learning needs of mathematics teachers. Beswick's (2014) study found that providing teachers with options for what kinds of supports they could leverage was more effective in soliciting their needs than asking them open-ended questions. Thus, Kerry decided to conduct a learning cycle around using a survey, with one item offering multiple options for support and a second item offering multiple options for formats of professional learning activities (e.g., observing a lesson), to solicit her math teachers' professional learning needs. In her learning log, Kerry predicted she would

receive up to three responses out of the 15 teachers to whom she sent the survey. She received nine. Kerry wrote that while she was pleasantly surprised with the number of responses to the survey, she found it difficult to respond to all the math teachers' divergent needs. In her reflection of the use of the survey, she noted that her next test would omit the second item asking teachers what format they prefer for professional learning activities.

Kerry's case illustrates her shift towards engaging in iterative cycles of testing. Though Kerry began the class with an overly general theory of action and a skepticism of the value of iterative cycles of testing, she began to scope a manageable, testable theory of action and charted out a small change idea to help her learn about her theory and adapt the change idea based on how the change went. Rather than implement lesson study at scale, Kerry began to learn her way into providing responsive professional learning to her mathematics teachers and enabled her to build confidence in her theory of action and her project more broadly.

## Case Study 2: Nicole

Nicole was a second-year doctoral student in the P12 program. Similarly to Kerry, her experience in narrowing the problem she was trying to address was limited. At first, she wanted to create a planning and teaching tool she drew from Universal Design for Learning (UDL) and Culturally and Linguistically Relevant Pedagogy (CLRP) to scaffold math learning for English Learners (ELs) and Students with Disabilities (SWD) (see Appendix D). She assumed that was the best solution to address math underachievement for ELs and SWD. Through the guided activities and consultations in her course, she was better able to represent her theory of action through a revised driver diagram that was informed by teachers (users), doctoral peers, and faculty members. The process of scoping her problem and ideas about how to address the problem was very much informed by the learning opportunities created for her within the FAAIN course. This course offered Nicole the opportunity to maximize the utility of improvement science tools in a way that was adaptive and responsive to her needs. The readings, the reflection piece through the learning log, and the collaboration with her instructors supported Nicole's journey in improvement work.

Initially, Nicole thought she had to start with an intervention to test. However, through the course reading and consultation she documented the following: "Adding Student and Teacher Voices via empathy interviews as primary drivers were the most significant changes I made to my driver diagram and helped me zoom in on a more specific aim and fine-tune my problem of practice." Nicole followed Hinnant-Crawford's (2020) recommendation to leverage the power of a PDSA cycle to refine the aim. Nicole noted: "Conducting teacher empathy interviews became my PDSA for Cycle I. Hinnant-Crawford (2020) discusses using a PDSA cycle to determine my aim. That's what Cycle I has helped me do." Learning through her first PDSA cycle resulted in a more attainable aim and clearer drivers to achieve that aim.

After conducting ten empathy interviews with the assistance of colleagues who were aspiring administrators and enthusiastically joined her investigation of the problem, Nicole's data revealed complex teacher perceptions and understanding about the underachievement of ELs and SWD in mathematics. In fact, the empathy interview data directly contradicted some of her assumptions about what teachers thought about their students who were classified as ELs and SWD. She realized teachers grasped the



complexity of challenges these students face and were excited about engaging in a learning process that allowed them to better differentiate their instruction. Nicole documented her prediction about her first cycle in this way:

I anticipated that teachers would acknowledge the underperformance of ELs and SWD in mathematics. I was pleasantly surprised that their answers focused more on the curricular/instructional/learning challenges these students face rather than emphasizing work completion and not knowing their math facts (which I seem to hear a lot).

Her findings also allowed her to see the dialogical nature of improvement science tools to frame change and learning. Once she had the space to grapple with new questions and conflicting data that challenged her assumptions, Nicole made adjustments. In her revised version of her driver diagram, UDL became a primary driver rather than the change idea. She credits a conversation with the instructor to help her rethink the drivers she had first crafted:

After meeting with Dr. X., we talked about possibly positioning the lesson planning tool as a primary driver. This may assist me in being able to take a slice of this massive idea that has multiple inputs to achieve the aim and streamline my research.

Nicole is forging a path to improvement by building up her knowledge and understanding of her current system, the entry points to stage changes, and the centrality of ensuring she is being user-centered.

As her learning evolved—aided by the readings, the learning log, and the support of the instructors—Nicole redesigned her driver diagram to include places where she could intervene to make improvements. For example, she situated teacher planning time as a place where (secondary driver) a collective UDL/CLRP lesson could be designed by teachers with her support. Embracing a well-defined process aided Nicole in finding high leverage places in her system where she could support teacher learning to make mathematics instruction more accessible for ELs and SWD. In addition, her new approach included the buy-in of the teachers she was hoping to support because she had recruited their input and involvement through her interview process. By Week 9 of the semester, Nicole was prepared to share the progress of her project with peers through a workshop protocol that was part of her course. For Nicole, having the opportunity to explicate her thinking and actions resulted in a more refined driver diagram and plan for implementing her change idea—testing her planning tool in the field.

The intentional sequence and scope of the Forecasting and Addressing Needs course allowed Nicole to trust herself to leverage the power of improvement science tools by spending a whole PDSA cycle learning from teachers, the users she wanted to support. Investing her time in this way resulted in a more precise definition of her problem and aim statement. Her next iteration involved testing the tool she had created with second grade students during a math lesson. Once again, the improvement work log allowed her to capture her learning and appreciation for the complexity that using a new tool might hold for a teacher. She observed:

The tool is ultimately meant for teachers. I learned that I probably needed to plan alongside the teacher if I was to teach/facilitate the lesson because the teacher can use the tool with more specificity given his/her knowledge of the students. I think she would have gladly taken the time but I didn't want to add another thing to her plate.

Although she had a successful lesson with the students in a teacher's classroom, Nicole recognized that if she wanted teachers to interact and use this tool, they would need more in-depth capacity building and scaffolds than she might have anticipated. After the course, Nicole is much better positioned to engage with teachers in her educational system to collaboratively work on improving mathematics instruction for students classified as ELs and SWD.

Nicole began with a deep desire to support math instruction, particularly for students with disabilities (SWD) and English Learners (ELs). Her initial approach led to a colossal problem of practice and what seemed to be an insurmountable project. However, after an intentionally curated process that included readings, an improvement work learning log, a workshop protocol with peers, and consultations with her instructors, Nicole was able to understand that her initial theory of action was too broad and prescriptive. The guidance provided through a focused line of inquiry led her to rethink and redesign her driver diagram and thus her ideas for change that might lead to improvement in mathematics instruction.

## Learning to Scope

The ethos of improvement science is to “unearth our problems, understand our current systems, and have prophetic imagination about what can be, and then work to bring that about. Improvement science is a methodology that can help us do just that” (Hinnant-Crawford, 2020, p. 5). In the course, Forecasting and Addressing Instructional Needs, the doctoral students were given opportunities to unearth problems and understand their systems resulting in prophetic imagination (forecasting) that allowed them to test out change ideas that could indeed become improvements. The guided activities and opportunities to discuss and reflect on what they were learning created a rich journey through which they were able to scope the problem to a reasonable size and ascertain whether their changes were in fact improvements. The impact of each instructional tool is summarized.

### Workshop Protocols

The evolution of the protocols from workshop one to workshop two differentiated the reflection for students to enhance the impact of the consultation. Being responsive to student needs and progress within their improvement projects solidified the learning and allowed students to learn from one another based on where they were in the improvement process. In addition, the process of workshopping itself modeled the dialogic nature of iteration as a necessary component of improvement. Here, it was the course instructors that demonstrated iteration to the course to improve their facilitation of learning in dialogue with doctoral candidates' learning progression. Improvement science tools seek to create a common language among users that leads to collective action towards a common aim (Bryk et al., 2015). In this case, the improvement science tools and differentiated protocols provided a framework for all students to participate fully in the consultation and gain profound insight into their problems of practice and theories of action.

### The Improvement Work Learning Log

No learning can occur without reflection. Any authentic analysis of current conditions in an educational system requires a naming of the world that results in praxis—action and reflection that result in emancipatory practices and authentic learning (Freire, 2014). Learning to engage in practices that can bring about equity and

social justice to educational contexts may seem overwhelming to students who seek to interrogate current conditions and bring about change. Improvement science invites a close study of systems that produce problems and the creation of a theory of action that manifests places where changes can be implemented and measured to ascertain their impact. However, the tools alone may not be as powerful as when coupled with reflection tools like the Improvement Work Learning Log. The log used in the course invited a deep level of reflection that pushed students to shift and expand their mindsets to better address their PoPs. The questions allowed students to codify their learning by naming their world and thus propelling their practice into praxis–action and reflection that led to improvement. Thus, having a set of tools to stage and manage change coupled with powerful reflection helped students like Kerry and Nicole carry out significant improvement projects.

### Collaboration

We posit that the co-teaching model in the FAAN course provided an additional layer of support for students and faculty who were able to co-design and co-construct a pathway for students to practice improvement science in a safe space. In our work, we acknowledge our desire to prepare students to be education leaders that recognize and name injustice in educational systems and are ready to lead transformation. Leading in this way requires vulnerability, engagement with others, and collaboration. The course instructors co-designed the course, co-facilitated class sessions, shared grading responsibilities, met regularly to discuss student progress, and made adjustments based on students' learning. Here instructors collaborated with each other and worked to provide an alternate model of the dialogical nature of teaching and learning. Faculty prioritized collaboration and co-construction, soliciting input and feedback that was integrated into course activities. Through these parallel approaches, where faculty were engaged in their process of iteration, testing approaches to learning through workshoping and learning logs, and students were interrogating their approaches to complex problems of practice, collaboration was positioned as a vital component of leadership. Programs may want to consider and reflect on the current levels of collaboration across their institutions, including in the co-design and co-teaching of courses. Such collaborative approaches may represent a myriad of benefits for students as they embrace more formal leadership roles in their current educational systems or as they lead larger improvement projects in their current systems.

### THE POWER OF SHARED-LEARNING

Through this doctoral program, educational leaders learn to embrace a praxis of research-practice-reflection that accelerates learning to effect changes that result in improvement. The two cases discussed in this study revealed the various opportunities candidates had to stop and reflect, with the support of peers and faculty, to reassess their grasps on the PoPs and shape their improvement projects. These leaders have learned invaluable lessons about the power of disciplined iterative cycles to bring about significant changes to their current systems: "To exist, humanly, is to name the world, to change it. Once named, the world in its turn reappears to the namers as a problem and requires of them a new naming. Human beings are not built in silence, but in word, in work, in action-reflection" (Freire, 2014, p. 88). The leaders in the case studies and

in the doctoral program in general, are in fact building their identities as leaders in word, work, and in action-reflection.

The adaptive nature of the Forecasting and Addressing Instructional Needs course revealed a contextually-driven learning space that built on students' expertise and centered learning fast as an invaluable part of the process. Leadership preparation programs aim to develop leaders who center equity through their work and who have the tools to enact lasting improvements to our current educational systems. The inclusion of intentional spaces to stop and reflect, to question and clarify, and to revise and iterate is crucial to the needs of school leaders facing complex PoPs. If our aim is to prepare and sustain social justice leaders, we must then create systematic and systemic pathways that help leaders see learning as necessary and reciprocal in nature within various educational partner groups (François & Hunter Quartz, 2021). As educational doctorate programs continue to explore, revise, and adapt to meet the leadership preparation demands of the field, it is important to develop processes and mechanisms that allow them to be responsive to candidates' evolving needs. The authors have presented detailed examples of what adaptation and responsiveness looks like in the context of a single course like Forecasting and Addressing Instructional Needs. Engaging a praxis of research-practice-reflection that is dialogic is mutually beneficial for candidates and faculty. Praxis supports candidates' learning as developing improvement leaders and faculty who are invested in living the ideals of improvement by continuously revising their instructional practice.

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## APPENDIX A

### Improvement Work Learning Log

*What is the purpose of the Learning Log?*

Learning logs are used to document learning in practice. They are used to chronicle your learning journey over time. In an improvement project, documenting what you learn is an important part of the process. Anchoring your learning in practice is contingent on your ability to effectively measure the impact of your change idea. The learning log helps you reflect, plan, and record evidence to inform future action.

*How “to do” the Learning Log?*

This document is unique to you, the user, so there is no right or wrong way to complete it. Consider describing evidence that expands on or supports your process.

Learning Log Reflection: Driver Diagram

1. What were the key learnings you derived about your current system by building your Driver Diagram?
2. What are some areas you see for improvement?
3. Share your Driver Diagram with 2-3 colleagues in your current context. How did their insights or reflections shift and/or reinforce your current thinking about your Driver Diagram?

Learning Log Reflection: Cycle 1

1. What did you want to learn from this test?
2. What data did you collect?
3. What did you anticipate or predict as a result of this test?
4. What did you learn from this test?
5. What were some unintended consequences from this cycle that happened as a result of your change idea?
6. How will what you learned inform what you will do next time?

Learning Log Reflection: Cycle 2

1. What did you want to learn from this test?
2. What data did you collect?
3. What did you anticipate or predict as a result of this test?
4. What did you learn from this test?
5. What were some unintended consequences from this cycle that happened as a result of your change idea?
6. How will what you learned inform what you will do next time?
7. What might be a good way to present your findings to other stakeholders in your system?

## APPENDIX B

### Workshop Protocols

Week 4

In Your Groups, Join a Breakout Room

1. Count off to decide who will begin. Designate a timekeeper.
2. Presenter: share your driver diagram (2 minutes)
3. Audience: after presenter shares, ask clarifying questions about the theory of improvement represented in the driver diagram (5 minutes)
  - o How is the system reflected in the driver diagram?
  - o What is the connection across drivers?
  - o What would people in your system say about your driver diagram?
4. Presenter: reflects out loud, sharing how the questions and discussion deepened their thinking (1 minute)

Week 9

Where are you in the improvement process?	Probing Questions
<p><b>I'm planning for my cycle...</b></p> <ol style="list-style-type: none"> <li>1. Share your <b>driver diagram</b> and talk about your <b>change idea</b> with the group.                             <ul style="list-style-type: none"> <li>o What is your throughline? Why is this the place where you chose to begin?</li> </ul> </li> <li>2. Share your process for implementation of your first learning cycle with your group.                             <ul style="list-style-type: none"> <li>o What are you piloting? What data are you collecting? What do you anticipate learning through this first learning cycle?</li> </ul> </li> </ol>	<ol style="list-style-type: none"> <li>1. Is the aim clear, specific, actionable, and timebound?</li> <li>2. What is the feasibility of this work?</li> <li>3. What data did you review/collect to help you identify a starting point? What data will you revisit throughout the project?</li> <li>4. How are you working with others? How do you plan to gain their support and/or participation?</li> </ol>
<p><b>I've completed at least one learning cycle...</b></p> <ol style="list-style-type: none"> <li>1. Share your driver diagram and talk about your change idea with the group.                             <ul style="list-style-type: none"> <li>o What is the aim of your project? What is the throughline?</li> </ul> <p>Where did you begin? Why did you begin here?</p> </li> <li>2. You've completed at least one learning cycle. Share with your team.                             <ul style="list-style-type: none"> <li>o What did you do?</li> <li>o What did you learn?</li> <li>o Will it work? Why or why not?</li> <li>o How do you know?</li> </ul> </li> </ol>	<ol style="list-style-type: none"> <li>1. Is the aim clear, specific, actionable, and timebound?</li> <li>2. What is the feasibility of this work?</li> <li>3. What data did you review/collect to help you identify a starting point? What data are you revisiting throughout the project?</li> <li>4. If you worked with others, how did you gain their support and/or participation?</li> <li>5. What were some things that you learned that were completely surprising or unanticipated?</li> <li>6. Where will you go next?</li> </ol>

### APPENDIX C

#### Note-Catching Protocol

##### Note-taking and Feedback Process

1. Number off.
2. Select a timekeeper and note taker (per presenter).
3. Person 1 will present (5 mins).
4. Group will add clarifying & probing questions on the table provided (3 mins).
5. Discussion (7 mins).
6. Repeat for the next person.

##### Note Catcher

Notetaker will capture the presentation. Each member will then take time to write down their question(s). Group will ask questions and notetaker will capture discussion notes.

#### Note-Catching Matrix

Presenter:

Notetaker (catch notes from the presentation and discussion during the questions portion): Timekeeper (set a timer for each portion of the protocol):

General Presentation Notes (5 mins)

•

Clarifying & Probing Questions (10 minutes total: 3 mins. for folks to write in their questions in the table below. 7 mins. for discussion)

Name	My Questions	Notes

### APPENDIX D

#### Candidate Driver Diagrams

Figure D1. Kerry's Driver Diagram at the Beginning of the Course

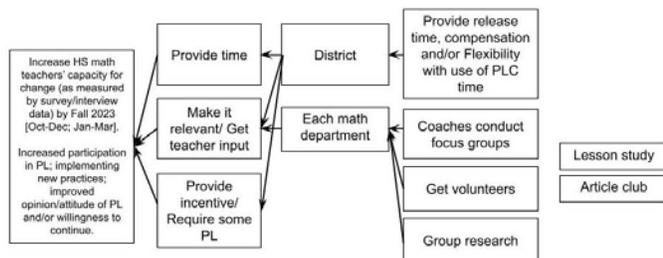


Figure D2. Kerry's Revised Driver Diagram

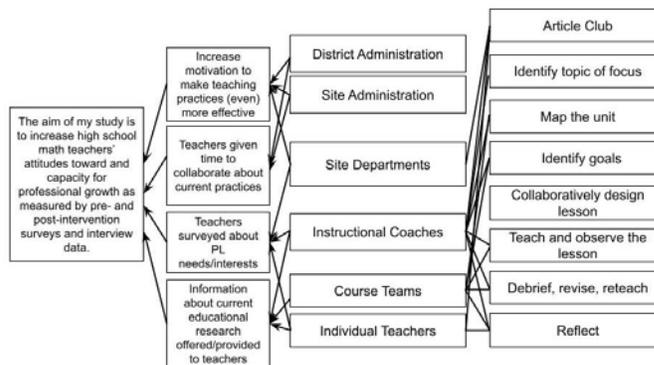


Figure D3. Kerry's End-of-course Driver Diagram

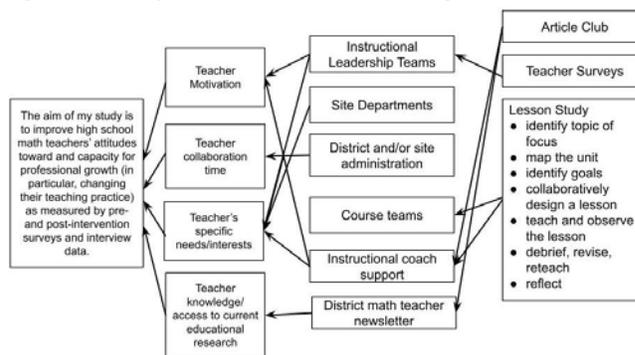


Figure D4. Nicole's Driver Diagram at the Beginning of the Course

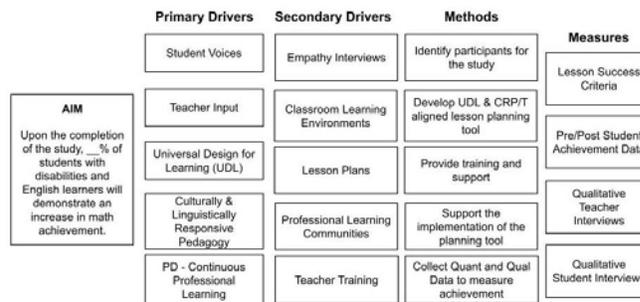


Figure D5. Nicole's End-of-course Driver Diagram

