

# Beyond the Networked Improvement Community: Designing PLCs to Spread Learning from the Better Math Teaching Network

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**Partners for Network Improvement**

Research, Strategy, & Evaluation





# Partners for Network Improvement

Research, Strategy, & Evaluation

Partners for Network Improvement (PNI) is a research and evaluation group based at the University of Pittsburgh's Learning Research and Development Center. Led by Jennifer Russell, one of the key developers of the Network Improvement Community Development Framework, PNI both leads networks and supports network leaders in their work to design, implement, and adapt improvement networks. Developmental evaluation is one tool PNI uses to help network leaders develop strong improvement networks.

## Developmental Evaluation

Although industries such as healthcare have used improvement science for decades, the use of improvement science and networked improvement communities is relatively new in education. Because this work is complex and innovative, and because improvement science by nature requires rapid tests of change, adaptation to context, and systems thinking, the Nellie Mae Education Foundation invested in an intensive developmental evaluation of the Better Math Teaching Network (BMTN). PNI conducted a developmental evaluation that studied and supported the networked improvement community's (NIC) initiation, development, outcomes, and dissemination of lessons learned.

PNI's developmental evaluation of BMTN aimed to:

- Infuse an evidence-based critical friend/thought partner perspective into the network development process
- Track growth and the development of the NIC as a learning organization
- Produce useable knowledge for the education field and specifically for other educators, policymakers, funders, and researchers interested in the NIC model as a way to organize for improvement and address high-leverage practical problems
- Advance the evaluation field by testing and refining models for evaluating improvement processes and NICs in education contexts

## Acknowledgements

We would like to thank the BMTN hub leaders and the 62 teachers who opened their practice and their learning space, and welcomed us in. We are inspired by their love of math, passion for students, and desire to never stop improving. We would especially like to thank the BMTN teachers who worked with us in 2019 and 2020 to help us understand how they were moving their network learning into their schools, districts, and states.

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# The Better Math Teaching Network

From 2016 to 2021, the Better Math Teaching Network (BMTN) aimed to transform high school mathematics teaching in New England. Researchers and teachers worked together to make high school Algebra I classes more student centered. Launched by researchers at the American Institutes for Research (AIR), with support from the Nellie Mae Education Foundation (NMEF), the network was grounded in the following [five core principles](#):

- 1. Teachers are central to change.** Teachers shape students' learning experiences and beliefs about math. It is possible to create classrooms that are more strongly student centered—classrooms in which all students are actively and meaningfully engaged in learning math.
- 2. Student-centered teaching is complex and almost impossible to do in isolation.** Teaching to maximize student engagement and understanding is complex. One way to deal with this complexity is for teachers to participate in structured, collaborative learning with other teachers and researchers.
- 3. Teaching can be continuously improved.** Teaching is a craft to continuously hone. Teachers use practices daily that lend themselves to ongoing, incremental improvement. Continuous improvement methods from industry and healthcare hold promise for education.
- 4. Quick-cycle improvement methods provide opportunities to study and improve teaching.** Many of the practices teachers want to improve on can be studied with quick-cycle research and development methods. Teachers can test and refine strategies within and across lessons, realizing improvements every few weeks, rather than waiting until summer break.
- 5. Research and practice should be seamlessly integrated.** Too often, research and practice fail to inform each other. The BMTN included researchers and practitioners who worked arm-in-arm to test and refine improvement strategies in real classroom settings. Mutual respect fueled the work.

Network leaders, referred to as the network hub, organized the BMTN as a networked improvement community (NIC) to address a common problem of practice using improvement science. They drew on research to define three principles for Deep Engagement in Algebra (DEA), which anchored teachers' work as they strove to make their practice more student centered:



**Connect:** Make connections among mathematical procedures, concepts, and application to real-world contexts, where appropriate.



**Justify:** Communicate and justify mathematical thinking as well as critique the reasoning of others.



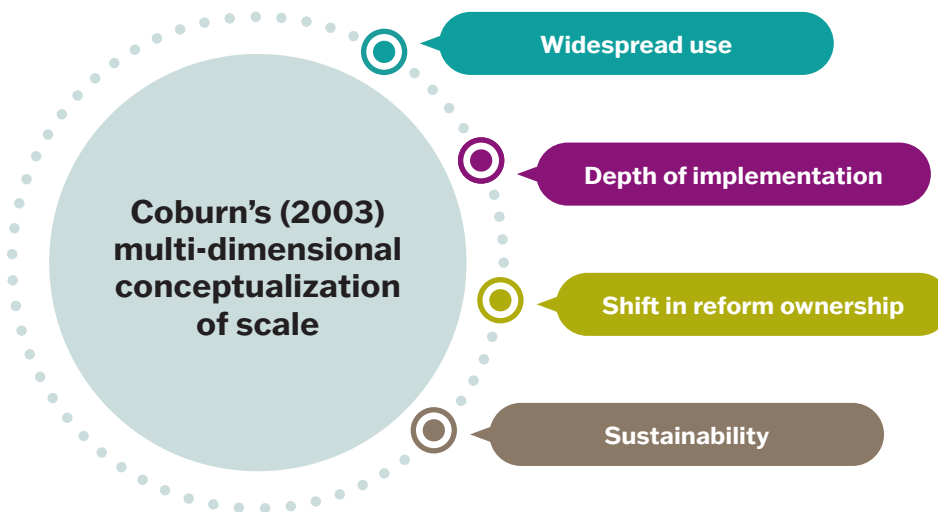
**Solve:** Make sense of and solve challenging problems that extend beyond rote application of procedures.

The BMTN was piloted with a group of nine teachers during the 2015–2016 school year and added teachers the following three years. In all, a total of 63 teachers engaged in the BMTN. Selected from a pool of volunteers that applied to join the network, participating teachers worked in urban, suburban, and rural contexts and taught at least one Algebra I course to 9th grade students. They engaged collaboratively to continuously improve their teaching, enhancing learning for thousands of high school math students throughout New England.

# Building a Networked Improvement Community

Inspired by the networked improvement community (NIC) concept (Bryk, Gomez, Grunow, & LeMahieu, 2015), researchers at the American Institutes for Research (AIR) launched the Better Math Teaching Network (BMTN) to address the problem of high rates of high school students disengaged from mathematics learning. Teachers in the BMTN employed improvement science methods such as the Plan-Do-Study-Act (PDSA) cycle to test student-centered routines that could result in deep engagement in algebra.

In the fall of 2016, the Nellie Mae Education Foundation (NMEF) funded Partners for Network Improvement (PNI) to launch a developmental evaluation. The goal of the evaluation was to provide timely and actionable information to network leaders—the BMTN hub—and members, which would allow them to accelerate their capacity to meet the network’s aim. As the BMTN matured, the focus of the developmental evaluation shifted from studying the establishment of network operations and development to understanding how the network was organized to spread its learning and design for sustainability. PNI drew on a range of data sources<sup>1</sup> and Cynthia Coburn’s (2003)<sup>2</sup> conceptualization of scale to understand and present five strategies for scale that the BMTN employed.



1 See Appendix: Data Collection.

2 Coburn, C. E. (2003). Rethinking scale: Moving beyond numbers to deep and lasting change. *Educational Researcher*, 32(6), pp 3–12.

# Amplifying the Impact of Networked Improvement Communities

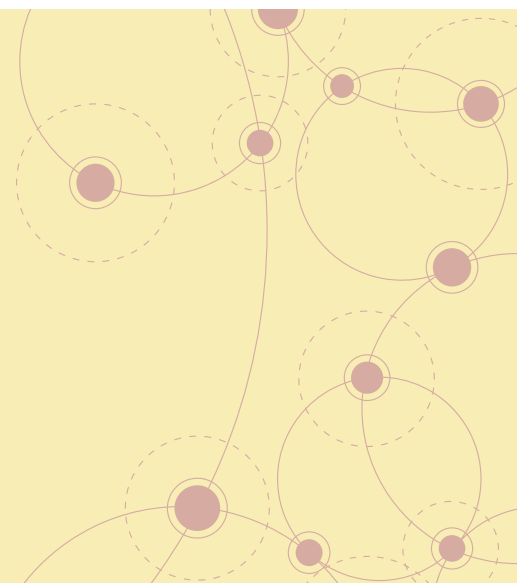
Networked improvement communities are intended to bring together educators who accelerate progress toward a shared improvement aim by engaging in systematic collaborative inquiry. As a network matures, we find that network hubs often grapple with ways to scale and sustain the work to realize the NIC's potential.



One approach network hubs take toward achieving scale is to support the spread of the network's learning, processes, and/or resources beyond network participants. Given the design of the BMTN—63 teachers working in 44 different schools across all six New England states—the network could not expect to directly influence math achievement schoolwide. Therefore, the BMTN hub sought to amplify the impact of the network by sharing what it was learning in a variety of ways aimed at reaching educators beyond the 63 participating teachers.

Efforts to scale are dependent on the maturity and efficacy of a network's knowledge management and consolidation of learning functions—these are the mechanisms by which knowledge from iterative, individual tests of change are organized, curated, and validated. Thus, a network's efforts to scale can be enabled or constrained by the quality and quantity of the knowledge management and consolidation of learning functions. This also means that what will be meaningful and feasible to share from network efforts will be developmental in nature. That is, as the work of the network matures, the form and content of what is shared will also evolve.

The NIC model for improvement in education has been in use explicitly for a little more than a decade. NICs are temporary organizations, typically dependent on finite funding streams. In some cases, NICs are funded long enough to build tools and routines that enable the network's learning to be shared beyond the network. Our understanding of this process is still emergent. As an instructionally focused NIC, the BMTN provides a powerful case to explore approaches to scaling network learning. Lessons learned from this case might be instructive to other NICs as they mature.



# BMTN Professional Learning Communities (PLCs)

## First Wave PLCs (Network Year 3, 2018–2019)

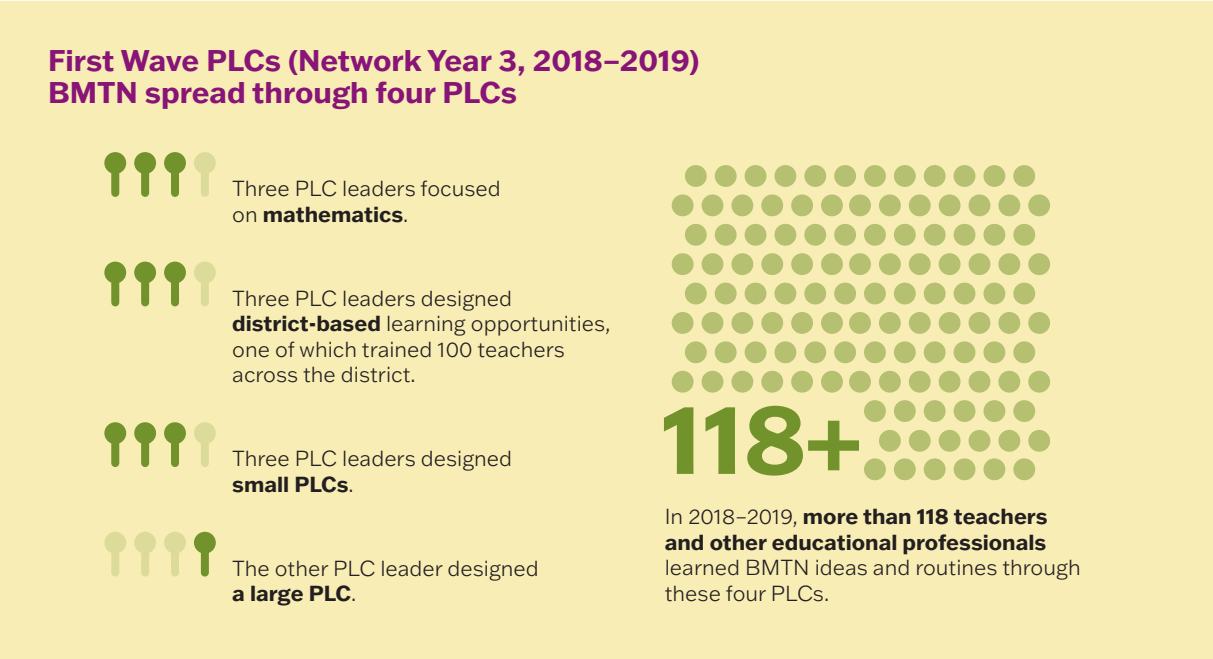
Each year, BMTN teachers tested self-identified strategies for making their classrooms more student centered. Their testing was guided by the network’s definition of Deep Engagement in Algebra (DEA): connect, justify, and solve.

BMTN teachers tried out routines that asked students to solve challenging problems, justify their answers, explain their thinking, and make connections among concepts. As the BMTN teachers became more comfortable with the student-centered math strategies, they began to share these strategies with teachers in their own schools. In the beginning, this sharing was primarily informal—they might share with one or two colleagues.

At the same time, the BMTN hub began to cultivate a series of strategies and tasks that BMTN teachers were using with success. Using learning gleaned from the network, the BMTN hub launched a PLC in another school district. The time for more formal spread had arrived, and the hub invited BMTN teachers to design and implement ways to bring the BMTN learning into their own local contexts in the form of PLCs. As BMTN teachers volunteered to pilot this idea, the hub intentionally created space for them to determine what this might look like and how it might be designed within their own schools, districts, or regions.

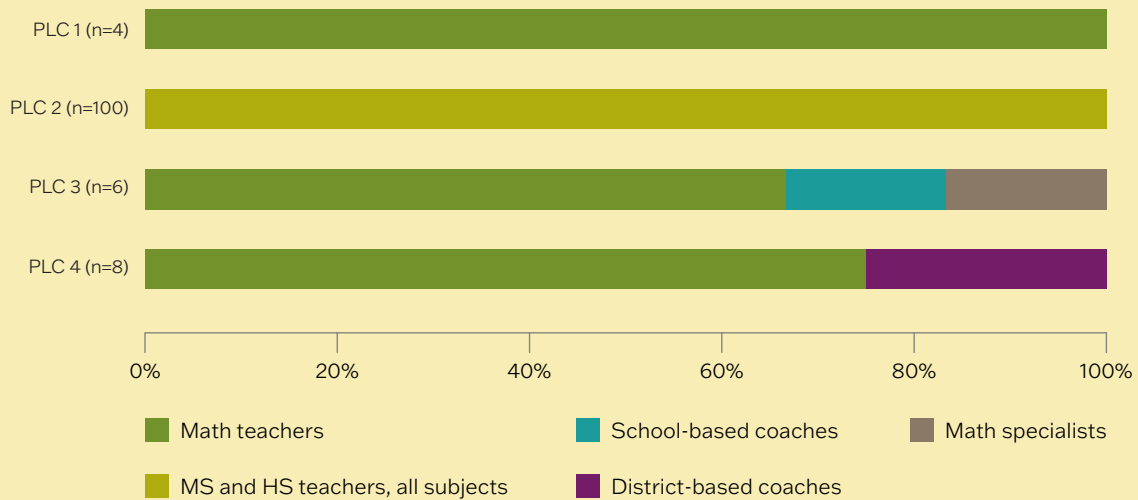
**20% of BMTN teachers reported that they led meetings to spread network ideas in Year 3.**

The first year of PLCs resulted in a portfolio of efforts that varied tremendously in terms of intensity, focus, and effectiveness. We studied four of the first wave PLCs to understand this method of scale. Here is a snapshot of what we found:

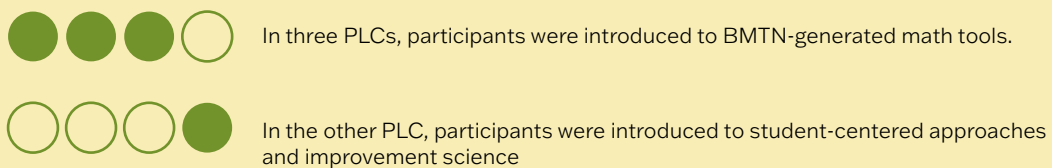


## First Wave PLCs (Network Year 3, 2018–2019) BMTN spread through four PLCs

### Who participated in the PLCs?



### What elements of BMTN show up in the PLCs?



## BMTN teachers bring ideas back to their local contexts

By Year 4, the majority of BMTN teachers were infusing their local context with ideas from the network in some way.





Most BMTN teachers—32 out of 39—reported bringing ideas from BMTN back to their local context.

**They reported the following ways that BMTN influenced local colleagues**



**28** influenced other math teachers in their schools



**13** influenced other math teachers in their districts



**13** influenced other teachers in their schools who do not teach math



**10** influenced how school leadership thinks about improvement, math teaching, and/or student-centered teaching



**3** influenced how district leadership thinks about improvement, math teaching, and/or student-centered teaching

The impact was highest in schools, districts, and states in which the BMTN teachers designed and implemented PLCs. This impact was intentionally supported by the BMTN hub. As the fourth year of the network launched, the hub provided an opportunity for interested teachers to design and implement more formal PLCs.



## Second Wave PLCs (Network Year 4, 2019–2020)

During the second wave (2019–2020), the BMTN hub focused the PLC work based on what they had learned the previous year:

- The local PLC had to engage teachers in testing rather than simply sharing a BMTN resource or routine.
- The PLC had to include multiple contact points with local teachers—a one time workshop would not be sufficient.
- BMTN teachers could opt to lead a PLC in place of testing their own change ideas.
- The BMTN hub convened PLC leaders several times throughout the year to support each other.

There are several dimensions on which these PLCs vary that factor into how the work unfolded and its potential for impact and sustainability. Some of these dimensions focused on logistical decisions about how best to integrate the work into a teacher’s local context. Other dimensions focused on design decisions about how educators collaboratively engage in the improvement work.

### Design Decisions

#### Logistical

- How is the PLC situated within a school (in the math department or school-wide) or across schools?
- What is the content focus of participating educators?
- How many educators will engage?
- Are local participants volunteers or are they mandated to participate?
- Does the focus of the PLC relate to the mathematics focus of the BMTN?
- Does the focus of the PLC align with the school's priorities?
- What BMTN content is used in the PLC work?



#### Collaborative improvement

- Origin of improvement work: Do PLC participants design their own change ideas or do they test BMTN change packages?
- Variation of improvement work: Do all participants in a PLC work on the same change idea or is there variation among what participants are testing?

In the spring of 2020, 15 BMTN teachers reported that they had run a series of meetings in their local contexts to spread BMTN ideas. These PLCs varied in size, audience, and work, as reflected below.

## Second Wave PLCs (Network Year 4, 2019–2020) BMTN spread through 15 PLCs



**Almost 75% of these teachers shared PLC leadership with a colleague.**  
The majority of these teachers collaborated in this work with a local colleague (some were fellow BMTN teachers, others were colleagues not in the network).



**87% of PLC leaders focused on mathematics.**  
The others worked with educators from multiple content areas.

### Which colleagues did the 15 BMTN teachers bring together in their PLCs?



**9 (60%)**  
Other teachers in the same department



**3 (20%)**  
Other teachers in the same district



**2 (13%)**  
Other teachers in the same school

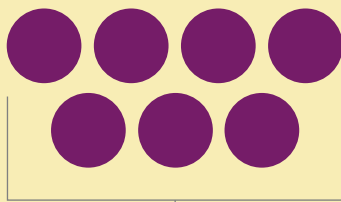


**1 (7%)**  
Other teachers in the same state

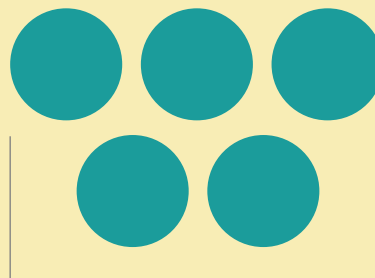
### How big were the PLCs?



**3**  
2 to 4 members



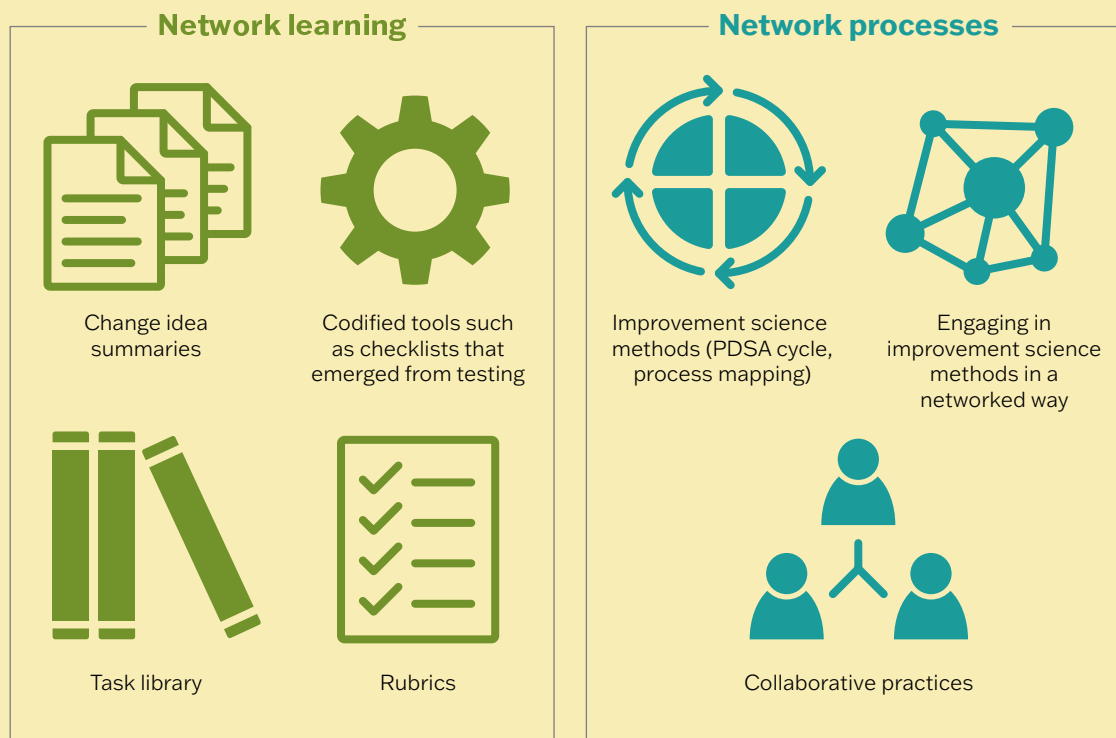
**7**  
5 to 9 members



**5**  
10 to 15 members

## Second Wave PLCs (Network Year 4, 2019–2020) BMTN spread through 15 PLCs

### Which elements from the BMTN were spread through PLCs?



In Year 4, we studied four PLCs to better understand this variation. We share details of these case studies in the following vignettes:

1. The Structured Math Talk PLC
2. The Tiered Checkpoint PLC
3. The Continuous Improvement PLC
4. The BMTN-Maine PLC

After the vignettes, we discuss what we learned from studying the four PLCs as well as the broader set of data we gathered from all 15 teachers who built PLCs in their final year in the network. Specifically, we discuss patterns of influence, design challenges, and teacher leaders' reflections on sustainability.

# The Structured Math Talk PLC

As department chair in her Vermont high school, Tara was able to leverage her school leadership position and—together with her BMTN colleague Josh—formed the **Structured Math Talk PLC**. Their goal was to get their math department to become more student-centered—specifically, to have students justify their thinking more robustly. The PLC focused their improvement efforts by implementing a Structured Math Talk routine. Students learned a consistent way of discussing their thinking in math, which allowed them to form deeper connections and justify their thinking.

**BMTN content:** BMTN teacher-tested change ideas, network-level insights

**Origin of improvement work:** Testing BMTN change packages

**Variation of improvement work:** All teachers tested a shared change idea

## Widespread use

**What:** Math department PLC

**Who:** Eight math teachers

**When:** 2/3 of department meeting time (35 minutes, biweekly)

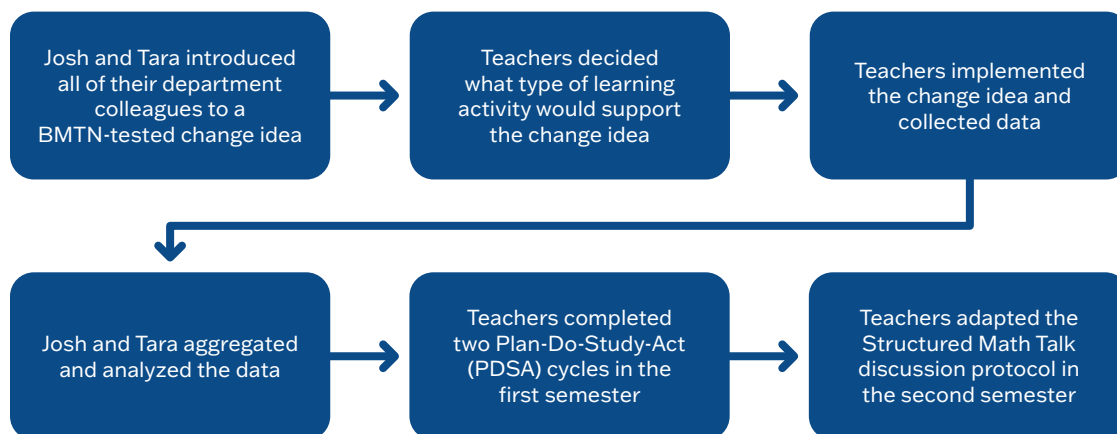
**Engagement:** Mandated

**Attendance:** Consistent

*Giving students those sentence starters was incredibly effective for helping them start their thoughts . . . they are talking about math deeply, and I think that this is not necessarily something they would be able to do before.*

*–Structured Math Talk PLC teacher*

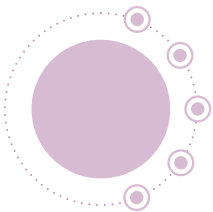
## Process



*Students were able to form deeper connections and justify their thinking. It was important for students to realize the power of being able to talk about mathematics and their problem-solving process.*

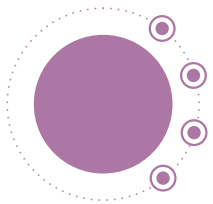
*–Structured Math Talk PLC leader*

## Depth of implementation



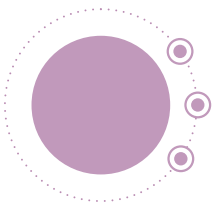
### Reported shift in teaching practice

- New instructional strategies
- Increased opportunity for student dialogue
- Use of improvement science to effect change in teaching
- New insights on classroom environment via purposeful inquiry
- Collaboration with colleagues to effect change



### Reported influence on students

- Greater conceptual understanding
- Enhanced engagement
- Growing capacity to justify thinking
- Improved problem-solving abilities



### Influence on local context

- Using departmental planning time focused on math instruction provided a chance for the entire faculty to develop a shared vision
- Faculty had time to discuss the meaning of student-centered learning
- Faculty valued time to collaborate

## Shift in reform ownership

Ownership of the reform was taken over by the Structured Math Talk PLC leaders as they embedded it into the practice of their high school math department. PLC teachers intentionally shifted their classroom practice to include more mathematical discourse. Josh continues to support the math department and mentor new teachers to implement Structured Math Talks. In her new role as district-level math coach, Tara plans to spread Structured Math Talks throughout the district.

## Sustainability

This PLC sustained throughout the pandemic, but with some inconsistency due to the nature of remote/hybrid learning. Post-pandemic, there is promise for the continuation of this work.

*It created a baseline for our department that discourse in the math classroom is important and improves student performance. . . . We wanted Structured Math Talks to be a common student experience in all our classes so there could be continuity as they move through our classes from year to year. . . . I think part of our idea with the PLC focus on discourse was that some of us were doing it, and it was really benefiting students. We wanted that to spread, so all classes had an emphasis on discussion and discovery-based mathematics.*

*–Structured Math Talk PLC leader*

The Structured Math Talk PLC involved a whole math department as they engaged in BMTN-tested routines. As a result, hundreds of high school students were influenced by this PLC.

# The Tiered Checkpoint PLC

Donna and Ben co-led the Tiered Checkpoint PLC at their high school, leveraging the Tiered Checkpoint Routine that Ben had tested and refined in the BMTN as well as Donna's role as math lead teacher. Their goal was to increase student collaboration and opportunities for students to justify their thinking. The PLC focused their improvement efforts by implementing checkpoints, a way to review for an upcoming assessment. Students worked on these checkpoints in a structured, timed system that included individual, partner, small group, and whole class components. This way of implementing review is much different than the traditional method of giving students individual time followed by a teacher-directed overview.

**BMTN content:** BMTN teacher-tested change ideas, network-level insights

**Origin of improvement work:** Testing BMTN change packages

**Variation of improvement work:** All teachers tested a shared change idea

## Widespread use

**What:** Math department (subset) PLC

**Who:** 14 (of 32) math teachers

**When:** Embedded into regularly scheduled monthly flex PLC meetings

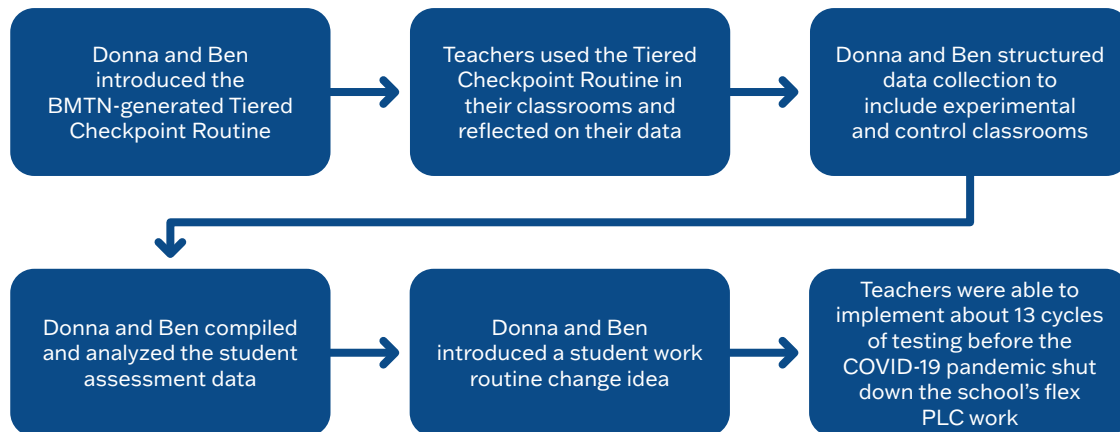
**Engagement:** Voluntary, within mandated structure

**Attendance:** Consistent

*I would say that many people in our department have taken a liking to the Tiered Checkpoints and the presentation of student work routines to the point where they would rather adopt them or will keep trying them next year even if there's not a formal PLC.*

*-Tiered Checkpoint PLC leader*

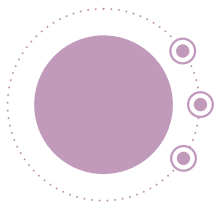
## Process



*I think it was wildly successful and is something that is going to stick. The teachers saw it, felt it, and believed it. There is a big push to have more discourse in the classroom. It's something that our department is getting better at every day. We're working hard to be better at [student engagement], so I think this would be a real carrot on the stick to get some more teachers to engage in it. I think it's a movement.*

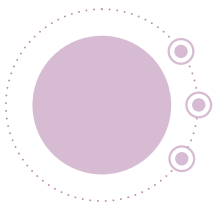
*-Tiered Checkpoint PLC leader*

## Depth of implementation



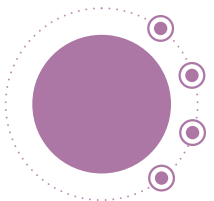
### Reported shift in teaching practice

- Increased opportunity for student dialogue
- Modifications to classroom practices
- Movement toward more student-centered practice



### Reported influence on students

- Increased ownership and responsibility for learning
- Greater degree of collaboration and interaction among peers
- Observed improvements in common assessment scores for classrooms utilizing the Tiered Checkpoint



### Influence on local context

- Affected department culture and learning practices
- Influenced math department coherence in practices and shared understanding
- Shaped how teachers evaluated new practices overall
- Refocused teacher efforts on systematically collected data rather than drawing exclusively on informal observations

## Shift in reform ownership

Tiered Checkpoint PLC leaders took ownership over the reform, embedding it as a professional learning opportunity for a subset of their math department colleagues. As a result, PLC teachers changed their practice. The shift to include more student collaboration and mathematical discourse improved student test scores in those classrooms.

## Sustainability

Unfortunately, the flex PLCs were suspended as a result of the pandemic.

*I'm not even sure if [the students] were aware of the skills they were developing, but they did become a little bit more independent, a little bit more willing to talk to each other. I think a lot of it at first is, if they don't know how to answer a question, they know they don't know this, and they're scared to let other people know that they don't know something. I think getting over that was a big part of it—so they could realize that oftentimes, everyone else has the same questions that they do.*

*—Tiered Checkpoint PLC teacher*

In the Tiered Checkpoint PLC, close to half the math department used a BMTN tested routine that improved student engagement in mathematics and, therefore, increased the number of students deeply engaged in mathematics. Hundreds of students were influenced by this PLC.



# The Continuous Improvement PLC

Michelle's involvement in the network shifted her teaching in that she became much more student centered. She wanted colleagues in her Vermont high school to have the same opportunity she had: to use PDSA cycles as a way of making their classrooms more student centered. The goal of the Continuous Improvement PLC was to increase student engagement across all content areas in her school. She collaborated with the school improvement coordinator to build the PLC. Each teacher in her PLC tested their own change idea. They focused their improvement work on implementing mindfulness, partner work, homework routines, questioning techniques, and metacognition.

**BMTN content:** Improvement science processes

**Origin of improvement work:** Each teacher in the PLC crafted a unique change idea

**Variation of improvement work:** Each teacher tested an individual change idea

## Widespread use

**What:** Cross-subject PLC

**Who:** Eight high school teachers  
(math, English language arts, art, music)

**When:** Three 2-hour after-school meetings

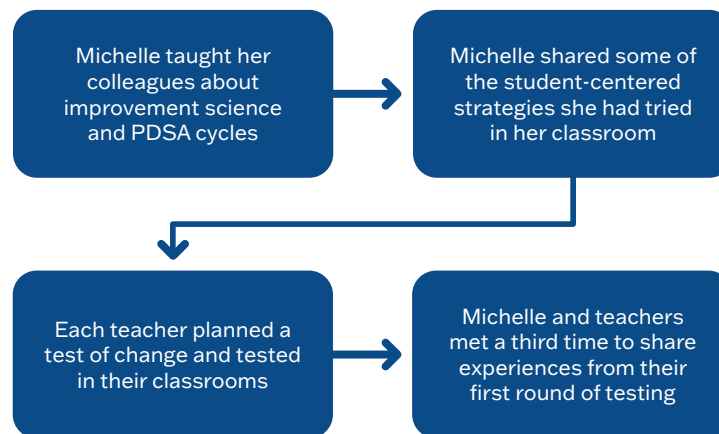
**Engagement:** Voluntary

**Attendance:** Inconsistent

*Because I implemented this practice, I saw a significant difference in test scores on each unit from the same material taught the previous year. The students took the same assessment, and their scores were between 5 and 15 points higher overall.*

*-Continuous Improvement PLC leader*

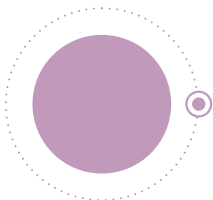
## Process



*Students are seeing that I am continuing to learn and adapt, and that is giving them confidence to try things in class and explore more, too.*

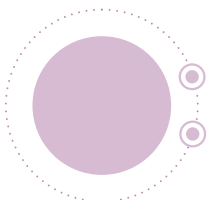
*-Continuous Improvement PLC leader*

## Depth of implementation



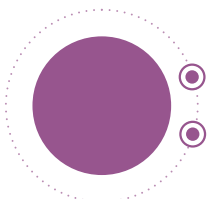
### Reported shift in teaching practice

- Movement toward more student-centered practice



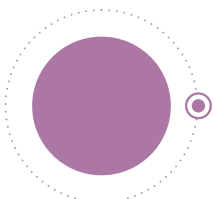
### Reported influence on teachers

- New knowledge and tools for using measurement and data in practice
- Heightened appreciation for collaboration with peers



### Reported influence on students

- Increased ownership and responsibility for learning
- Greater degree of collaboration and interaction among peers



### Influence on local context

- This PLC gave teachers a taste of continuous improvement and how to think about increasing student engagement

## Shift in reform ownership

The Continuous Improvement PLC leader was committed to sharing her learning with her school-based colleagues. She had support from her principal and partnered in the PLC work with the school improvement coordinator. The PLC was not able to take hold, due to a combination of inconsistent participation and the pandemic disruption. There is some evidence that a few teachers are thinking differently about their practice as a result of their engagement in this PLC.

## Sustainability

Unfortunately, the teachers stopped meeting due to the pandemic. Post-pandemic, there is promise for the continuation of this work as the PLC teachers still express interest.

*I think it's an opportunity that we don't get in our school very often, to talk to each other that way or to have the opportunity to run the meetings ourselves. You know, a lot of times we talk, but it's about a very specific content that they [the administration] have given us.*

*–Continuous Improvement PLC teacher*

Because the aim of BMTN is math-related, this PLC did not directly advance the full BMTN aim. It did, however, advance the student-centered aspect of the aim by helping non-math teachers become more student centered in their practice.

# The BMTN-Maine PLC

Pam collaborated with an assistant professor of educational leadership at the University of Southern Maine who was co-director of the Southern Maine Partnership and interested in improvement science. Their partnership leveraged their collective expertise in math and improvement science as well as their local networks including math teachers, curriculum coordinators, and coaches. The goal of the PLC was to introduce math professionals across southern Maine to the ideas of improvement science and help them increase student engagement in mathematics by strengthening students' justifications. To focus the PLC's improvement work, Pam modified another BMTN teacher's justification routine that included using sentence starters and peer feedback.

**BMTN content:** Improvement science processes, BMTN teacher-tested change idea

**Origin of improvement work:** Testing BMTN change packages

**Variation of improvement work:** All teachers tested a shared change idea

## Widespread use

**What:** Regional math PLC

**Who:** 13 middle or high school math teachers, coaches, and curriculum coordinators

**When:** Three, 3-hour "dine and discuss" meetings outside of school hours

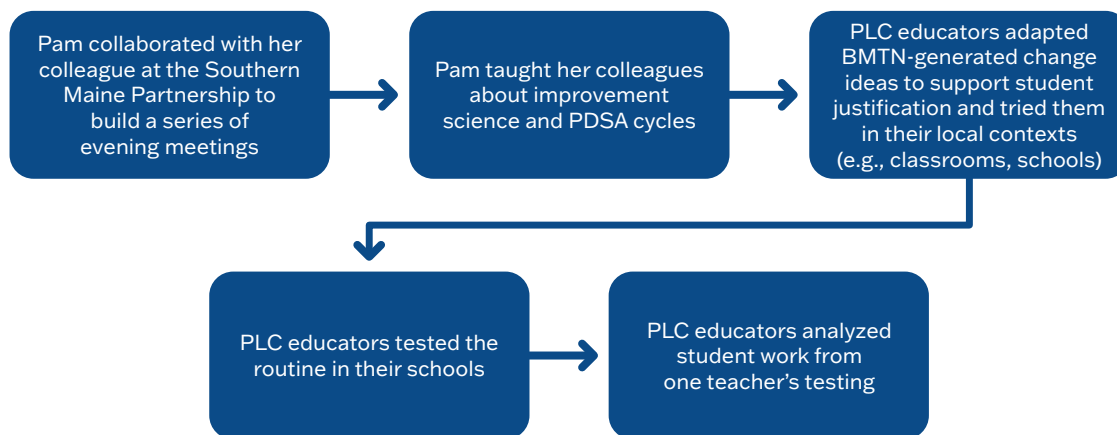
**Engagement:** Voluntary

**Attendance:** Inconsistent

*The way I look at the lesson, my role and the student's role in learning mathematics has changed. There is more emphasis on students making their own connections.*

*-BMTN-Maine PLC leader*

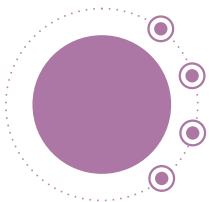
## Process



*If we have this lens, this focus, this way that we could collect our own data, instead of having data being imposed on us . . . how about if I'm able to show you that my students are engaging in things that are at a much deeper level than any NWEA would ever show you? Maybe we could make a case that teachers are reliable sources of data.*

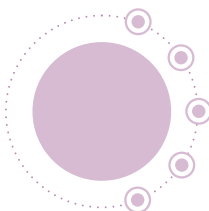
*-BMTN-Maine PLC leader*

## Depth of implementation



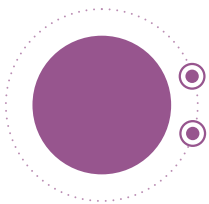
### Reported shift in teaching practice

- Modifications to classroom practices
- Movement toward more student-centered practice
- Utilization of improvement science to effect change
- Dissemination to colleagues beyond PLC



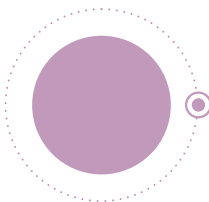
### Reported influence on teachers

- New knowledge and tools for using measurement and data in practice
- Heightened appreciation for collaboration with peers
- Enhanced observations of classroom environments
- New insights on instructional practices
- Acquisition of new instructional strategies



### Reported influence on students

- Growing capacity to justify thinking
- Greater enjoyment in class



### Influence on local context

- This PLC gave participants a taste of continuous improvement and how to think about increasing student engagement in mathematics through justification

## Shift in reform ownership

Pam was committed to sharing her learning and building a collaborative community of math educators. The PLC was not able to take hold, due to a combination of inconsistent participation and the pandemic disruption. There is evidence that a few participants are thinking differently about their practice as a result of their engagement in this PLC. During the pandemic, Pam switched her focus to her own school and built a small network of teacher colleagues with whom to spread the BMTN work.

## Sustainability

This PLC stopped meeting when the pandemic hit. In fall 2021, Pam reflected on the difficulty of doing this kind of work virtually; she sees the potential for the PLC to continue when other forms of adult learning return to an in-person format.

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The focus of the work in the BMTN-Maine PLC was to support student justification in mathematics. This design has the potential for large and sustained impact on the BMTN aim if the implementation is made consistent.

# The BMTN-Maine PLC

## “Justifying Your Thinking” Routine

1. Start with a task that is broad but not time consuming.
2. Provide a sentence starter for a conjecture.
3. Give students two minutes to begin working the problem. It is not expected that they finish the problem in this amount of time. Use a timer that will make a sound when the time is up.
4. After two minutes, run a Structured Math Talk (SMT) protocol. Use a timer that will make a sound when the time is up. This is not a time to respond or have a discussion. Instead, it is a time to share ideas, thoughts, or stuck points.
  - Be sure that each student has a partner. If there is an odd number of students, the teacher can be a partner.
  - Partner 1 speaks for 30 seconds, explaining their beginning thoughts about the problem, how they plan to solve, the reasoning, or what they are stuck on or confused by in the problem.
  - Partner 2 then speaks for 30 seconds, explaining their beginning thoughts about the problem, how they plan to solve, the reasoning, or what they are stuck on or confused by in the problem.
  - (Optional) Give partners one minute to discuss what they just heard each other say, or their conjectures about the problem.
5. Give students another eight minutes of Private Reasoning Time (PRT) to complete the task: write a conjecture, test the conjecture, and write a justification based on testing.
6. Give six minutes for trading papers with a partner and having them give feedback: something they understand, what they might be confused about, and questions they might have.
7. Return papers to their owners and allow up to 10 minutes for students to add on to or adjust their justification based on the feedback.



*One of the biggest changes over the course of my career was getting more curious about student work and thinking. That has come from lots of different experiences that I've had. This was a chance to kind of dig in. . . . I'm pretty selective about what I go to for professional learning now because I figure if I get one new thing, that's great. But this seems like it's going to give me more.*

*-BMTN-Maine PLC teacher*

# PLC Leaders: Motivation and Benefits

## What motivated BMTN teachers to lead a PLC?

Our four case teachers who led PLCs in 2019–2020 reported three primary motivations for leading a PLC:

**1. To stimulate one’s own professional growth through supporting others’ learning**

These experienced teachers noted the value for their own growth by supporting the learning of other teachers, noting that such leadership experiences are both personally and professionally enriching. For teachers with little leadership experience, the PLC provided opportunities for new roles as leaders for colleagues’ learning.

*On a more personal basis, one of the things that I see myself doing in the future is that I want to help teach teachers. I’d like to try and help teachers be more student centered—look for better techniques and practices and get them more comfortable in the classroom.*

*– BMTN PLC leader*

**2. To effect change in one’s own school, department, or region**

Several PLC leaders reported a desire to bring the positive impacts of the BMTN on their practice to teachers in their context. Three of the PLCs were specifically driven by the goal of creating cultural change within a school or region.

**3. To carry on and spread the spirit and content of the BMTN**

Each of the PLC leaders mentioned a commitment and sense of duty to carry on the legacy of the BMTN because of the powerful impact it has had on them personally and professionally.

*I think it’s selfish because I don’t want to, suddenly, not have that kind of network anymore. I’m pretty scared about it. I don’t want to go back to not being accountable for trying new things and [not] forcing myself to think differently and focus on my math teaching. . . . I could still do that, even on a small scale.*

*– BMTN PLC leader*

Each of these motivations is predicated on the teachers’ perceived value of the BMTN both personally and professionally. These teacher leaders believed that there was valuable content as well as processes from the network that merited spreading to others. What’s more, they felt competent and/or supported enough to serve as the vehicle for that sharing.



## In what ways did PLC leaders grow and learn?

Leading a PLC was a learning and development opportunity for the BMTN teacher leaders. For some, it was one of many professional growth experiences. For others, it was their first experience in a leadership role. In two of the case study PLCs, less experienced teachers partnered with more veteran colleagues to co-design and co-lead the work.

Based on their BMTN PLC experiences, the PLC leaders reported growth in important ways, including:

- Understanding people's risk-tolerance levels
- Building buy-in / working with less-willing colleagues
- Being patient with the process
- Coaching colleagues to use improvement science tools

*Another thing is how effective a small change can be in a classroom, especially with those that are a little hesitant. All of the teachers are coming back and letting me know that they're able to consistently implement this change idea and they have seen pretty positive results overall. To hear them all say that they want to do the Tiered Checkpoint in all of their classes is just wonderful. It's nice to see that you can take these ideas, use the research, use the improvement science, and really change the way the teachers teach.*

*– BMTN PLC leader*

# PLC Participants: Motivation and Benefits

## What motivated local teacher participation in the PLC?

The Structured Math Talk PLC was the only PLC of the four case studies that required department-wide participation. It was embedded in an existing model of professional development within the school's math department. Despite the mandated nature of this PLC, Structured Math Talk PLC teachers shared similar motivations for engaging in the PLC as did the teachers in the other three PLCs.

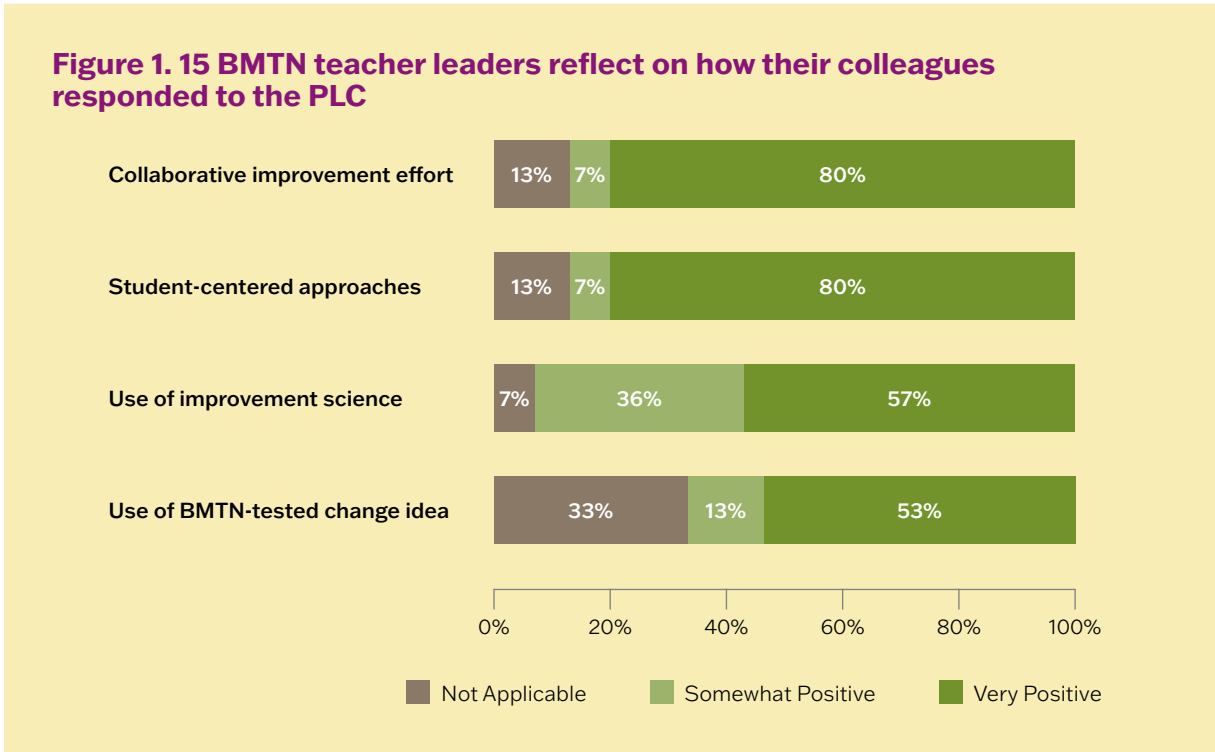
- **Leaders' expertise spurred teachers to engage.** Teachers joining PLCs held high esteem for and trust in their colleagues who led the BMTN spread efforts. Some teachers described these leaders as important role models in their own professional trajectories, and many had prior collaborative relationships with these leaders.
- **BMTN findings and lessons learned intrigued other teachers to engage in similar work.** Participants appreciated the opportunity to engage with instructional routines that were evidence-based and teacher-tested. Some teachers expressed interest in testing innovative ideas that their colleagues had experimented with in their classrooms.
- **Disciplinary focus was a compelling draw.** Student-centered instruction and engaging in improvement science were motivating influences on PLC participation. With improvement science's emphasis on incremental change, some teachers welcomed the opportunity to select a singular focus to study and refine. Other teachers appreciated the attention paid to mathematics instruction and student engagement. School-based professional development is often content-neutral; high school math teachers appreciated the disciplinary focus of the PLC.
- **Alignment with existing content, instructional priorities, and structural professional development models made the work of the PLC accessible.** Some teachers pointed to the value of their PLC work as aligned to existing content priorities within their school/district. Adaptability and fit of this effort to the school's current structure of professional development was also a motivation for engagement among some PLC teachers.





# What benefits did participating teachers report?

In addition to our six case study teachers, nine other BMTN teachers led PLC work in their own schools and districts in 2019–2020. Most of the 15 BMTN teachers who led PLCs identified collaboration as a widely noted benefit, as shown in **Figure 1**.



As one member of the BMTN-Maine PLC noted:

*I was interested in professional learning communities since we didn't really have PLCs this year at our school. I wanted to be able to do some of that work that we weren't getting at school.*

BMTN teachers also reflected that most of their colleagues appreciated the student-centered focus of the PLC work (**Figure 1**). Members of the Tiered Checkpoint PLC expanded on this idea:

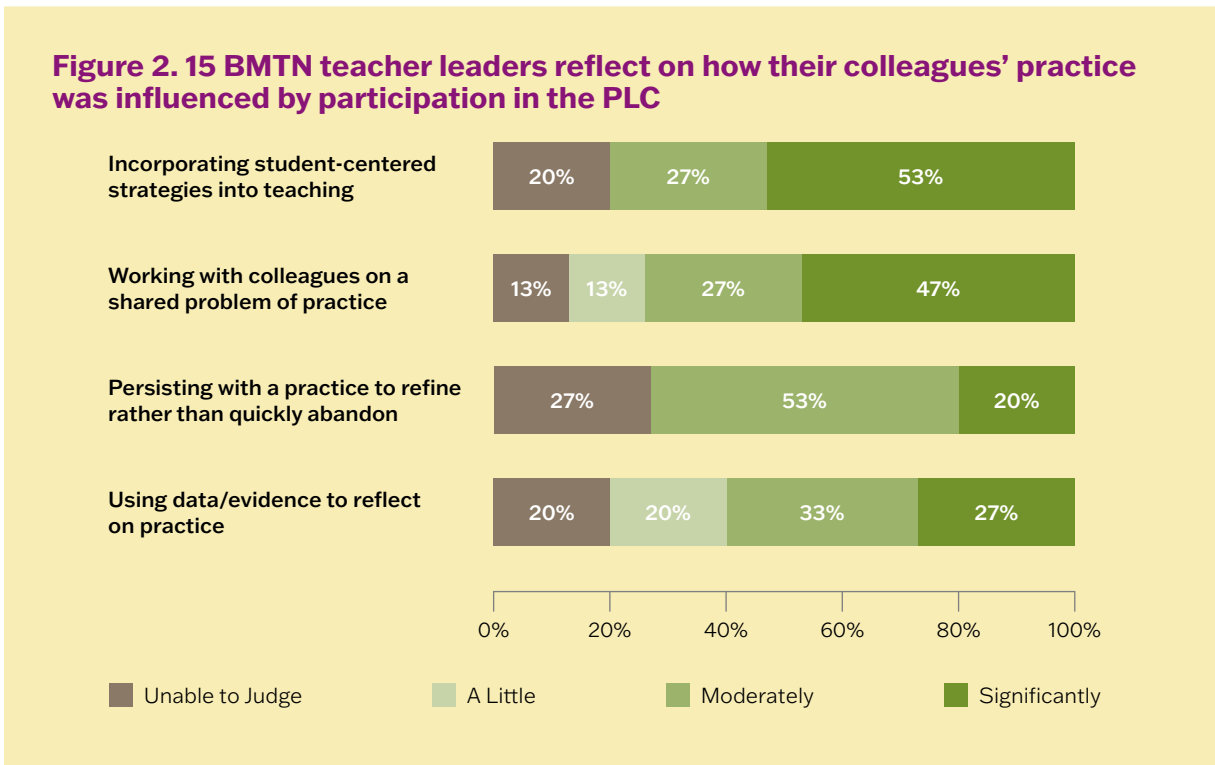
*I am quick to intervene. Now I want to let the kids figure it out with each other before I jump in. I'm running around the classroom less, and they ask less questions of me—they go to a peer first.*

*Curbing my enthusiasm in the classroom was huge—it was a hurdle that I had to break . . . to take a step back, be more patient, and allow the kids to struggle more—basically sit back and listen to them make mistakes and not intervene at all until the very end. It was kind of counterintuitive to me. But in the long run, it became much more natural.*

# Influence of the PLC

## In what ways was teachers' practice influenced?

Change to classroom practice is how teacher learning is actualized to impact student learning. PLC leaders were able to see how their local colleagues changed their practice. As shown in **Figure 2**, surveys of the 15 BMTN teachers who led a PLC in 2019–2020 suggest that the PLC approach was effective in the following ways:



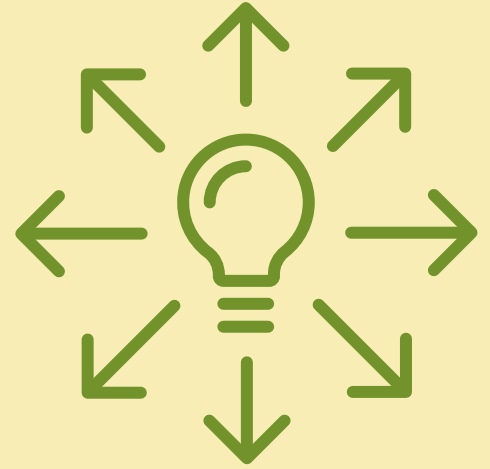
One of the Tiered Checkpoint PLC leaders shared the story of a somewhat resistant teacher who was convinced by the testing to fully adopt a new instructional strategy:

*When looking at [a teacher's] results, I noticed that if she did it true to the Tiered Checkpoint, her students' scores were actually higher than her other changed/hybrid method. I think, now, she's fully embraced the Tiered Checkpoint. The process and looking at the data convinced her that there is a better way; being true to the process has changed her teaching methods and opened her brain up a little bit more to [this idea that] maybe I should collect data first and make decisions second.*

Teachers participating in the case study PLCs indicated, through interviews and survey responses, the ways in which they thought the PLC experience had shaped their classroom practice, as reflected below.

### Ways the PLC experience shaped teachers' classroom practice

- Acquisition and implementation of new instructional strategies
- Adjustments and modifications to current classroom practices
- Movement toward student-centered instruction within the classroom
- Utilization of improvement science to effect change in practice
- Gaining new insights on classroom environment via purposeful inquiry
- Dissemination to teachers beyond the PLC
- Utilization of collaboration to effectively spread improvements



## How was student learning influenced?

The aim of the BMTN, and the purpose of the PLCs, was to increase student-centered teaching, and thus improve student engagement in mathematics. While we did not directly assess student impact as part of the developmental evaluation, we did gather data on PLC leader and PLC teacher participant perceptions (in the four case studies) of how students' experiences and learning may have been influenced by the PLC work.

In interviews, PLC participants reported that students were shouldering more responsibility for their learning, demonstrating a greater willingness to share with their peers what they did not know or understand, and cultivating their own "voice" in the classroom. Teachers offered evidence of greater conceptual thinking, collaboration, and problem-solving skills among their students. Some of these reports about influence on students represent dramatic shifts because students in high school math classrooms are often accustomed to working alone.

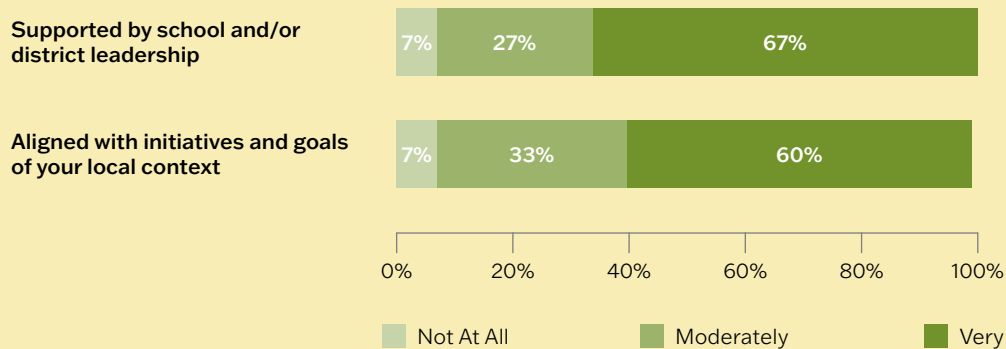
As they reflected on their work with their colleagues, PLC leaders shared observations about how the tested routines were influencing student experiences and learning. One leader from the Structured Math Talk PLC said:

*I think that the fact that they [PLC teachers] noticed that they were able to take away the structure once kids got comfortable is an indicator of student engagement. I also heard "kids start to turn to each other to ask for help before they turn to me" type of thing. So, my students are getting used to the fact that we talk about math in here and they're then applying it in different settings when I'm not asking them to do a structured math talk activity. I think that's another example that there was student engagement.*

# Alignment with Local Context Matters

PLCs are dependent not only on the supports and resources provided by the NIC itself but also the conditions and supports of the local context. Nearly 2/3 of the BMTN teachers who led PLCs reported that their PLC work was very aligned with the goals of their school/district and supported by their local leadership, as reflected in **Figure 3**. Overall, this positive report on support and alignment indicates that the PLC model was a good vehicle for spread.

**Figure 3. 15 BMTN teacher leaders reflect on how supported and aligned their PLC was to their school or district**





# Key Conditions that Enabled the BMTN PLCs to Flourish<sup>3</sup>

## Well respected teacher leaders

- **BMTN teacher leaders who are well respected by their colleagues.** When teachers have strong, positive relationships with their PLC leader, they are more willing to engage with the content. Trusted colleagues are also well positioned to support teachers who may be hesitant or resistant to change.

## Collaborative partnerships

- **Schools in which there were two BMTN teachers to co-lead the PLC.** Designing and implementing learning experiences for colleagues takes time and is aided by purposeful partnership.

## Alignment with local systems

- **Schools and districts that value and prioritize BMTN's focus on student-centered practices** (especially in mathematics) and disciplined improvement processes.
- **PLCs that integrate the work into existing routines** (e.g., math department meetings). Integration into existing structures enhances and cultivates greater consistency and sustainability.
- **Schools or districts with existing professional learning community structures, routines, and norms** that are tethered to teacher evaluation and accountability. When the local context is already comfortable with collaborative learning models, infusion of the PLC model is simple; when tethered to existing teacher expectations, it boosts participation and engagement.
- **Schools or districts that can offer “credit” for participating in PLCs** toward pay scale steps or other concrete connections to their evaluation or compensation models.

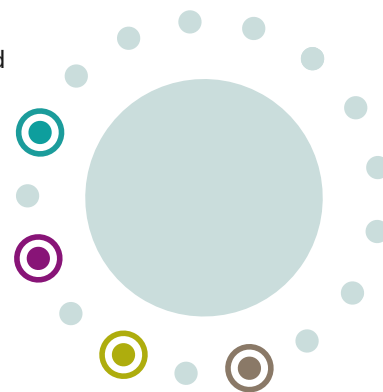
## Support from local leadership who can provide resources

- **BMTN teachers with leadership capacity in school.** BMTN teachers who are in school leadership roles (e.g., department chair) have more access to faculty time, can engage entire faculties, and can establish departmental goals that correspond to their PLC's goal.
- **Provision of an ally in a school or district leadership role for the PLC work.** In the absence of a formal leadership role, BMTN teachers who can partner with a school or a district leader (such as principal, improvement coordinator, math coach) to gain access to school/district resources, buy-in, and other support can be key to building a successful PLC. The support and momentum that is achieved when the PLC leader has an invested partner in the work can make a marked difference.
- **Availability of modest local resources** for materials, food, and in some cases, leaders' time.

<sup>3</sup> These conditions reflect what we learned from our 2019–2020 case studies.

# PLCs as a Strategy for Scale

The evidence from the second wave of PLCs (2019–2020) provides encouragement that this PLC strategy could be used to scale a NIC. As mentioned in the last section, three of the four PLCs directly contributed (or were positioned to contribute) to the BMTN aim before the COVID-19 disruption. In addition, the fourth PLC had the potential to increase the degree of engagement among high school students across content areas, as those teachers tested new routines using improvement science methodology. Although not advancing the math aim, that PLC did focus on increasing student engagement in New England high schools across content areas.



Using Coburn’s four dimensions of scale, we reflect on ways in which the PLC strategy shows promise.

## Widespread use

The opportunities for spread increase when a NIC has reached a stage of maturity to be able to support PLC leaders with improvement science tools, tested routines, and/or measures to forward the NIC’s aim. As the BMTN matured, more teachers spread the network’s learning and that spread became more formalized. In the early years, it started as informal sharing; by Year 4, 15 BMTN teachers reported implementing PLCs in their local contexts. In this way, the PLC strategy expanded the number of teachers, classrooms, and students using tested practices that supported movement toward the NIC aim.

## Depth of implementation

Having many more teachers and students exposed to ideas from the BMTN is one aspect of scale, but does not guarantee depth of use or quality of implementation. As we saw BMTN teachers shift from informally sharing ideas with their colleagues to building PLCs in their schools and districts, the opportunity for deep change emerged—altering “teachers’ underlying assumptions about how students learn, the nature of subject matter, expectations for students” (Coburn, 2003). Our case studies showed that when the work was aligned with school and district priorities, and teacher engagement was consistent, teachers began to think differently about how students learn math and also began to engage students differently in their classrooms. A Structured Math Talk PLC teacher reflected on the shift in her students’ understanding as a result of the changes she was making:

*Allowing students the time and structure to engage in meaningful conversations about mathematics definitely had a positive impact on student learning. I think that the Structured Math Talks helped to deepen student understanding of the math concepts that I was teaching.*

## Shift in reform ownership

The 15 BMTN teachers who led PLCs engaged in the challenging work of building a PLC—a clear case of owning the work involved in scaling the network’s learning. After the formal network support and funding ended, 45 BMTN teachers responded to this survey question: How likely are you to take the lead on ensuring this work continues and/or grows in your school? More than half (25 teachers) said they were likely to take the lead, and six of these were “very likely.” This suggests that as the formal work of the network was ending, many of the BMTN teachers had taken ownership for scaling the learning.

## Sustainability

NICs in education require resources to establish, operate, and sustain. One persistent challenge across all major educational change efforts is how to sustain effective initiatives when funding expires. Sustainability of the work in PLCs is mediated by a range of factors including:

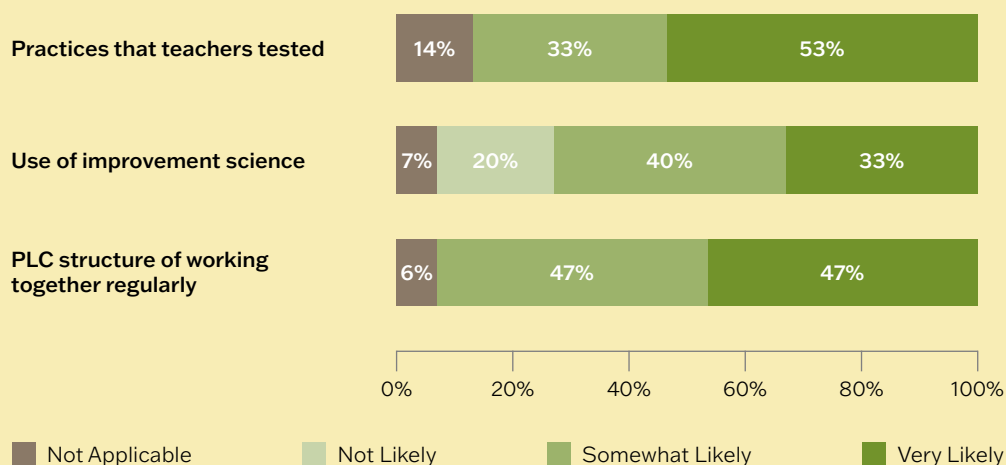
- Satisfaction/engagement of PLC leaders and local teachers
- Alignment of the PLC with local context priorities and resource allocations
- Perceived efficacy of the PLC's efforts
- A range of individual, organizational, and broader socio-political conditions

There are different ways to conceptualize sustainability in the case of a NIC:

- Sustainability of the NIC practices and relationships
- Sustainability of the classroom practices tested within the NIC
- Sustaining the tested routines/learning through other structures (PLCs)
- Sustainability of the PLC structure itself within the local contexts
- Sustainability of the BMTN vision through aligned satellite PLCs

Most BMTN PLC leaders were optimistic that the practices that teachers tested in their PLCs, and the use of the PLC structure itself, would be sustained going forward. There was slightly lower agreement that the use of the improvement science methodology would be sustained in their local contexts. These are reflected in **Figure 4**.

**Figure 4. 15 BMTN teacher leaders reflect on which aspects of their PLC will be sustained**



The COVID-19 disruption prevented the PLCs from continuing as intended and limited the data that we were able to obtain at the end of the school year. It remains to be seen whether the PLC efforts can be resumed once schools and educators are able to move out of COVID-19 adaptation mode.

# Design Principles for Productive PLCs

## Affordances and constraints of variations

Among the small set of eight PLCs we studied over two years, the variation in design choices for PLCs allowed us to learn about the affordances and constraints of each. We note four dimensions of PLC design that appeared to mediate effects on the PLC culture, coherence, and impact.

### 1. Focus of the work: Within math department, school-wide, or cross-school

The five PLCs that were located within math departments appeared to have more robust implementation and engagement. In these cases, all the BMTN foci and resources were relevant and usable for all participants, reducing the burden on the PLC leader. Department-focused efforts also used existing structures (department meetings, joint planning time) to create opportunity to engage in the PLC work, reducing the demand for new routines or additional out-of-school time.

### 2. Participant engagement: Mandated or voluntary

Across the eight PLCs studied, half had voluntary participation and half mandated participation. In the mandated participation contexts, the structures for participation were fully aligned with and/or embedded within existing school/district professional development. Teachers whose participation was mandated noted lower value than participants who voluntarily participated in a PLC.

### 3. Improvement cycle focus origination: Designing one's own change idea vs. testing BMTN change packages

In the first round of PLCs, some leaders chose to have participants generate their own change ideas because they thought it would give participating teachers a stronger sense of ownership. In retrospect, these leaders noted this was challenging. Given the relatively “low touch” nature of the PLCs in comparison to the BMTN itself, these leaders concluded that it is more effective to have PLC members use BMTN-generated change packages.

### 4. Improvement cycle focus variation: Single shared change idea or variation among participants

PLC leaders also had to choose whether to have all participants use the same change idea or to offer several options at the same time. In interviews, PLC leaders reflected that having multiple change ideas creates a heavier load for support and decreased the cohesiveness of the PLC. Offering a single change that is tested by all participants streamlines the support that is needed and helps leverage the collaborative opportunities.





## Design principles and considerations

We seek to distill lessons about design principles and tensions in using the PLC model for scaling and sustaining NIC work, grounded in our observations of the BMTN's efforts. These design principles may not be applicable to NICs that are not instructionally focused and/or do not engage individuals from different local contexts. However, informal leaders from a NIC spreading what they are learning with their local colleagues is a valuable scaling strategy that can inform other network leaders' spread efforts.

We offer the following potential design principles and considerations:

- 1. Articulate how the proposed PLC will advance the NIC aim,** especially in relation to whether participants' focus will be on trying out tested routines from the NIC or on learning improvement science methods.
- 2. Establish a clear connection between the PLC goal and the school/department's priorities.** This can provide a sense of purpose, increase the likelihood of school/district leadership buy-in, and contribute momentum for the PLC work.
- 3. Use co-leadership models to the greatest extent possible.** Leaders need support and thought partnership to create robust and sustained experiences.
- 4. Look for opportunities to embed the PLC within existing school/department structures.** PLCs that are able to use existing meeting structures appear to have better teacher engagement and more momentum for the work, at least initially. For PLCs that are not embedded in the school day, other incentives may be necessary.
- 5. Employ a PLC design that includes regular meetings balanced with applied work in teachers' classrooms.** This builds relationships, allows for time to learn the improvement science process, and gives reluctant teachers time to open up to change.
- 6. Support PLC leaders to assess and respond to teacher readiness for change** and adapt their coaching to teacher needs and readiness.
- 7. Provide participating PLC teachers "controlled choice"** to both nurture ownership and relevance and to keep learning demands manageable.
- 8. Take into account the scope and rollout of the PLC in relation to the demands** on participating teachers, so that it is not overwhelming or tedious.
- 9. Build in accountability to maintain momentum.** Improvement work requires consistent iteration. Leaders must be intentional about the actions that are critical to advance the work and then support teachers in engaging in those tasks.
- 10. Keep improvement at the forefront.** Using small tests of change, maintaining a learning stance, and staying open to trying new things (and celebrating how to learn from failure) keeps teachers motivated and willing to take risks.

# Conclusion

Involvement in the BMTN has changed teacher practice for all 63 teachers directly involved in the network. Beyond the network participants, many of the routines, tools, and practices will be used in their local contexts in a variety of ways. The BMTN hub's formalized effort to support BMTN teachers in spreading the learning of the network into local contexts (through PLCs) yielded effects on the instructional practices of local teachers in schools, districts, and states throughout New England as well as insight into how NICs might organize for scale. As we begin to better understand how and what effectively spreads from NICs, we will learn more about how instructionally focused NICs can not only serve as an effective professional learning space during the years of network activity, but how the learning can continue when the funding runs out. The PLC model appears to be an effective strategy for scale, but there is more to learn once the formal support and operation of the network ends.

# References

Bryk A., Gomez L., Grunow A., & LeMahieu P. (2015). *Learning to improve: How America’s schools can get better at getting better*. Cambridge, MA: Harvard Education Publishing.

Coburn, C. E. (2003). Reconceptualizing scale: Moving beyond numbers to deep and lasting change. *Educational Researcher* 32(6), pp 3–12.

# Appendix: Data Collection

Data sources	Explanation	Data collected
Interviews: PLC leaders	Interviews with BMTN teachers who led PLCs conducted at multiple time points	Year 3: N=4 Year 4: N=6
Network health survey PLC leaders	Surveys of all BMTN teachers to measure key features of the NIC concept, formal and informal connections to one another, and efforts to scale the BMTN work	Year 3: January 2019, June 2019 Year 4: February 2020, May 2020
PLC artifacts	Documentation provided by leaders sharing the work in their local schools/districts (e.g., slides used in presentations, templates for documenting tests of change, etc.).	Year 3: Collected from 4 teachers Year 4: Collected from 6 teachers
Interviews: PLC participants	Interviews with non-BMTN teachers who participated in four local spread efforts	Year 4: N = 12
Surveys: PLC participants	Surveys of non-BMTN teachers who participated in two BMTN teacher-led local spread efforts	Year 3: N = 84 Year 4: N = 18



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