MTEP 2.0: Launching a New Focus on Program Transformation

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The Mathematics Teacher Education Partnership (MTE-Partnership) was established in 2012 by the Association of Public and Land-grant Universities to address a major problem in secondary mathematics teacher preparation: a shortage of secondary mathematics teachers entering the profession who are well prepared to ensure their students can meet rigorous state mathematics standards for college- and career-readiness. Over 90 universities and over 100 school systems joined this consortium, which adopted the networked improvement community (NIC) design (Bryk et al., 2015). An aim of producing more and better beginning mathematics was established, and the *Guiding Principles of Secondary Mathematics Teacher Preparation* (MTE-Partnership, 2014) provided a common framework guiding the work. Over the following years, Research Action Clusters (RACs) were launched to address particular problems of practice in secondary mathematics teacher preparation—including the clinical preparation of candidates, mathematical content knowledge relevant to teaching, and recruitment and retention—as well as working groups focusing on equity and social justice and on program transformations. Hundreds of mathematicians, mathematics teacher educators, K–12 personnel, and other partners were engaged in the work of these RACs and working groups, which has resulted in nearly 100 presentations and dozens of articles about the work. In addition, the MTE-Partnership has received over $9 million in funding from the National Science Foundation and other foundations to support its work, both general support for convenings and the operation of the conference as well as support for specific RACs and working groups. The work of this first phase of the MTE-Partnership is summarized in a monograph (Martin, Lawler, Lischka, & Smith, 2020) published by the Association of Mathematics Teacher Educators (AMTE) in its Professional Book Series. More information about the MTE-Partnership can be found at www.mtep.info.

This conference marked the ninth annual convening of the MTE-Partnership, but was quite unlike the proceeding conferences in two major regards. First, due to travel restrictions imposed as a result of COVID-19, the conference was moved to a virtual format during the planned dates of June 28-30, 2020. Second, while previous conferences focused primarily on the work of the RACs, this conference marked a transition to the second phase of the MTE-Partnership, dubbed MTEP 2.0. While the current RACs will continue to work toward their goals, and new RACs may even emerge to address emerging priorities, the primary focus of MTEP 2.0 is to support the transformation of secondary mathematics teacher preparation programs. Each team that is a part of the MTE-Partnership is generally only involved in one (or perhaps two) of the RACs—meaning that they are addressing only

some of the areas of critical need. To fully meet the aim of the MTE-Partnership, teams must shift toward more holistic program transformation and integrate the work of the MTE-Partnership across multiple RACs into their local improvement efforts.

<div align="center">Overview of the MTEP 2.0 Transformation Process</div>

This section provides a brief overview of the MTEP 2.0 process for transformation, including literature on program transformation, the emerging vision of MTEP 2.0 based on that literature, and an outline of the conference, including a series of transformation exercises that teams completed as a part of a transition to MTEP 2.0.

Program Transformation

Understanding program transformation builds on research on institutional change. Most of this change literature is related to businesses and has been adapted fairly recently to educational settings (e.g., Burnes, 2011). We will briefly review two frameworks for institutional change that integrate this emerging research and will then argue that the NIC design used by the MTE-Partnership can effectively incorporate attention to important aspects of program transformation.

First, Elrod and Kezar (2016) developed a model for systemic institutional change applicable to STEM education that might be applied to secondary mathematics teacher preparation; see Figure 1. The change process is depicted as a river to "to show the dynamic, flowing nature of change" (p. 8). Elrod and Kezar emphasized that this was not a linear process but rather a dynamic process. Thus, the different stages need not be traversed in order but rather serve as a guide for the issues that need to be addressed. Note also that the process can loop back to the beginning or an earlier stage, as depicted by the dashed yellow arrow.

Figure 1. Model for systemic institutional change (Elrod & Kezar, 2016, p. 9).

The second model comes from the *Standards for Preparing Teachers of Mathematics* (AMTE, 2017) and is specific to mathematics teacher education; see Figure 2. Much like Elrod and Kezar's (2016) model, this model depicts the process of program transformation not as non-linear but rather cyclical. The elements in this cycle "should be considered while those involved with preparing teachers of mathematics work to implement" (p. 164)

improvements to meet the vision of that document. They also emphasize the length of the cycle can vary dramatically depending on the grain size of the proposed changes.
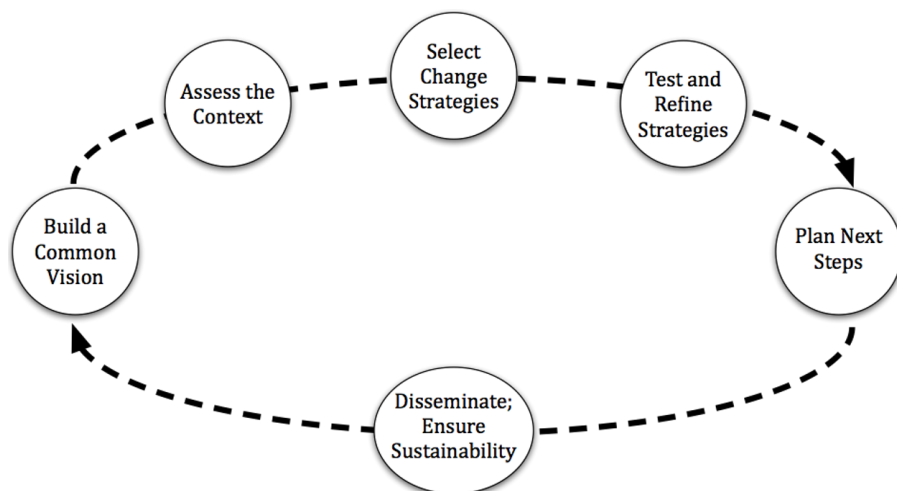

Figure 2. Depiction of the change cycle for improving mathematics teacher preparation programs (AMTE, 2017, p. 165).

We now consider the four elements of the NIC design (Bryk, Gomez, Brunow, & LeMahieu, 2015) and relate them to the two models shown previously:

- **Focused on a common aim.** This ties closely to building or establishing a vision described in the two models.
- **Guided by deep problem analysis.** This relates to identifying and analyzing challenges and opportunities, assessing the context in the second model along with choosing or selecting change strategies.
- **Disciplined inquiry based on continuous improvement.** The key here is to rely on data to make decisions about whether a change strategy is productive and to make any necessary adjustments. The NIC model typically includes the use of Plan-Do-Study-Act (PDSA) cycles to guide the improvement process. As the old maxim goes, "Not all change is an improvement."
- **Networked to accelerate progress.** Both cycles above focus on dissemination, although the NIC model includes a broader view of networking in which members of the NIC collaborate to test the same change idea and share the knowledge they are generating.

We argue that the NIC design is an optimal approach to supporting the transformation of secondary mathematics teacher preparation, given the focus of the NIC design and its alignment to models for educational transformation. In addition to guiding the overall actions of the MTE-Partnership network, the NIC design can also be used to guide the work of transforming individual programs.

Vision for MTEP 2.0

In this section, we will briefly discuss the conceptualization of the next phase of the MTE-Partnership (dubbed MTEP 2.0) as a NIC, building on the original design of the MTE-Partnership. This work is organized by a subset of the MTE-Partnership Planning Committee who also serve as the authors of this chapter. We discuss several key elements of this new design in this section. First, while the *Guiding Principles for Secondary Mathematics Teacher Preparation* (MTE-Partnership, 2014) effectively provided "a shared vision to be explored and refined by the MTE-Partnership and others involved in preparing secondary mathematics teachers" (p. 1), the

Standards for the Preparation of Teachers of Mathematics released by the AMTE in 2017 present a national vision for mathematics teacher preparation. The Planning Committee felt it would be useful to update our Guiding Principles to better align with AMTE's vision, and a crosswalk of the documents resulted in the *Updated Guiding Principles for Secondary Mathematics Teacher Preparation* (MTE-Partnership, 2020). This change was ratified by the membership in Spring 2020.

Second, the definition of membership in MTEP 2.0 was realigned to focus on teacher preparation programs who are using the NIC design to support their improvement efforts. The primary membership of MTEP 2.0 will be **Program NICs**, which include individuals working to improve a specific mathematics teacher preparation program; these individuals may include mathematics teacher educators, mathematicians, administrators, K–12 teachers and administrators, and other supportive entities and interested stakeholders. However, Program NICs may also be a part of a **Partnership Team,** one or more program NICs along with other stakeholders working on improving secondary mathematics teacher preparation at a state or regional level. While the old saying is that "all change is local," some change efforts may be more powerful at the regional partnership team level.

Third, the aim was updated to focus more explicitly on program transformation as follows, although a specific date for achieving the aim has not yet been set.

By 7/1/2025, 50 MTEP 2.0 programs will be actively engaged in an explicit, localized, prioritized improvement process toward alignment with the Updated Guiding Principles.

Finally, the process of updating the driver diagram to focus on the revised aim began; see Figure 3 for an initial list of primary and secondary drivers.

Figure 3. Initial primary and secondary drivers for MTEP 2.0.

Note that the driver diagram will continue to be updated over the coming months based on input from those engaged in the MTEP 2.0 effort. Taken together, these elements help frame the launch of the MTEP 2.0 network.

The 2020 MTE-Partnership Conference Program

The conference program consisted of three types of sessions, which were reimagined to fit the virtual format for the conference. Each session type was intended to support the new emphasis on program transformation.

Research Presentations. The purpose of these sessions was to report on research being conducted by RACs or local program teams that might be useful to other teams as they think about how to transform their programs. Originally conceived of as breakout sessions, the research sessions were presented asynchronously on the MTE-Partnership OpenCanvas platform. For each session, a video presenting the content of the session was included along with an associated discussion forum for additional interaction with conference participants. These sessions were open for the three weeks surrounding the conference and continue to be posted on OpenCanvas.

RAC Work Time. Historically, RAC work time has been a central focus on the annual conferences. While the original plan for this conference included somewhat less time for the RACs, the move to a virtual conference made including RAC work time as a part of the program problematic. Thus, only one synchronous two-hour session was included in the program, with the understanding that RACs would schedule additional virtual meeting times outside of the conference meeting times as needed.

Transformation Exercises. A series of five two-hour plenary sessions were designed to help Program NICs begin to conceptualize their work as NICs. The following exercises are correlated to the frameworks presented earlier:

- **Exercise I: Gathering stakeholders.** Thinking about who should be included in the NIC membership is a critical first step in establishing the NIC.
- **Creating a common vision.** This consists of two parts—better understanding the context through a root cause analysis and then consider an aim and drivers that will guide the transformation process.
    - **Exercise II: Root cause analysis**
    - **Exercise III: Aim and Driver diagram**
- **Exercise IV: Beginning to develop change strategies.** Here the program NICs begin to consider one or more PDSA cycles they might undertake to begin the transformation process.
- **Exercise V: Planning next steps.** Finally, the program NICs were encouraged to design a process to enable them to continue this process.

Together, these exercises were designed to lead the NICs to complete an application to join MTEP 2.0.

Each session began with a brief presentation and then provided time for program NICs to work in a Zoom breakout room, with an assignment due to be submitted the following day. Each session focused on one of five "transformation exercises" designed to step program NICs through the foundational steps for launching transformation efforts. The following sections of this chapter provide the background information for each of the exercises, the assignment given, and a summary of the responses received.

Focus on Equity and Social Justice

Equity and social justice have always been an important aspect of the MTE-Partnership work. The original *Guiding Principles* included clear statements about equity, and the aim of MTE-Partnership included explicit attention to increasing diversity of mathematics teacher candidates. Many of the RACs included specific attention to equity in their work. The Equity and Social Justice Working Group (ESJWG) was launched in 2017 to foreground attention to equity and social justice; their efforts have included providing guidance to the RACs in increasing attention to equity and social justice. However, items related to equity continued to be identified as areas of concern on the needs assessment that teams completed prior to the conference. A discussion forum was launched

on the MTE-Partnership OpenCanvas platform as a paper of the conference where participants could pose questions related to equity and social justices; members of the ESJWG monitored (and continue to monitor) that discussion form. Participants were also encouraged to include attention to those issues in their work in the transformation exercises outlined below. We are continuing to explore ways to better highlight equity issues across the work of MTEP 2.0.

Transformation Exercise I: Gathering Stakeholders

The first step in establishing a NIC is to identify who is or should be involved. Elrod and Kezar (2016) discuss how to identify potential team members when the goal is a team that focuses on changes in introductory STEM education, including "grassroots faculty leadership, mid-level leadership among department chairs and deans, and support from senior leaders in the administration. Campus professionals from student affairs, outreach, and advising are also important members of the team" (p. 5). Secondary mathematics teacher preparation is somewhat more complex, since it typically involves two colleges—education and sciences. In addition, school partners are an important part of the team, both in hosting field experiences for candidates and in hiring candidates after completing the program. Thus, a program NIC might include:

- Mathematics teacher educators
- Mathematics faculty
- Higher education administrators
- Other internal partners (e.g., faculty members from special education, language acquisition, equity and inclusion, field supervision)
- K–12 mentor teachers
- K–12 administrators
- Other external partners (e.g., regional/state level personnel, learning centers)

The goal of Transformation Exercise I is for NICs to identify key stakeholders who can contribute to their work toward the achievement of their goal(s).

Activities and Assignments

Individuals were sent to Zoom breakout rooms to work with their local Program NIC or Partnership team (as appropriate) to provide answers to the following prompts:

- Identification or restating the goal(s) of the NIC
- List of institutions included in the NIC; indicate which of these included targeted secondary mathematics teacher preparation programs
- List of individuals currently involved in your NIC (name, institution, role, email)
- List of additional individuals who should be involved (name, institution, role, email)
- Discussion: Does your team membership reflect access and equity?
- Identification of the lead person (contact person) and a back-up
- Additional discussion questions (as time permits):
  - How do you or will you engage with your NIC members? (both within your institution and across your broader partnership)
  - How will you account for turnover in your group?
  - Who "owns" the problem of mathematics teacher preparation?

- Identification of next steps in establishing your NIC membership (what, by when, who will take the lead and be responsible for ensuring the task is completed)

Summary of Responses

Nineteen responses were submitted by teams composed of either a Program NIC or Partnership Team; Table 1 provides a summary of the responses. Note that much variation was found depending on multiple contextual factors, including organization of the university and school system.

Table 1

Roles Included in Responses to Transformation Exercise 1

ROLE	N
Mathematics teacher educator	19
Other teacher education faculty	11
College of education administrator (chair or dean)	15
Mathematics faculty	14
Mathematics administrator (chair or dean)	9
K–12 teacher	13
K–12 administrator (school or district)	17
State department of education	8
Community college faculty	7
Student in the program	3
Other stakeholders external to education	5

It may be of particular note that not all teams included a mathematics faculty member or a representative from their mathematics departments, although some mathematics teacher educators may be located in a mathematics department. Likewise, not all teams included a K–12 classroom teacher; although, all included either a K–12 teacher or administrator. Nearly half the teams included a representative from the state's Department of Education, and many included a representative from an associated community college. Three teams proposed including a student on the team, and five included some other partners external to education.

A few unexpected roles were proposed that seemed to have potential value, including: college of education certification officers and field experiences coordinators, college or university recruitment office representatives, K–12 mathematics coaches or specialists, K–12 district recruitment or retention office representatives, and various community representatives (such as a school board member) or groups.

Finally, it was noted in follow-up discussions that not every member of a NIC needs to participate at the same level. While there may be a core leadership team, other members may only be engaged in particular aspects of the work particular to their job role, and still other members (such as administrators) may engage in a more advisory role, meeting with the team periodically to provide feedback on its plans.

Transformation Exercise 2: Root Cause Analysis

Transformation Exercise 2 was focused on enabling teams to begin the process of identifying a problem and determining the causes for that problem through a root cause analysis. Specific goals for the session included: introduce the purpose and process for a root cause analysis, provide examples of completed root cause analyses, engage in cross-team root cause discussion, engage Program NICs in the Root Cause Analysis Card Sort activity, and provide next steps in the process for application to MTEP 2.0 regarding a root cause analysis.

A root cause analysis is defined by Bryk et al. (2015) as the process of analyzing the complex systems within our organization to help answer the question: "Why do we get the outcomes that we currently do?" (p. 66). The goal of a root cause analysis is to iteratively identify causes of the identified larger problem until specific, manageable targets have been identified. Ultimately, these component issues of the larger problem help inform the process for developing the Driver Diagrams.

Activities and Assignments

After the description and examples of the root cause analysis, participants engaged in a brief cross-NIC discussion to share first impressions of the problems that NICs across the partnership are experiencing. This gave participants an opportunity to consider root causes to problems programs are facing from a broader perspective, which they then shared with their local NICs. A [Card Sort activity](#) followed, in which local partnership NICs engaged in sorting potential root causes within six themes from least important to most important. The Root Cause Analysis Card Sort activity engaged local partnership NICs in beginning the process of identifying the root causes of the problem they had identified.

At the conclusion of this exercise, each local NIC submitted the results of its preliminary analysis by sharing the top four to six most critical challenges facing their team. In addition, teams were asked to share a short description of how they arrived at these critical challenges.

As teams moved forward in work following the conference, they were encouraged to choose activities to conduct that would support the process of clearly identifying a problem statement and its root causes: sorting causes with sticky notes, poster-boarding ideas, revisiting the card sort activity, or creating a fishbone diagram. In order to move forward and apply to MTEP 2.0, teams are asked to submit an updated problem statement, most critical root causes of that problem, and an explanation of how they arrived at the root causes.

Summary of Submissions

Eighteen of the 22 Program NICs and Partnership Teams submitted documents with the root causes identified. Teams listed between four and seven root causes, with most teams identifying five root causes as their top priorities. The submissions were aggregated and then coded to identify overarching themes or emerging challenges for the NICs. Initial submissions for this activity identified the following major challenges facing local NICs: attractiveness of teaching as a profession or lack of respect for teaching as a profession, declining enrollment and recruitment issues, lack of collaboration among stakeholders, equity and social justice, and policy or structural issues within teacher preparation.

Within the broad themes, NICs individualized their issues. For instance, stakeholders pertaining to an individual NIC were listed, or particular challenging structures within a given institution were highlighted. This indicates that while many of the NICs faced similar challenges, each could identify the issues specific to their context. Transformation Exercise 2 was designed to be an initial examination of root causes for the NICs. It was anticipated that as groups worked, these causes would be refined and even revised. This exercise served as a starting point and provides insight only into initial thinking about the overarching challenges facing NICs.

Smith, W. M., & Augustyn, L. C. (Eds.). (2020). *Proceedings of the ninth annual Mathematics Teacher Education Partnership (virtual) conference.* Washington, DC: Association of Public and Land-grant Universities.

Transformation Exercise 3: Aim and Driver Diagram

Transformation Exercise 3 was focused on moving from the root cause analysis to defining an aim and creating a driver diagram. Driver diagrams include overarching (primary) and specific (secondary) change levers and change strategies to positively impact the identified change levers. Specific goals for the session were:

● Move from prioritized root causes into choosing levers for change and change strategies
● Create a draft driver diagram

Driver diagrams are only one of many different ways to organize a program's transformation plan. Driver diagrams are a representation of a partnership's shared understanding of priorities and targeted change levers (Bryk et al., 2015). Driver diagrams are designed to illustrate clear connections among root causes, hypothesized change levers, and change strategies. Although Program NICs and Partnership Teams prioritized root causes that underlie their transformation efforts, the top priorities change over time. A driver diagram can help a Program NIC or Partnership Team avoid mission creep by always coming back to a negotiation of a shared vision and top priorities. Driver diagrams also change over time to evolve with the transformation efforts, as progress is made and the contexts change.

Activities and Assignments

Prior to drafting driver diagrams, participants were provided several example driver diagrams, including the current MTE-Partnership driver diagram. Participants also engaged in a card sort task to determine primary drivers versus secondary drivers versus change ideas for a set of five examples drawn from current Program NIC driver diagrams. With the limited time during the conference, Program NICs were encouraged to start with just one prioritized root cause to develop one change lever and change idea (moving on to more as time allows, and after the June 2020 conference). We provided participants with several different templates to use for driver diagrams, including a Google slide deck and Google spreadsheet, and the suggestion that a team could use a Padlet.

During the opening for Transformation Exercise 3, we suggested teams define an equity-focused aim. Transforming secondary mathematics teacher preparation programs must necessarily have a focus on equity, if the transformed program is to improve mathematics teaching and learning for all students, and address current opportunity and outcome gaps in this country. We further suggested Program NICs use a common structure for defining their aim:

By [DATE], [name of partnership] will improve [target outcome] by [measurable amount].

Just as writing good research questions is a difficult and iterative process, determining an appropriate aim to represent the common vision of a partnership is an iterative and evolving process. We expected Program NICs and Partnership Teams to draft an aim during the MTE-Partnership conference, but that the aim would undergo multiple revisions over the ensuing months.

Summary of Submissions

Twenty-two Program NICs and Partnership Teams submitted driver diagrams and aims. The driver diagrams contained one to six primary drivers, one to seven secondary drivers, and one to nine change ideas. The authors analyzed the aims, drivers, and change ideas to determine the major focus (or foci) of each Program NIC. Summarized in Table 2, we identify the major foci for the Program NICs; Program NICs had up to three major foci, so the sum is greater than the number of teams.

Table 2

Proposed Foci of Transformation Efforts for Secondary Mathematics Teacher Preparation

Main Focus of Efforts	Number
Recruitment	11
Equity	10
Stakeholder Involvement	7
Shared Vision	6
Diversity	3
Clinical	3
Community	1
Cultural Competence	1
Retention	1

Note: Based on drafts submitted June 2020 for aim and driver diagrams.

Nationally, university-based teacher preparation programs have experienced steep declines in the past decade. A 2019 report from the Center for American Progress used teacher data provided by teacher preparation programs (as required by Title II of the 2008 Higher Education Act) to determine teacher numbers and demographics. They report:

Nationally, there were more than one-third fewer students enrolling in teacher preparation programs in 2018 than in 2010. Nearly every state in the nation has experienced declining enrollment in teacher preparation, with some states experiencing drastic declines of more than 50 percent. (Partelow, 2019, para. 13)

Thus, the majority of Program NICs chose a major focus on recruitment of diverse candidates for secondary mathematics teacher preparation programs. Most Program NICs also drafted an explicit focus on equity or diversity. With many Program NICs beginning their transformation journeys, quite a few have an initial focus on increasing stakeholder involvement and developing a shared vision among the stakeholders.

Program NICs and Partnership Teams will be refining their aim and driver diagrams over summer and fall 2020 (and beyond); we do expect the major foci on recruitment, equity, and development of a shared vision among stakeholders to continue through the next round of revisions. With agreed-upon aims, drivers, and change strategies, Program NICs and Partnership Teams can keep their transformation efforts focused on their priorities.

Transformation Exercise 4: PDSA Cycles

The goals of the Transformation Exercise 4 session were to define what PDSA cycles are, discuss why PDSA cycles are helpful, share an example from one of the teams engaged in the NSF project launching this work, provide forms that teams may use to create their own PDSA cycles, and provide teams with the opportunity to develop PDSA cycles focused on a change idea from their driver diagrams.

The core framework of improvement science is the PDSA cycle, a process for rapid cycles of learning from practice, coupled with three fundamental questions that drive improvement work:

1. What are we trying to accomplish?

2. How will we know that a change is an improvement?
3. What change can we make that will result in improvement? (Lewis, 2015, p. 54–55)

The PDSA cycle begins with a **plan** in which team members articulate the change, record predictions about what they expect will happen, and design a way to test the change on an appropriate scale. Next is the **do** phase in which team members attempt the change, collect data, and document how change was implemented. The third phase is **study** in which the team analyzes the data, compares the results to the prediction, and gleans insights for the next cycle. The final phase is **act** in which the team decides on what to do next based on what they learned and will abandon the idea, make adjustments, or expand the scale (Bryk et al. 2015, p. 122).

PDSA cycles are the key mechanism by which we learn in improvement. They provide a way to test and revise theories at an appropriate scale. Implementers often gain more by doing something (even if it's small) rather than obsessing over getting it "right" from the start. PDSA cycles give teams a common approach that they can use to discipline their efforts, so their efforts are efficient (Lewis, 2015, p. 54–55).

Below are tips for implementing PDSA cycles well (Bryk, Gomez, Grunow, & LeMahieu, 2015, p. 120–121):

1. For most contexts, it is better to start with small, rapid tests of change and then expand the initiative out as the improvement team learns. (The faster a network can learn, the faster it can move from small-scale testing to systemwide implementation.)
2. The PDSA cycles should be minimally intrusive.
3. Develop empirical evidence at every step to guide subsequent improvement cycles.

Activities and Assignments

During the MTE-Partnership virtual conference, Program NICs and partnership teams were asked to complete the following task:

> As a team, use one of the change ideas from your driver diagram to complete the plan phase of a PDSA cycle:
>
> a. Pick one that you can implement within the next months.
> b. You will be asked to share your plan via OpenCanvas.
> c. We ask that you report on the PDSA cycle once it is completed. (This is one of the deliverables for the MTEP 2.0 application.)

Teams were given the choice between two templates to use as a format for the plan phase of the PDSA cycle. Below are the major components of the template that teams were asked to complete.

Title:

Primary Driver:

What change idea is being tested?

What is the goal of the test?

Duration:

Questions: Questions you have about what will happen. What do you want to learn?

Predictions: Make a prediction for each question. Not optional.

Data: Data you'll collect to test predictions

Summary of Submissions

Twenty-three NIC teams submitted responses for the task above. A review of the responses was conducted during the period of July 10, 2020, through July 15, 2020. The following conveys the summary of the common themes from this review.

- Eight NICs proposed a PDSA cycle that focused on recruitment.
- Seven NICs proposed a PDSA cycle focused on a common vision or understanding of mathematics teacher preparation among stakeholders.
- Four NICs proposed a PDSA cycle that focused on equitable or social justice pedagogy.
- Two NICs proposed a PDSA cycle related to clinical experiences.

We are hoping that the NICs will refine their plans and carry out short rapid PDSA cycles that will allow them to see whether their change ideas are improvements and act accordingly.

Transformation Exercise 5. Planning Next Steps

As a fifth and final task for emerging Program NICs toward advancing transformation efforts of the secondary mathematics teacher preparation program at their site, we asked teams to plan next steps. The agenda for this working session was to first do a review of the transformation process, preview the requirements to renew membership in MTEP 2.0, and then ask each team to work to establish a timeline of next steps.

Synthesis: How a NIC Generates Knowledge

The review of the transformation process began with sharing some of the work generated by teams so far in the conference, specifically some of the driver diagrams and associated PDSA proposals. A driver diagram serves as a visual representation of a group's working theory of practice improvement. In sharing three examples, we highlighted the structure of the diver diagram, in which an *aim statement* appears furthest at left (in our models), with the *primary drivers* just to the right. These represent that group's hypothesis about the main areas of influence necessary to advance the improvement aim. Further right are the *secondary drivers*, system components hypothesized to activate the primary drivers. Farthest to the right were a set of change ideas, an action or process that may positively impact the drivers.

Figures 4 and 5 provide two examples that emerged during work on Exercise 3. Highlighted especially in Figure 5 is the relationship between the change idea, drivers, and aim. The change ideas are tested through the PDSA cycle discussed above.
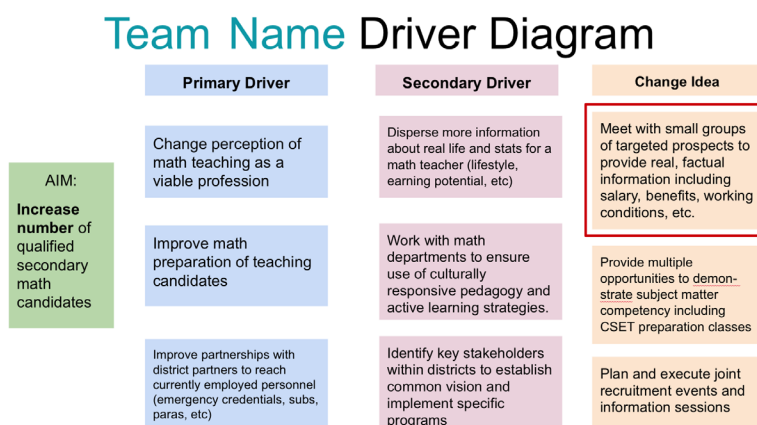

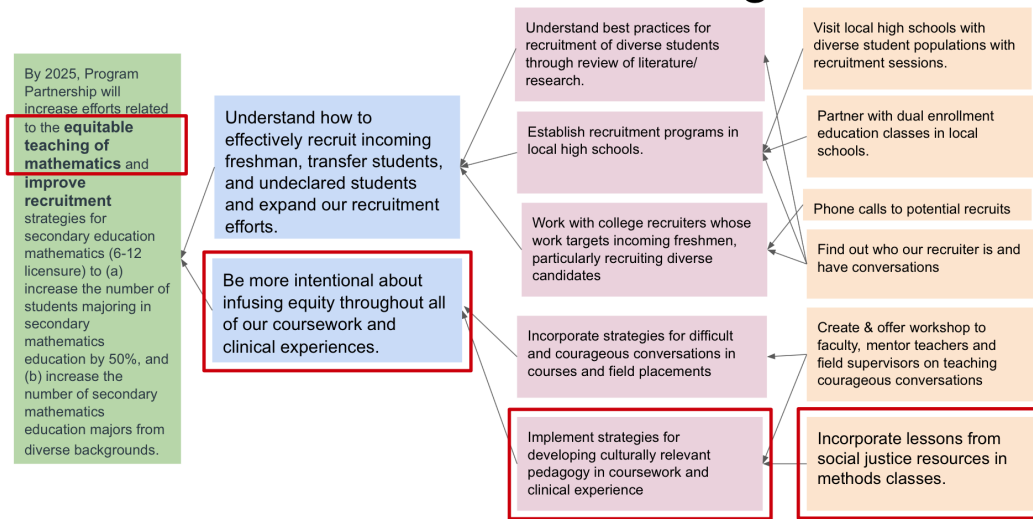*Figure 4.* Sample driver diagram: Change idea about recruitment.

Figure 5. Sample Driver Diagram: Change Idea Regarding Instruction in Methods Course.

The change ideas highlighted (red outlined boxes) in Figures 4 and 5 initiated the drafting of the PDSA cycles shown in Figures 6 and 7, respectively. In each of these samples, the change idea being tested is highlighted, showing its connection back to the associated driver diagram. In addition, the goal of the test is identified. A draft of the plan for implementation is also noted, emphasizing the identification of questions / curiosities paired with predictions about how the effort will unfold, in addition to identification of the data necessary to be collected in order to test the predictions.

The collection, replication, and advancement of knowledge within a NIC through multiple PDSA cycles is the basic method of inquiry in improvement research—a pragmatic, scientific method for iterative testing of changes in complex systems. In short, this 90-minute working session began with a brief review of the work done by program-based NICs to this point in the conference, and summarized the process by emphasizing the broad organizing structures of a NIC and how a NIC generates knowledge.

Challenges of the NIC Model

The review of NIC structures and processes laid groundwork for some reflection on Program NIC's work to date, as well as to raise awareness of the challenges common to implementation of the NIC model for transformation efforts. These challenges center on a significant shift for many in the MTE-Partnership community who have been trained in classical research methodologies that are not directed at improvement nor focus on the complexity of systems. As researchers, we often struggle with the NIC methodology of (1) rapid iteration of small scale tests, and (2) engaging others within the network to learn from one another, accelerating capacity for learning to improve.

As a NIC, the MTE-Partnership is a "professional community structured around the accomplishment of a shared improvement aim" (Dolle, 2014, para. 3). We draw upon research as grounding our work and conduct research ourselves. However, the work of our NIC does not stop with knowledge generation; rather, it is a collaborative effort toward improving the preparation of secondary mathematics teachers. Our efforts prioritize learning and sharing practical "know how" to accomplish program improvements over theoretical "knowledge

that" an effort or practice created system improvements in one context and may (or may not) result in the same in another. As such, the data we are collecting are aimed at improvement, to be shared across the network, as opposed to the normed purpose in academia, to publish a paper. While this is not to say publications will not emerge, the primary purpose is to refocus the purpose of the work to transformation.

In addition to shifting the purpose from knowledge generation to knowledge implementation, the structure of the PDSA cycle is also foreign to many researchers and educators—specifically the emphasis on small and fast iterations as the testing cycle of change ideas. It is a shift away from thorough and complete design in advance, paired with careful data collection and analysis over time. Instead, we think in small chunks of actions to be measured: go fast, get data, share, and react. Our measures can be "good enough," with the goal to give actionable feedback on the change idea—answering questions such as, did it seem to work, is it worth pursuing. As one example, if a group were planning to test the change idea in Figure 6, the field notes kept during the small group discussion at the end of each session could be structured by a carefully designed protocol. This structure can allow for a disciplined inquiry, creating data that can be usefully discussed and compared across sites, yielding actionable next steps.

A final challenge experienced within the MTE-Partnership community is the capacity and commitment for NICs to keep up with documentation, including the recording and sharing of PDSA cycles. Two important structuring elements of a NIC include allow for the acceleration of improvement: disciplined inquiry organized by PDSA cycles, and a commitment to document and share what was done, learned, what might be tried next—tapping the power of the network. The MTE-Partnership project to date has found success in both areas, but also identifies both as an ongoing challenge that must be given careful attention.

PDSA FORM

Test Title:	Recruitment Outreach				Date:	6/29/2020
Tester:			Cycle#:	1	Driver:	Change perception of math teaching as a viable profession
What change idea is being tested?		Meet with small groups of targeted prospects to provide real , factual information including salary, benefits, working conditions, etc.				
What is the goal of the test?*		To build a stable and effective pipeline of math teacher prospects and candidates				

1) PLAN				3) STUDY
Questions: Questions you have about what will happen. What do you want to learn?	**Predictions:** Make a prediction for each question. Not optional.	**Data:** Data you'll collect to test predictions		**What were the results?** Comment on your predictions in the rows below.
What are the criteria to identify the best "targeted prospects"?	Math undergrad majors, members of pre-teaching clubs, tutors, district personnel, second career professionals	Track attendance and sort data by invitation source and prospect background	→	
What real, factual information will be most impactful when communicating with prospects?	Earning potential, benefits packages, lifestyle (weekly and yearly)	Administer survey to attendees to gauge highest impact takeaways	→	
How is the incoming perception of the prospects the same or different than after completing the session?	Prospects don't know before seeing the data and joining the session.	Small group discussion at the end of each session	→	
			→	
Details: Describe the who/what/when/where of the test. Include your data collection plan.				**What did you learn?**
Teacher Recruitment Task Force will create a recruitment plan and generate recruitment messages. Conduct outreach meetings and collect data per above. Outreach meetings will be executed in Fall 2020 on CSUEB campus, other partner campuses, and/or Zoom as applicable. Start with CSUEB then follow with MSTI partner community colleges (Chabot, Ohlone, Contra Costa).				

2) DO (Briefly describe what happened during the test, surprises, difficulty getting data, obstacles, successes, etc.)	4) ACT (Describe modifications and/or decisions for the next cycle; what will you do next?)

Figure 6. Sample PDSA form: Change idea about recruitment.

PDSA FORM

Test Title:	Social Justice Activity Sequence in Secondary Methods			Date:	June 29, 2020
Tester:		Cycle#	1	Driver:	Be more intentional about infusing equity throughout all of our coursework and clinical experiences.
What change idea is being tested?	Incorporate lessons from social justice resources in methods classes.				
What is the goal of the test?*	Pilot and refine (e.g., lesson study format) activities that enable prospective teachers to incorporate social justice lessons in secondary methods courses				

1) PLAN				**3) STUDY**
Questions: Questions you have about what will happen. What do you want to learn?	**Predictions:** Make a prediction for each question. Not optional.	**Data:** Data you'll collect to test predictions		**What were the results?** Comment on your predictions in the rows below.
What is needed to help PTs engage with difficult conversations and lesson topics in mathematics?	We need to provide examples and resources for PTs to use. Practice having difficult conversations. Build coherence across other experiences PTs have at the same time in the program.	Instructor plans for activities. Instructor reflection on activities. Pre/Post survey in course (qualitative) to gather PT perspective.	→	
How do PTs engage with the activities?	Students will uncover and confront unconscious bias.	Pre/Post survey in course (qualitative).	→	
Will their participation in this activity sequence impact their lesson planning (future teaching)?	Students will begin to incorporate social justice topics and/or culturally relevant pedagogies in their lesson plans.	Lesson plan analysis (Long term - perhaps consider lesson plans in student teaching) Practicum/Residency Observations (if appropriate)	→	
Did the sequence of activities unfold as we planned?	There will be adjustments!	Instructor plans for activities. Instructor reflection on activities. Peer Observations of Instructor/Lessons	→	
Details: Describe the who/what/when/where of the test. Include your data collection plan.				**What did you learn?**

Figure 7. Sample PDSA form: Change idea regarding instruction in methods course.

Transformation Is an Ongoing Process, Not One-and-Done

Prior to sending Program NICs to work on the final transformation exercise, we closed with recognition that this conference presented a lot of information. The time spent in the conference was only enough to plan initial efforts, serving as a starting point for ongoing transformation efforts. We held the conference with the full expectation that every Program NIC and Partnership Team would need to engage additional stakeholders, collect additional data, and have further discussions before solidifying the ideas generated during the conference into a coherent transformation plan.

Furthermore, over time, we expect team members, priorities, and strategies to change. As such, Program NICs need to regularly revisit the transformation process to see how people, contexts, and priorities have changed and what adjustments are needed. Thus, there are some important mindset considerations that have emerged from the work within the MTE-Partnership. The work of the MTE-Partnership will persistently grow and evolve. Along the way, although our efforts will be "possibly wrong and definitely incomplete" (Bryk et al., 2015), our efforts will remain useful in the disciplined and coordinated effort to improve our programs to prepare secondary mathematics teachers. Not every change idea will succeed, but every attempt is an opportunity to learn what might work next time around. And, even successful ideas can be improved.

While there will likely be side benefits, such as publications, articles, and perhaps even grants, the aim of the MTE-Partnership is improving our programs to prepare secondary mathematics teachers. Teamwork and communication are essential to making this happen within the large MTE-Partnership. The NIC design has been intentionally chosen, as improvement is a collaborative community effort. All of our programs are trying to prepare

effective teachers, aligned with the AMTE *Standards for Preparing Teachers of Mathematics* (2017). A NIC allows us to coordinate and accelerate our efforts rather than all individually trying to do essentially the same thing. Within the coordinated efforts, we acknowledge that every context is different, and change ideas must be adapted to fit local conditions and constraints. Thus, the focus of our work is *integrity of implementation* rather than the more traditional *fidelity of implementation*. The NIC model itself provides a framework for us to operate as a scientific learning community. It helps us remain focused on disciplined inquiry focused on a common aim, and operate in a coordinated fashion to accelerate the development, testing, refinement, and implementation of interventions. The NIC structures of the MTE-Partnership are meant to guide action, and learn from one another to accelerate local transformation efforts.

Activities and Assignments

We asked each Program NIC to use this transformation exercise to begin to establish a plan to continue their progress after the conference is over. Prior to providing specific instructions to begin to establish this plan and an associated timeline, we identified some specific deadlines and the elements of the application to MTE-Partnership 2.0. The deadlines included:

- Responses to Transformation Exercises – July 1, 2020, 1:00 p.m. EDT.
- Application to MTE-Partnership 2.0 – October 15, 2020.

The MTE-Partnership 2.0 application consists of four major components, three of which have several elements. These are summarized in Table 3.

Table 3

Components of the MTE-Partnership 2.0 Application

MTE-Partnership 2.0 Application

Organization of the Program NIC
    Description of the NIC and its members
    Identification of a lead contact and a backup
    Letters of support from key stakeholders

Development of a charter
    Root cause analysis–describe the process and the conclusions reached, possibly including a diagram
    Driver diagram—describe the process used and the drivers identified, including a draft diagram

At least one PDSA cycle completed and documented.   Note: It does not have to be a success; the success is that it was completed.

Commitment to data collection
    Data on program completers (annual)
    Continuing documentation of PDSA cycles
    Program Progress Survey (annual)—periodic revisiting of the charter

Supports and Resources

During the presentation associated with Transformation Exercise 5, we also pointed out specific supports and resources that will be available to teams as they move forward, which they might incorporate into their planning. The MTE-Partnership has a number of resources for Program NICs, generated by the work of Research

Action Clusters (see reports of the RACs in these proceedings). Additionally, the membership of the MTE-Partnership serves as a resource for Program NICs—hundreds of people who are working on similar transformation efforts. Each team has been assigned a coach from the conference planning team with whom they can interact throughout the process. In addition, during Fall 2020, a list of people with particular areas of expertise will be identified as consultants for support with particular problems. For example, members of the Equity and Social Justice Working Group were available for consultation through a discussion thread in OpenCanvas throughout the conference.

MTE-Partnership will host periodic webinars to help teams understand aspects of the NIC process more deeply. These will be referred to as **NIC-casts**. The RACs have been developing solutions to problems they have been working on and are sharing those through Canvas. Additional resources in Canvas include background materials for preparation for the conference. This is where leveraging the NIC structure can become most valuable.

The Task

During the working time of this exercise, Program NICs were asked to look forward to consider their next steps in the project. Specifically, teams were asked to initiate development of a plan to continue progress after the conference is over. This task was guided by three questions:

1. Identify actions you can take before Fall semester begins.
2. Identify actions you need to take by October 15, 2020 (submission of MTEP 2.0 application).
3. Identify additional actions for the rest of the school year.

Additional questions were posed to prompt discussion:

- When will your team meet next? How will you communicate?
- What lingering questions do you have about how you can make progress in the transformation process?
- What further support do you need from MTEP?
    - As a change agent?
    - For your Program NIC?
    - For your Partnership Team?
- What are your immediate next steps following the conference?

Summary of Submissions

Responses were separated by questions 1 through 3 and sorted by Program NICs. We were interested to see what types of actions teams identified and prioritized. Unsurprisingly, each team identified actions specific to their unique context. However, two distinct themes emerged. The first was about identifying and building a collective vision among local stakeholders involved in the preparation of secondary mathematics teachers. Actions planned within this included inviting and convening stakeholders, as well as collaborative activities that may help to build shared vision among those stakeholders. Such activities included review of program data, gathering concerns of stakeholders via survey, and revisiting elements of the driver diagram.

The second theme was a focus on beginning to implement change ideas. Many teams had a focus on recruitment, and some planned next steps included building upon the organizing meetings to share more about the program, create an orientation video, create a webpage, and develop a list of priorities and strategies. Other planned work included a focus on gathering information, reading known resources, and forming learning communities (such as a book study group).

Responses regarding the October 15 target focused very strongly on identifying Program NIC members and building shared vision and commitment to the preparation of secondary mathematics teachers. As Program NICs looked to identify aims across the year, the aims tended to focus on data collection and continuing to build the Program NIC community.

Next Steps Following the 2020 MTE-Partnership Conference

The 2020 MTE-Partnership Conference marked a transition to the second phase of the MTE-Partnership, dubbed MTEP 2.0, that focuses on promoting local transformation of secondary mathematics teacher preparation programs. In particular, the transformation exercises during the conference were designed to help Program NICs begin to conceptualize their work as a NIC, with the goal of submitting an application to join MTEP 2.0.

An initial deadline of October 15, 2020, was announced for applications to join MTEP 2.0. Although a rolling deadline will continue after that date, and Program NICs will continue to be encouraged to join, those meeting the October 15 deadline can be included in a proposal being developed for submission to the National Science Foundation to further develop and research MTEP 2.0. The grant would provide enhanced support for travel by the MTEP 2.0 members along with other resources, under the auspices of a research grant to study community transformation efforts and how the MTE-Partnership is able to support local transformation efforts.

A follow-up survey sent after the conference indicated that 15 to 19 Program NICs and Partnership Teams planned to submit an application to join the MTEP 2.0. In total, the 19 teams that plan to submit an application represent 40 campuses that offer a secondary mathematics teacher preparation program, with one team including all 11 campuses in the state that offer secondary mathematics teacher preparation, and close to 40 school districts.

As Program NICs begin their work as a part of MTEP 2.0, a number of future activities are planned to continue to build the network and recruit new members:

- **A virtual workshop in conjunction with the 2021 virtual AMTE Conference**—February, 2021 (no date or time specified)
- **2021 MTE-Partnership Conference**—June 24-26, 2021, in Scottsdale, Arizona, and online (conditions permitting)
- **2022 MTE-Partnership Conference**—planned to be held in conjunction with the 2022 AMTE Conference in February 2022

Transformation work is never "done"; rather, transformation is an ongoing process for a system, and a mindset for the change agents within those systems. As identified by the Carnegie Foundation for Education (e.g., Bryk et al., 2015), successful transformation efforts often follow a 1-5-25 model. For the MTE-Partnership, we are moving from the "5" (the teams involved in the NSF-funded NIC-Transform, DUE-1834539 and 1834551) to the "25" (MTE-Partnership 2.0). Our goal for the next stage of community transformation is to actively include 50 mathematics teacher preparation programs in our transformational NIC within the next four years. We acknowledge that program transformation efforts have been significantly impacted by the current global pandemic. However, the disruption of the "normal" in fact provides many opportunities for transformation. Thus, we look forward to the next four years of growing our transformational NIC in order to improve more equitable secondary mathematics teaching and learning.

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