

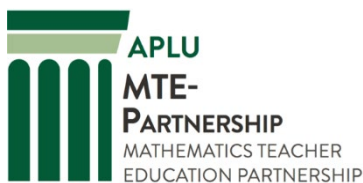
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# PROCEEDINGS OF THE NINTH ANNUAL MATHEMATICS TEACHER EDUCATION PARTNERSHIP CONFERENCE

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## THE MTE-PARTNERSHIP: TRANSFORMATION. EQUITY. LEADERSHIP.

Wendy M. Smith  
and  
Lindsay C. Augustyn  
(Editors)



June 28–30, 2020  
Online  
United States

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Edited by Wendy M. Smith and Lindsay C. Augustyn

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### Preface

These proceedings are a written record of the presentations and papers presented at the Ninth Annual Mathematics Teacher Education Partnership Conference held online, June 28–30, 2020. The theme for the conference was “The MTE-Partnership: Transformation. Equity. Leadership.” We are pleased to present these Proceedings as a resource for the mathematics and mathematics education community.

[www.mte-partnership.org](http://www.mte-partnership.org)

<sup>1</sup> Any opinion, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.



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# INTRODUCTION

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## 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](http://www.mtep.info).

This conference marked the ninth annual convening of the MTE-Partnership, but was quite unlike the preceding 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.

### Overview of the MTEP 2.0 Transformation Process

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.

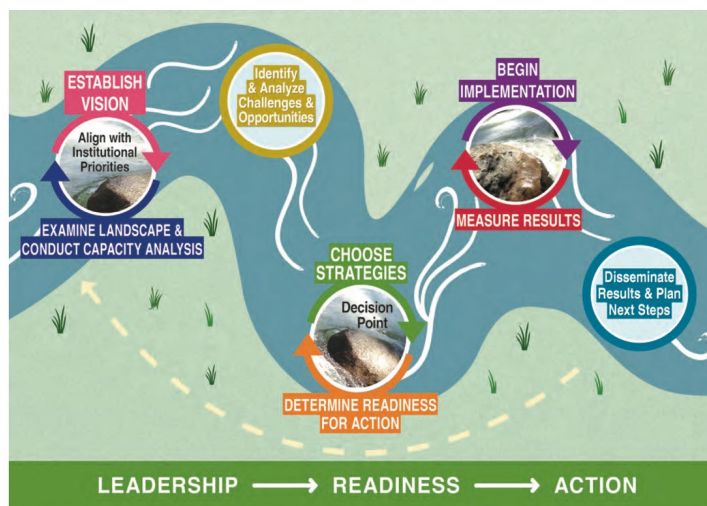


Figure 1. Model for systemic institutional change (Elrod & Kezar, 2016, p. 9).

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.

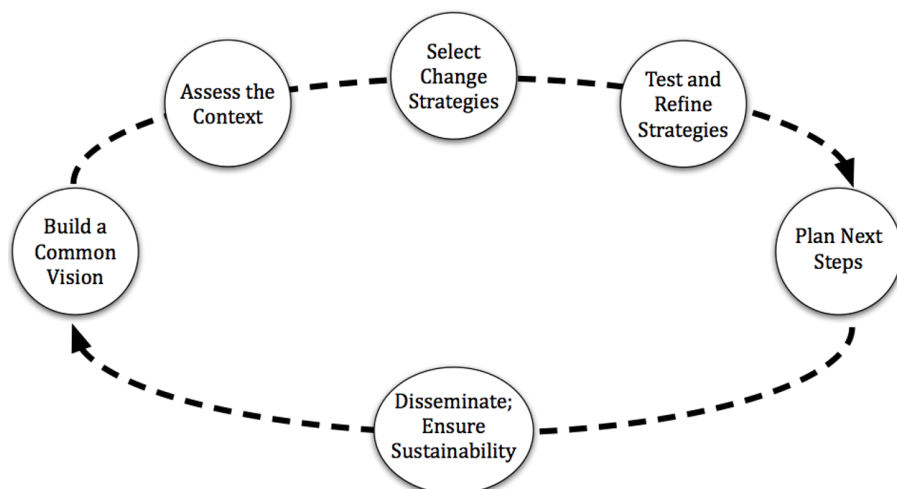


Figure 2. Depiction of the change cycle for improving mathematics teacher preparation programs (AMTE, 2017, p. 165).

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*

<b>ROLE</b>	<b>N</b>
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.

### 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*

<b>Main Focus of Efforts</b>	<b>Number</b>
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 driver 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.

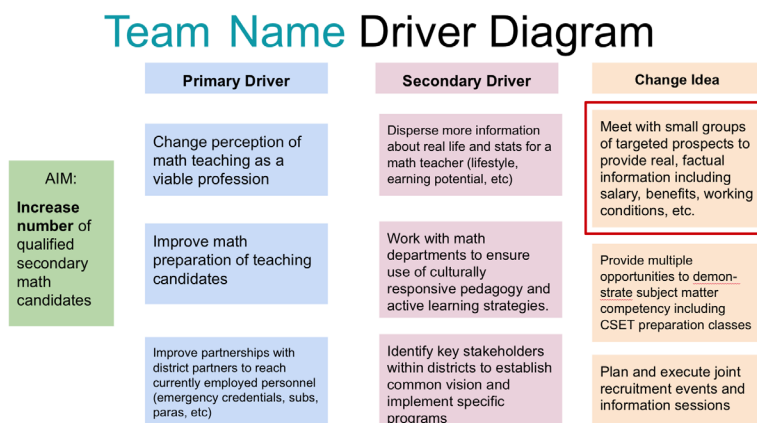


Figure 4. Sample driver diagram: Change idea about recruitment.

## Team Name Driver Diagram

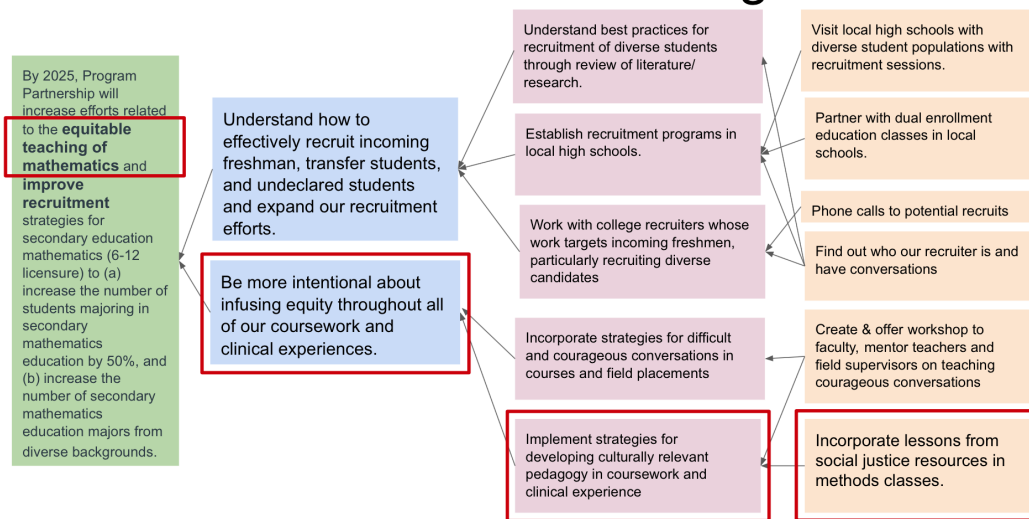


Figure 5. Sample Driver Diagram: Change Idea Regarding Instruction in Methods Course.

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			
<b>Test Title:</b>	Recruitment Outreach	<b>Date:</b>	6/29/2020
<b>Tester:</b>		<b>Cycle#:</b>	1
		<b>Driver:</b>	Change perception of math teaching as a viable profession
<b>What change idea is being tested?</b>	Meet with small groups of targeted prospects to provide real, factual information including salary, benefits, working conditions, etc.		
<b>What is the goal of the test?*</b>	To build a stable and effective pipeline of math teacher prospects and candidates		
1) PLAN		3) STUDY	
<b>Questions:</b> Questions you have about what will happen. What do you want to learn?	<b>Predictions:</b> Make a prediction for each question. Not optional.	<b>Data:</b> Data you'll collect to test predictions	<b>What were the results?</b> 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	→
			→
<b>Details:</b> Describe the who/what/when/where of the test. Include your data collection plan.			<b>What did you learn?</b>
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).			
<b>2) DO</b> (Briefly describe what happened during the test, surprises, difficulty getting data, obstacles, successes, etc.)		<b>4) ACT</b> (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			
<b>Test Title:</b>	Social Justice Activity Sequence in Secondary Methods		<b>Date:</b> June 29, 2020
<b>Tester:</b>		<b>Cycle#</b> 1	<b>Driver:</b> Be more intentional about infusing equity throughout all of our coursework and clinical experiences.
<b>What change idea is being tested?</b>	Incorporate lessons from social justice resources in methods classes.		
<b>What is the goal of the test?*</b>	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
<b>Questions:</b> Questions you have about what will happen. What do you want to learn?	<b>Predictions:</b> Make a prediction for each question. Not optional.	<b>Data:</b> Data you'll collect to test predictions	<b>What were the results?</b> 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	→
<b>Details:</b> Describe the who/what/when/where of the test. Include your data collection plan.			<b>What did you learn?</b>

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*

<b>MTE-Partnership 2.0 Application</b>
<p><b><i>Organization of the Program NIC</i></b></p> <p>Description of the NIC and its members            Identification of a lead contact and a backup            Letters of support from key stakeholders</p>
<p><b><i>Development of a charter</i></b></p> <p>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</p>
<p><b><i>At least one PDSA cycle completed and documented.</i></b></p> <p>Note: It does not have to be a success; the success is that it was completed.</p>
<p><b><i>Commitment to data collection</i></b></p> <p>Data on program completers (annual)            Continuing documentation of PDSA cycles            Program Progress Survey (annual)—periodic revisiting of the charter</p>

### 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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# **RESEARCH ACTION CLUSTER REPORTS**

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## Clinical Experiences (CERAC)

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### Problem Addressed and General Approach

Teacher preparation programs face significant challenges in providing secondary mathematics teacher candidates with quality clinical experiences. The problem is two-fold:

1. There is an inadequate supply of quality mentor teachers to oversee clinical experiences. Too few teachers are well versed in implementing the *Common Core State Standards for Mathematics* (CCSS-M; National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010), and teachers are especially inexperienced with embedding the standards for mathematical practice into their teaching of content standards on a daily basis. Further, many veteran teachers do not implement the mathematics teaching practices as discussed in *Principles to Actions: Ensuring Mathematical Success for All* (National Council of Teachers of Mathematics [NCTM], 2014) on an ongoing basis.
2. Bidirectional relationships between the teacher preparation programs and school partners in which clinical experiences take place are rare. Such relationships that reflect a common vision and shared commitment to college- and career-ready standards and other issues related to mathematics teaching and learning are critical to the development and mentoring of new teachers.

The work of Clinical Experience Research Action Cluster (CERAC) encompasses a number of the principles and principle indicators from the 2014 Mathematics Teacher Education Partnership's (MTE-Partnership) *Guiding Principles for Secondary Mathematics Teacher Preparation Programs*, including fostering partnerships between institutions of higher education, schools and districts, and other stakeholders, such as state Departments of Education, and is focused on preparing teacher candidates who promote student success in mathematics.

Moreover, the 2017 Association of Mathematics Teacher Educators' *Standards for the Preparation of Teachers of Mathematics* (AMTE Standards) state:

An effective mathematics teacher preparation program includes clinical experiences that are guided on the basis of a shared vision of high-quality mathematics instruction and have sufficient support structures and personnel to provide coherent, developmentally appropriate opportunities for candidates to teach and to learn from their own teaching and the teaching of others. (p. 26)

In the CERAC, higher education faculty and partner school districts and schools work together to actively recruit, develop, and support in-service master secondary mathematics teachers who can serve as mentors across the teacher development continuum from pre-service to beginning teachers. Moreover, the CERAC helps to ensure that teacher candidates have the knowledge, skills, and dispositions needed to implement teaching practices found to be effective in supporting all secondary students' success in mathematics as defined in the CCSS-M and other college- and career-ready standards.

The CERAC consists of 27 university-led teams, each consisting of at least one mathematics teacher educator, a mathematician, and a school partner. The CERAC is divided into three sub-RACs based on the three types of field experiences that we are implementing and researching to meet the goals that we set forth in our primary drivers and our aim statement. See Figure 1 for the CERAC's driver diagram. The sub-RACs are: Methods, Paired Placement, and Co-Planning and Co-Teaching. Each sub-RAC is implementing Plan-Do-Study-Act (PDSA) cycles based on their goals and objectives. Teams work together via conference calls, email, and the Canvas platform. They use Dropbox, Google Drive, and Canvas as ways of sharing files and materials. Additionally, they have held face-to-face meetings as a RAC that included breakout meetings for sub-RACs. The sub-RACs have overlapping areas that drive and focus the RAC, such as the emphasis on the mathematics teaching practices (NCTM, 2014) and other equitable teaching practices, professional development for mentors related to the *Standards for Mathematical Practice* (National Governors Association & the Council of Chief State School Officers, 2010) and mentoring mathematics teacher candidates, and outcome measures. There are also specific goals to be attained within each of the sub-RACs, and each sub-RAC has developed its own specific research questions.

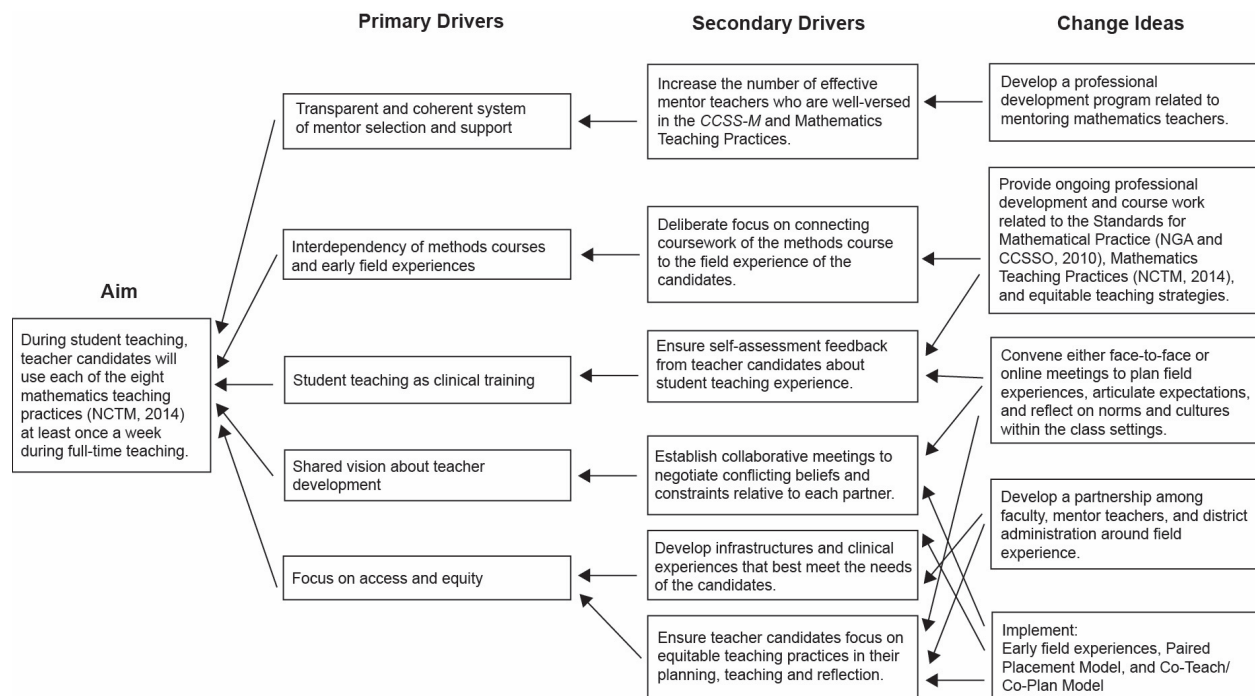


Figure 1. CERAC Driver Diagram.

### RAC Updates

Since the 2019 MTE-Partnership Conference, the CERAC has continued implementing the work related to the National Science Foundation-IUSE grant, *Collaborative Research: Attaining Excellence in Secondary Mathematics Clinical Experiences with a Lens on Equity* (DUE-1726998, 1726853, 1726362). The project is led by principal investigators from Auburn University, the University of South Florida, and the Association of Public and Land-grant Universities (APLU). We are implementing an improvement science study to answer the following question: *How does a continuum of collaborative and student-focused clinical experiences, including co-planning /co-teaching and paired placement fieldwork models, impact pre-service teachers' equitable implementation of the*

*Mathematics Teaching Practices (MTPs; NCTM, 2014) across multiple institutional contexts?* The research is being conducted by members of the three sub-RACs as described above.

In conjunction with the grant, the CERAC had a meeting of the Leadership Team and the Advisory Board members in October 2019, a face-to-face meeting of the RAC in November 2019, and other virtual leadership meetings throughout the academic year. We also updated our webpage at the APLU website: <https://www.aplu.org/projects-and-initiatives/stem-education/mathematics-teacher-education-partnership/mtep-racs/mtep-racs-clinexp.html>. Each of the sub-RACs also met monthly during this time period.

During the 2020 conference, RAC members reflected on their data collection plan; members from each sub-RAC were placed in cross sub-RAC teams to discuss data collection and other important elements of the CERAC, also three of the project's advisory board members (Dr. John Staley, Dr. Keith Leatham, and Dr. Dorothy White) provided their observations about the grant work and challenged the members to share their stories and scale up the work that we are doing. RAC members also discussed challenges related to the goals that they have set for themselves as a RAC and for the grant and found some solutions. We also had times during the CERAC meeting where members worked in their respective sub-RACs, discussing next steps and challenges related to COVID-19. Members of the CERAC contributed six chapters to the *Mathematics Teacher Education Partnership: The Power of a Networked Improvement Community to Transform Secondary Mathematics Teacher Preparation* monograph (Martin et al., 2020):

1. Grady, M., Sears, R., Stone, J., & Biagetti, S. (2020). Using co-planning and co-teaching strategies to transform secondary mathematics clinical experiences, (pp. 235–256).
2. Mangram, C., Clarke, P. A. J., Waller, P. P., Ellis, R. L., & Castro-Minnehan, C. (2020). Focus on improving clinical experiences in secondary mathematics teacher preparation, (pp. 281–292).
3. Strutchens, M. E., Erickson, D., Sears, R., & Zerkowski, J. (2020). Clinical experiences for secondary mathematics teacher candidates, (pp. 179–198).
4. Strutchens, M. E., Whitfield, J., Erickson, D., & Conway, B. (2020). Fostering collaborative and reflective teacher candidates through paired placement student teaching experiences, (pp. 257–280).
5. Strutchens, M. E., Sears, R., & Zerkowski, J. (2020). Improving clinical experiences for secondary mathematics teacher candidates, (pp. 199–209).
6. Zerkowski, J., Yow, J., Ellis, M., & Waller, P. (2020). Engaging mentor teachers with teacher candidates during methods courses in clinical settings, (pp. 211–234).

Furthermore, members of the leadership team gave the following presentations at national meetings during the 2019–2020 academic year.

Strutchens, M. E., Sears, R., Gobstein, H., Martin, W. G., Sutton, J., Zerkowski, J., Conway IV, B., & Mangram, C. (2020, January). *Collaborative Research: Attaining Excellence in Secondary Mathematics Clinical Experiences with a Lens on Equity*. Joint Mathematics Meetings, Denver, CO.

Strutchens, M. E., Sears, R., Zerkowski, J., Conway IV, B., & Mangram, C. (2020, February). *Collaborating to Improve Clinical Experiences for Secondary Mathematics Teacher Candidates*. Annual Association of Mathematics Teacher Education Conference, Phoenix, AZ.

Next, each sub-RAC will provide an update of their progress for the 2019–2020 academic year. They will also provide information about available resources and opportunities for engagement.

### Methods Sub-RAC

The Methods sub-RAC has focused our work on the development of modules that educate teacher candidates on critical components of the teaching and learning of mathematics, as well as adding a critical component of the

teacher candidate engaging with the mentor/cooperating teacher in an activity that is a culminating experience following the modules' university-based activities. Specifically, the Methods sub-RAC aims to provide the mathematics education field

- developed knowledge and understanding of critical components of teacher preparation in methods courses and connected field experiences for teacher candidates;
- a bidirectional learning trigger between teacher candidate and their mentor cooperating teachers in clinical settings; and,
- modules that have been tested and refined through PDSA cycles that engage teacher candidates and their mentor cooperating teachers with the Standards for Mathematical Practice (CCSS-M, 2010) and the Mathematics Teaching Practices (NCTM, 2014).

During the 2020 MTE-Partnership conference, the Methods sub-RAC members discussed our use of the PDSA cycles as a component of module validation and our continued use of NIC to learn about implementation in different settings. The members reflected on comments received from the California State Fullerton site regarding their pilot implementation of the Feedback Module. We determined that the Feedback Module needed greater focus on engaging the mentor/cooperating teacher in a collaborative learning experience with the teacher candidate. We also worked to refine and complete the Lesson Plan Module. Throughout the 2019–2020 academic year, members of the Methods sub-RAC met virtually to discuss our progress revising and refining the Lesson Planning and Feedback modules. The Lesson Plan Module is now available on Canvas. Enrollment in our Canvas course and information/updates on the modules can be found here: <https://cerac-methods.ua.edu/>. If you have questions about each module, email links are posted on our CERAC-Methods website and you can sign up for our Canvas course page housing the module materials. The Feedback Module is slated for use in Fall 2020 and Canvas ready in Spring 2021.

## Resources

- **Standards for Mathematical Practice (SMPs) Module**
  - The SMP Module is designed to provide teacher candidates and mentor teachers a bidirectional, shared experiences to better understand the SMPs and their relevance to impactful teaching.
  - This module is fully completed and available for use from our Canvas course page.
- **Lesson Planning Module for SMPs and MTPs**
  - The Lesson Planning Module is designed to discover teacher candidates' preconceived beliefs about lesson planning and move them toward a greater understanding of the components of high-quality lesson plans embedded in the Mathematics Teaching Practices designed to engage students in the Standards for Mathematical Practice.
  - This module is posted in our Canvas course page and is ready for Fall 2020 implementation.
- **Student Feedback to Improve Mathematical Goals**
  - The Feedback Module is designed to provide teacher candidates with opportunities to develop knowledge in effective feedback/assessment practices for providing student feedback that is constructive, critical, and equitable. The focus is on learning to provide rich and appropriate feedback to students based on the mathematical goals of the lesson/activity. Three variations/pathways for how to incorporate the Feedback Module within mathematics teacher preparation programs are a foci. This module is in a trajectory ready for use Fall 2020, Canvas-ready Spring 2021 and updates will be posted on our CERAC-Methods website periodically.

Please visit our website for information: <https://cerac-methods.ua.edu/>

### **Paired Placement Sub-RAC**

In 2019–2020, members of the paired placement sub-RAC were very productive. Leaders of the sub-RAC participated in CERAC leadership meetings and the CERAC Advisory Board Meeting. In addition, members of the sub-RAC presented at several local and national conferences. In particular, members presented the work of the group along with other members of the CERAC in a symposium session at Association of Mathematics Teacher Educators (AMTE) 2020 annual conference and the MTE-Partnership annual conference. In addition, findings from cross sectional RAC research were shared at the Georgia Association of Mathematics Teacher Educators. Furthermore, some members of the sub-RAC planned and implemented a workshop with members of the co-planning and co-teaching sub-RAC for teachers and teacher candidates at the University of South Florida.

Moreover, members of the paired placement sub-RAC continued to implement the model and related data collection instruments for their NSF grant. Members facilitated orientation sessions and workshops for teacher candidates and mentor teachers, updated syllabi based on previous PDSA cycles, and revised other resources for implementation of the model. To further disseminate the model and encourage broader use of the paired placement model by other teacher educators, the paired placement team created a living manual (<https://sites.google.com/view/thepairedplacement/>). The living manual provides information about the model, how to implement the model, research on the model, tools for implementation, and tips for successful implementation for mentors, supervisors, and candidates.

The paired placement team conducted PDSA cycles and collected data to answer questions relative to partnering with regional schools, co-teaching and co-planning, and the observational task protocols. Members of the paired placement sub-RAC have been working with the program evaluator, John Sutton, to compile data (as permitted and available between institutions) for cross-institutional analysis.

### **Co-Planning and Co-Teaching (CPCT) Sub-RAC**

CPCT sub-RAC members have worked to merge broader CERAC work into their courses. Some institutions have implemented methods modules as they fit into their own contexts. Tools from the co-planning/co-teaching modules also have been used during methods courses and internships to promote collaboration and increase success of the paired placement model. During the CERAC meeting June 30–July 2, 2020, the CPCT sub-RAC met to discuss a plan-do-study-act cycle for the upcoming academic year (2020-2021).

The CPCT sub-RAC members acknowledged that there exist challenges in collecting data if clinical experiences were to be offered online. They noted that the pandemic is creating uncertainty for the upcoming academic year as to ultimately what will be viable. Therefore, the sub-RAC indicated that they will collect what data they can, with the realization that data collection will vary based on institutional constraints and enrollment trends. Dr. Dorothy White, an advisory board member echoed the group's sentiment and noted that the realities of collecting data are going to be challenging going forward. Thus, she suggested the sub-RAC engage in re-examining the data previously collected through different lenses. Therefore, the group agreed that data collection may not be as robust, when compared to previous years, based on the uncertainty of educational operations due to the pandemic. The sub-RAC will also reflect on factors that may contribute to equitable mathematics practices based on existing data.

The CPCT sub-RAC also agreed that they will engage in chunking videos of professional development held at the University of South Florida in January 2018 and September 2019. The team will look for exemplars across the two video-recorded training sessions that can help with the implementation of co-planning and co-teaching

during clinical experiences. Thus, the videos will be divided into shorter segments so that they are easier to use and can be disseminated to others. Faculty (Dr. Maureen Grady and Dr. Charity Cayton) from East Carolina University will coordinate the video-editing.

Additionally, the CPCT sub-RAC acknowledged that there is a need to reflect on clinical experiences within a virtual space due to multiple districts providing the option for instruction to be face-to-face, asynchronous, or synchronous for the academic year. Thus, to meet the demands of our community and our current realities, the team members agreed that examples are needed as to how CPCT strategies can be enacted virtually. As a result, the sub-RAC plans to enact PDSA cycles around implementing CPCT strategies in virtual settings during the upcoming year. Dr. Ruthmae Sears agreed to spearhead this initiative. Despite the constraints and current challenges sub-RAC members have experienced due to COVID-19, they reflected on how they can advance the work. Particularly, they are planning to advance the work by providing resources that can be used virtually.

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## Active Learning Mathematics (ALM)

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### Problem Addressed & General Approach

The Active Learning Mathematics Research Action Cluster (ALM RAC) was formed to address the ongoing problems of undergraduate student success in first-year mathematics courses (Precalculus through Calculus 2—P2C2). Over 90% of 2.5 million students in the United States who take collegiate mathematics courses each year are taking courses at or below Calculus 2. Student success in first year mathematics courses (or lack thereof) can prompt changes in decisions to pursue STEM majors; student retention from first to second year and the four- and six-year graduation rates are highly correlated with grades in first year mathematics courses (in large part because mathematics courses are a near-universal requirement for graduation). Active learning strategies can improve student engagement and learning outcomes, but instructors need professional development and ongoing support to positively change their teaching practices. Further, different in-class materials (activities) are needed to better engage students.

The ALM RAC activities are detailed in our driver diagram (see Figure 1). Related to curriculum and assessment, ALM RAC partners work to develop and share materials that can support active learning, and also promote local coordination of assessment, through common homework, exams, and grading. Instructor capacities are addressed through initial and ongoing professional development; graduate student instructors are a unique (rotating) population of P2C2 instructors who need targeted supports. Student dispositions are measured via common surveys and other outcome measures. Focusing on a common vision entails significant will-building and local leadership to navigate policies and barriers, and to activate change levers (such as hiring and empowering a course coordinator).

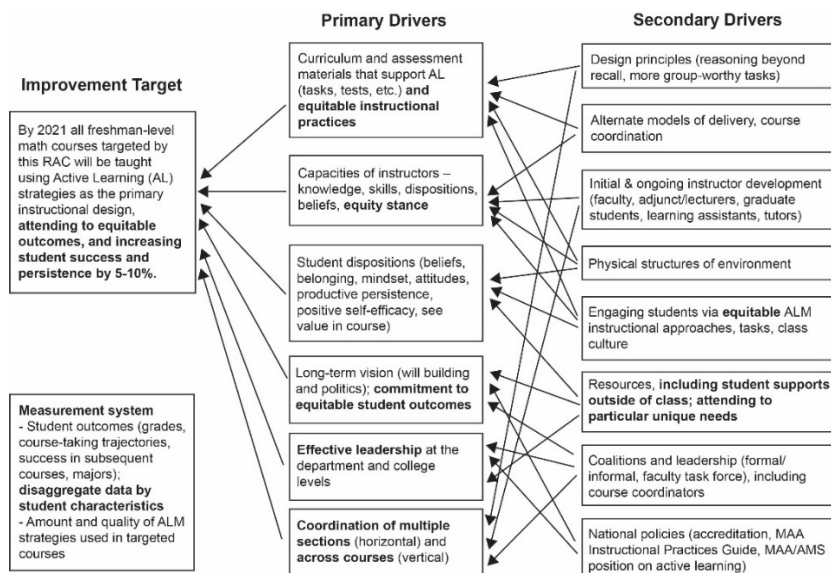


Figure 1. ALM RAC Driver diagram, as revised in 2019 to include leadership as a primary driver, and to update the secondary drivers.



Whereas ALM RAC members are focused on their own transformation efforts, a related coalition is studying how to effect departmental transformation to adopt and sustain active learning strategies. The Student Engagement in Mathematics through an Institutional Network for Active Learning (SEMINAL) project is a collaborative grant among the Association of Public and Land-grant Universities, the University of Colorado Boulder, the University of Nebraska–Lincoln, and San Diego State University (DUE-1624643, 1624610, 1624628, 1624639). Now in Year 4, SEMINAL’s research findings related to change levers for active learning, and sustaining departmental transformation efforts are aligned with ALM RAC efforts.

### **Current Progress**

The ALM RAC contributed a chapter to the 2020 Mathematics Teacher Education Partnership, summarizing our work to date and including multiple vignettes (Smith, Callahan, Mingus, & Hodge, 2020); one section of the book is focused on the mathematical content preparation of future teachers and also includes an overview chapter that is relevant to ALM RAC.

At our ALM RAC work time in June 2020, we spent time reviewing ALM RAC progress to date, to orient new members to our work and focus (see Appendix A). Given the global pandemic and ensuring impact on mathematics teaching and learning, strategies for actively engaging students in remote environments or in-person with physical distancing were where we focused most of our discussions. At the time, many faculty involved did not yet have a clear determination for fall format, so we talked about a range possibilities for actively engaging students in mathematics.

### **Resources and Opportunities for Engagement**

The ALM RAC welcomes additional partners who want to engage, from helping to develop a dynamic repository of materials, to engaging in lesson study for P2C2 lessons. During 2020–2021 we have monthly meetings set for the second Tuesday, July-May, at 3:30 p.m. Eastern time (contact Wendy Smith for the Zoom link). We are increasingly convinced how much contextual features and personal relationships impact the successful implementation and institutionalization of ALM efforts, so we appreciate having diverse partners whose collective experiences can better span the many variations.

We note that the 2018 publication by the MAA of an [Instructional Practices Guide](#), has many excellent principles for actively engaging students in learning mathematics. This publication is a great resource for helping to start local conversations about mathematics teaching and learning and has many practical tips for increasing student engagement. The SEMINAL project has a book forthcoming (Smith et al., Winter 2020–2021) that will focus on how departments changed their cultures to sustain active learning as the norm for first year mathematics teaching and learning. Local teams can implement or increase course coordination; coordination can help to sustain improvements and address inequitable student experiences and outcomes. Finally, those interested in improving P2C2 teaching and learning need to approach departmental transformation systemically, recruiting key leaders within and above the mathematics department in order to effectively initiate, implement, and sustain changes.

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Smith, W. M., Voigt, M., Strom, A., Webb, D. C., & Martin, W. G., (Eds.) (forthcoming). *Transformational change efforts: Student engagement in mathematics through an institutional network for active learning*. MAA/AMS Press.

## Appendix A

### ALM RAC 2019–2020 Progress on Primary Drivers

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#### Curriculum and assessment materials that support AL (tasks, tests, etc.) and equitable instructional practices

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Each campus is building its own set of materials; many pull from [University of Colorado materials](#). Textbook selection can be contentious and supports or inhibits ALM adoption. Building local materials can be a way to get people on board (ownership); sharing materials in useable form is an ongoing consideration (OneDrive, Google Drive, WikiSpace, Dropbox)

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#### Capacities of instructors – knowledge, skills, dispositions, beliefs, equity stance

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ALM RAC members each doing instructor professional development of some type (formal or informal) with instructors (including graduate student instructors, undergraduate learning assistants)

Student dispositions (beliefs, belonging, mindset, attitudes, productive persistence, positive self-efficacy, see value in course)

Some ALM RAC members are surveying students. Campuses engaged in comprehensive transformation efforts seem to be improving student outcomes.

Some ALM RAC members are preparing to use the [EQUIP](#) tool as a mechanism for collecting equity-related data for class participation.

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#### Long-term vision (will building and politics); commitment to equitable student outcomes

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Each ALM RAC member working on this; a key focus of ALM RAC meetings is sharing current lessons learned. Challenges to scaling up are often due to lack of buy-in. In some cases, collecting local data is (or is the foundation for) getting more people on board that there is a problem.

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#### Effective leadership at the department and college levels

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As a new driver, ALM RAC members are having ongoing conversations about how to effectively be leaders on their local campuses, how to work with formal leaders in and beyond the mathematics department, and how to frame ALM RAC work to align with leaders' priorities for campuses.

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#### Coordination of multiple sections (“horizontal”) and across courses (“vertical”)

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Each ALM RAC member is working on better coordination, along with hiring/designating coordinators. Getting buy-in for common assessments and common grading is a tough sell in some locations. Coordination can be argued as a structure for increasing equitable outcomes.

## The Mathematics of Doing, Understanding, Learning, and Educating for Secondary Schools (MODULE(S<sup>2</sup>))

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### Problem Addressed and General Approach

The Mathematics of Doing, Understanding, Learning, and Educating for Secondary Schools (MODULE(S<sup>2</sup>)) Research Action Cluster (RAC) is focused on the development of prospective secondary mathematics teachers' (PSMTs') mathematical knowledge needed for teaching (MKT; Ball et al., 2008; Rowland, 2013) within upper-level content courses. The work of the RAC aims to address the identified problems that (1) PSMTs often do not find connection between upper-level mathematics content courses and teaching secondary mathematics (Goulding et al., 2003; Zazkis & Leikin, 2010) and (2) PSMTs must deeply understand the mathematics they are going to teach and learn it in a way that is consistent with expectations of them as teachers (Banilower et al., 2013).

In response to these problems, the MODULE(S<sup>2</sup>) RAC has collaborated with mathematicians, mathematics educators, and K–12 teachers to design 12 educative curriculum (Davis & Krajcik, 2005) modules in the content areas of Geometry, Algebra, Statistics, and Mathematical Modeling. Each module includes opportunities for PSMTs to engage in mathematical tasks that are set in explicitly pedagogical settings, for the purpose of developing PSMTs' MKT. The MODULE(S<sup>2</sup>) RAC iteratively pilots and revises the materials in order to: understand how to support instructors in implementing the materials, understand the ways in which dissemination of the modules across a wide range of institutions can vary, and improve the quality of the modules, specifically in terms of develop PSMTs' MKT.

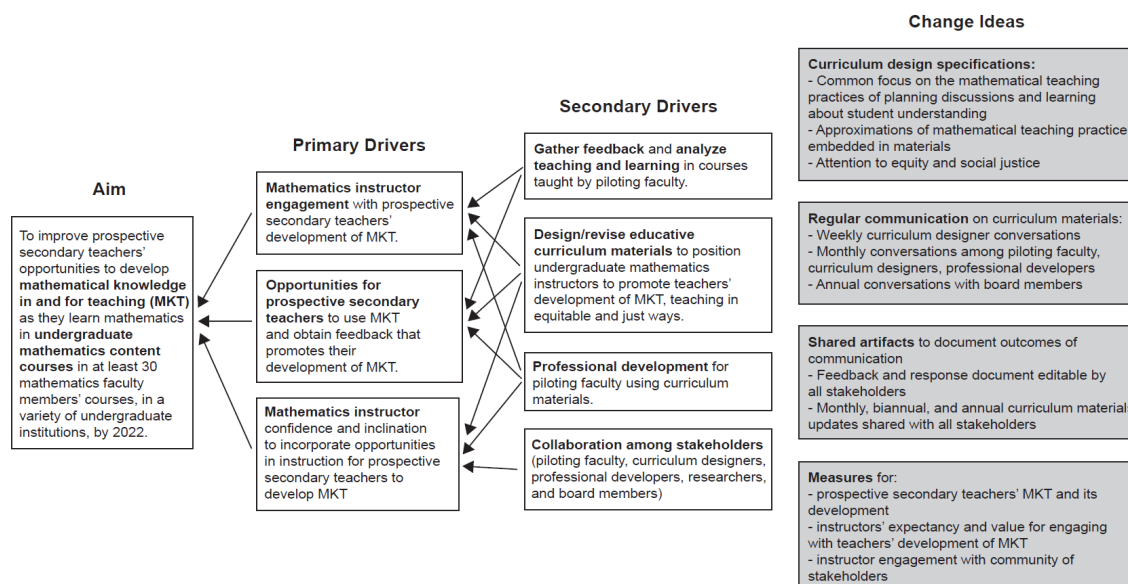


Figure 1. MODULE(S<sup>2</sup>) driver diagram.

Work of this RAC is structured according to our driver diagram (see Figure 1). For the last two years, the RAC has focused on the development of materials and understanding how to support piloting instructors in the enactment of the materials. That work continues as new iterations of piloting occur. In addition, the RAC is turning attention to broadening the dissemination of the materials and supporting programs in implementing the MODULE(S<sup>2</sup>) materials as part of program transformation efforts.

### Current Progress

In the 2019–2020 academic year, the Modeling and Statistics materials were piloted for the first time and the Algebra and Geometry materials were revised based upon piloter and team member feedback. With the interruptions in instruction due to COVID-19, the team has re-evaluated timelines and made plans to re-pilot with some of the instructors whose terms were interrupted due to moves to online teaching. The team has also decided to limit additional piloting for the 2020–2021 academic year, anticipating that many universities will be continuing in online formats. Instead, the 2020–2021 academic year will provide an opportunity to prepare for support of the materials after piloting is complete.

At the MODULE(S<sup>2</sup>) RAC meeting during the MTE-Partnership conference, discussions focused on future considerations for how the work of MODULE(S<sup>2</sup>) could help support program transformation through attention to mathematics content courses. Participants in the discussion acknowledged that the RAC's aims of connecting MKT theory and teaching practice could help to better connect teacher preparation and practice, increase prospective teacher retention, and create coherence within teacher preparation programs. In addition, discussion participants pointed out a sweeping issue of low-enrollment in secondary teaching-focused content courses. The MODULE(S<sup>2</sup>) RAC is positioned in such a way to address this problem by advocating for these types of courses and for materials with similar aims as those created by the RAC. A final suggestion for supporting program transformation focused on ways the MODULE(S<sup>2</sup>) curriculum material creation process could act as a model for material creation for other courses within teacher preparation programs.

After discussing support for program transformation, the RAC considered supports for instruction that may be needed in order to aid content course transformation. In order to support instructors in leading discussion-based courses, it was suggested that this RAC could aim to make mathematics education literature on the topic of discussion-based courses accessible to instructors and programs. Programs might then choose to provide this literature to instructors who are not yet convinced of the value of discussion-based teaching. It was also suggested that a variety of supports could be added to the already established professional development for the MODULE(S<sup>2</sup>) materials such as using collected data to demonstrate how an instructor may anticipate a student to respond to certain tasks.

Finally, the RAC discussed how MODULE(S<sup>2</sup>) could support program transformation with attention to social justice and addressing issues of racism. In developing the MODULE(S<sup>2</sup>) materials, participants pointed out that it is crucial that we consider a variety of viewpoints and inner conflicts of prospective teachers and that we provide support for instructors in becoming ready to have these conversations in their classroom. Within the materials themselves, it was suggested that more authentic tasks that go further in addressing social justice and racism could be added to each content area. Bringing in historical contexts of the mathematics content would allow students to see faces and hear voices that are similar to their own, and making certain that the suggested participation structure does not skip over minoritized voices. These discussion points and suggestions will provide direction for MODULE(S<sup>2</sup>) as the RAC moves forward.

### Resources

A selection of the MODULE(S<sup>2</sup>) materials are available by request in each of the content areas. In the 2020–2021 academic year, the MODULE(S<sup>2</sup>) team will publish components of materials in each content area through the Mathematics Teacher Education Partnership Canvas page. Institutions and/or faculty interested in access to the sample materials will be asked to share contact information in order to access materials so that the MODULE(S<sup>2</sup>) team may contact potential users. If you would like access to materials prior to that publication, please email [Jeremy.Strayer@mtsu.edu](mailto:Jeremy.Strayer@mtsu.edu).

### Opportunities for Engagement

The MODULE(S<sup>2</sup>) RAC invites members to join conversations about the future work of this RAC. Please contact [Alyson.Lischka@mtsu.edu](mailto:Alyson.Lischka@mtsu.edu) if you wish to be included in these conversations. In addition, we will be seeking pilots for all content areas in the future. If you or a colleague are interested in future piloting opportunities, please visit the MODULE(S<sup>2</sup>) webpage at <https://www.mtsu.edu/jstrayer/modules/modules2.php> and complete the form found there to indicate your interest.

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## Program Recruitment and Retention (PR<sup>2</sup>)

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### Problem Addressed and General Approach

It is well established that Program Recruitment and Retention (PR<sup>2</sup>) are complex issues. As highlighted in the chapter on recruitment and retention in *The Mathematics Teacher Education Partnership: The Power of a Networked Improvement Community to Transform Secondary Mathematics Teacher Preparation*, both recruitment and retention are “a complicated and multifaceted problem with responsibilities and expectations that cross various stakeholder groups” (Dickey et al., 2020, p. 309). PR<sup>2</sup> has spent the last several years trying to study methods for increasing the number of well-prepared, diverse students entering into a teacher preparation program. Despite multiple attempts at Plan-Do-Study-Act (PDSA) cycles, the RAC continually found several confounding issues: (a) our programs and institutions across the nation vary widely, (b) state and institutional policies impact each program differently, and (c) recruitment is often an “extra duty” of faculty—dedicated recruitment specialists most likely are at the college or university level, not the program level. The RAC acknowledges that these challenges must be overcome. Both qualitative and quantitative research needs to be conducted to understand how we attract and retain students in a secondary mathematics teacher education program.

### Current Progress

The RAC is currently developing a white paper that captures the challenges and barriers of recruitment and program retention. The goal of this white paper is to raise the awareness of how difficult it is to recruit students to secondary mathematics teacher education—much less to education or even to a traditional college or university. Concurrently, we are developing a grant submission to study how state and federal policies impact a program’s ability to recruit and retain students. Our study will investigate four research questions: (1) what state, institution, or program policies lead to improved teacher candidate persistence and retention; (2) what state, institution, or program policies hinder teacher candidate persistence and retention, (3) what state, institution, or program policies negatively impact equity and diversity in programs; and (4) how do variance in these policies due to COVID-19 impact teacher candidate persistence and retention? It is our hope that this research will inform the field by highlighting the impact (both positively and negatively) that state, institutional, and program policies have on students. Further, we hope to leverage the relaxing of policies due to the COVID-19 pandemic to demonstrate that many of the current policies are overbearing and potentially not necessary. Our research methodology will include program-level case studies as well as policy analysis that highlights themes and trends in policy enactment.

### Resources

The work of this RAC draws heavily on the work that is accomplished at our own institutions. Understanding how other institutions engage in recruitment has been very beneficial as we borrow and replicate ideas. For an outline of work at RAC member institutions, we encourage referencing Section IV: Opportunities for Recruitment and Retention in *The Mathematics Teacher Education Partnership: The Power of a Networked*

*Improvement Community to Transform Secondary Mathematics Teacher Preparation* (Martin, Lawler, Lischka, & Smith, 2020).

### Opportunities for Engagement

Once the white paper on *Issues and Barriers of Recruitment and Retention* is complete, it will be available for referencing. We will share with the larger MTE-Partnership membership. Additionally, MTE-Partnership members will have the opportunity to participate in the upcoming grant submission. Information will be shared with members as the grant development and submission progresses.

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## Supporting Teacher Retention in Diverse Educational Settings (STRIDES)

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### Problem Addressed and General Approach

The United States faces a continuing shortage of well-prepared secondary mathematics teachers, among the worst of any subject (Malkus, Hoyer, & Sparks, 2015). To address this issue, schools often rely on both in-service professional development, which not all teachers may opt to participate in, as well as initial teacher preparation programs, to recruit and retain highly qualified teachers. The quality of teacher preparation, particularly related to pedagogical practice, significantly impacts new teacher attrition (Ingersoll, Merrill, & May, 2014). Studies find that 50% of all teachers leave the profession within the first five years (Foster, 2010), and the rate of departure for mathematics teachers is highest in high-poverty schools (e.g., Goldring, Taie, & Riddles, 2014). According to the Learning Policy Institute, 40% of newly hired mathematics or science teachers are underprepared, and underprepared teachers are far more likely to teach in schools serving students of color and low-income students (Carver-Thomas, 2018). These studies speak to the urgency of both training highly qualified mathematics teachers and providing ongoing support during their induction years to ensure new teachers find the success and job satisfaction needed to retain them in the profession.

The Secondary Teacher Recruitment and Induction in Diverse Educational Settings (STRIDES) RAC members strive to create a sustainable and cohesive system of professional support (from pre-service through early years in the profession) to retain high-quality secondary mathematics teachers in the field. This report highlights the current work of the STRIDES team to develop timely interventions and supports through which to meet this goal.

### Theoretical Framework

Novice teachers often feel isolated, and those feelings of isolation are often associated with teachers leaving the field (Carroll & Fulton, 2004; Schlichte, Yssel, & Merbler, 2005). This work is grounded in the perspective that teacher retention would improve with the development of communities of practice to provide a support network to draw upon, including online communities (Wenger, 2011). Communities of practice are “groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly” (Wenger, 2011, p.1). Wenger further shared three features that characterize communities of practice: a domain of interest, a community (members who participate in joint activities and discussions), and shared practice. For our work, our domain of interest is teaching high school mathematics during the early years of a teacher’s career. The community consists of early-career teachers, mid-career mentoring teachers, curriculum specialists, and university program coordinators and mathematics teacher education faculty. The practice of focus is teaching mathematics. We recognize that the work of retaining teachers requires, in part, a focus on developing relationships within the educational community and promoting connectedness within the larger community (Minarik, Thornton, & Perreault, 2003).

### Past Progress

In the fall of 2014, the STRIDES Research Action Cluster (RAC) was formed to address the national crisis of teacher attrition. Experts agree that addressing this crisis meaningfully requires building a more cohesive system of teacher preparation, support, and development (Mehta et al., 2015). The overarching goal of this RAC is to expand meaningful support for early-career mathematics teachers and by doing so to increase teacher retention at-large.

From 2014–2016 the RAC developed a survey in iterative cycles of survey design. The purpose of the survey was for teachers to reflect on the professional learning activities and communities in which they participate, and to learn more about the current support systems that exist, in hopes to better support teachers and ultimately improve teacher retention rates. This survey was implemented nationally in 2016–2017 with 141 early-career secondary mathematics teachers responding (with matched pair responses in fall/spring). The data from this survey was analyzed in 2017–2018 and used to identify two focal areas (administrative relationships and local support). Data driven interventions were also designed, and the planning began for pilot implementation.

In 2018, two sub-RACs were formed, each taking on one of the focal areas aforementioned. One sub-RAC referred to itself as the “admin sub-RAC” and the other as “PLC sub-RAC.” From 2018–2020 pilot interventions were implemented nationwide on a small scale, with the overall goal to support early-career teachers in a purposeful way. The admin sub-RAC focuses its efforts on making substantive connections between early-career secondary mathematics teachers and administrators at their sites. In the spring of 2019, members of this sub-RAC completed a pilot study with teachers and site principals in the Knoxville, Tennessee, area. This experimental research study involved the principal and an early-career teacher in a “10-minute meeting” where the pair viewed a five-minute video illustrating the importance of discourse in the secondary mathematics classroom followed by five minutes of discussion about the merits of this instructional strategy. A second early-career mathematics teacher at the same school site did not participate in the intervention and served as a control participant. Electronic surveys were completed by all participants, administrators as well as both experimental and control teachers, before and after the intervention to measure feelings of support and self-efficacy. Relative to control participants, increased feelings of self-efficacy and support were found for all experimental participants at all sites where the intervention was conducted. Relative to before the intervention, increases in professional self-efficacy and increased feelings of providing support to teachers was found for the administrative participants as well. The PLC sub-RAC implemented an intervention designed to provide targeted support to first-year teachers by: (1) strengthening the mentor/mentee relationship through monthly communications; (2) suggesting targeted discussion topics between the mentor/mentee teachers; (3) and providing synchronous online meetings as well as social media outlets for the teachers to build a professional community. Some of the timely, targeted communications included teacher self-care, keeping testing in perspective, time management, goal setting, and orchestrating productive struggle and mathematical discourse. Data collection was done in the form of teacher/researcher communications such as emails, Google forms at mid and end of year, recorded Zoom sessions, and commentary from the social media group account. All active teacher participants report that the support received was positive and impactful, but the research team struggled to keep participants engaged throughout the academic year. Both sub-RACs used PDSA cycles to test interventions and make data-driven improvements to strengthen them over the two-year span.

Next steps for STRIDES in the 2020–2021 academic year include major changes in both sub-RACs. The admin sub-RAC is planning on scaling up this academic year with the support of the California State University (CSU) Chancellor’s Office, who will be providing institutional support and access to email contacts for approximately 600 early-career mathematics teachers who have completed their certification in the CSU system the past three years. The PLC sub-RAC is going back to the drawing board with several lessons learned to revamp

existing interventions as recruitment, participation, and active engagement of teacher participants have been issues.

### **STRIDES at the 2020 MTE-Partnership Conference**

STRIDES members began the conference with a pre-work assignment of divvying up all of the conference presentations. Each member took one to three sessions to watch and then reported via a shared document, and also spent significant time discussing each research session and whether there were any implications to our RAC. The RAC welcomed several new members this summer, which was very exciting. Next, we spent time discussing the possibility of writing a grant to support our work. As of now, all of STRIDES' work has been done with no funding. The decision was made that no one on the team has the capacity or desire to lead a large grant such as NSF, and we are unfamiliar with possible smaller-scale grants. We also believe that this work would be more sustainable if it was implemented with little to no funding.

The rest of the conference time was spent broken into sub-RACs. The admin sub-RAC further defined protocols for recruitment and implementation of the scaled up research study planned for the late fall in California. The PLC sub-RAC spent significant time thinking through lessons learned from the past two years and how we can use those to update and improve efforts for the upcoming year. We discussed: whom do we recruit, how do we recruit, are local efforts more impactful than national efforts, and how do we incentivize our program.

### **Resources Available**

STRIDES members have done multiple presentations at national conferences over the past several years as well as had their work published in multiple places. A few of those examples are listed below. Some of these are available online but all of them are available by reaching out to Lisa Amick.

#### Publications

- MTE-P annual conference proceedings from previous years
- “The Mathematics Teacher Education Partnership: The Power of a Networked Improvement Community to Transform Secondary Mathematics Teacher Preparation” (2020)
- Martinez, J., & Amick, L. (2019). What educational leaders need to know about early career mathematics teachers. *Journal of Mathematics Education Leadership*.

#### Recent Conference Presentations

- Gomez-Johnson, K., Martinez, J. A., Uy, F., & Williams, C. (2020, June). Developing relationships between early-career teachers and their principals: An intervention scaling dilemma. Presented at the annual meeting of the MTE-P, Scottsdale, AZ. (virtual conference)
- Amick, L., & Jakopovic, P. (2020, June). Impacting teacher retention by supporting secondary mathematics teachers in their first two years of teaching. Presented at the annual meeting of the MTE-P, Scottsdale, AZ. (virtual conference)
- Amick, L. (2020, February). Research-based, targeted interventions to support and retain early-career secondary mathematics teachers. Presented at the annual meeting of the AMTE, Phoenix, AZ.
- Uy, F., & Amick, L. (2019, November). Impacting teacher retention by supporting secondary mathematics teachers in their first year. Presented at the annual meeting of the SSMA, Salt Lake City, UT.

- Amick, L. (2019, June). Impacting teacher retention by supporting secondary mathematics teachers in their first year of teaching. Presented at the annual meeting of the MTE-P, St. Louis, MO.
- Amick, L. et. al. (2019, April). Working as a NIC to prepare secondary mathematics teachers to meet the AMTE Standards. Presented at the annual meeting of NCTM, San Diego, CA.

#### Upcoming Conference Presentations

- Amick, L., Campitelli, M., Jakopovic, P., Kysh, J., Parker, D., Pforts, A. Weiland, T., & Wilding, L. (2021, June). The design and implementation of an intervention to target and retain early-career mathematics teachers. To be presented at the 42nd annual meeting of the PME-NA, Mazatlán, Mexico.
- Amick, L. (2020, November). Supporting and retaining early-career mathematics teachers through targeted interventions. To be presented at the 2020 SSMA Convention in Minneapolis, MN.

### **Opportunities for Engagement**

Moving beyond the 2020 conference, the STRIDES team is interested in hearing from other members of the MTE-Partnership community to strengthen our recruitment and retention efforts. Insights into how local NICs might utilize the work of this RAC for local transformation, as well as suggestions and recommendations to continue to refine the team's efforts are solicited. The team would like to encourage new and returning MTE-Partnership members to join the team for the revised implementation of interventions during the 2020–2021 academic year, and to share this invitation with colleagues at your and other institutions, particularly those who have connections to local teams that might be interested in the work of STRIDES.

In addition to supporting the interventions, the team is open to collaboration to consider various internal or external funding opportunities that could strengthen the recruitment and participation of new teachers, teacher mentors, and local school partnerships, as well as potentially provide supports to members of the research team who are investing time and resources to analyze data and develop/deliver the interventions. If you are interesting in learning more about STRIDES or joining the RAC, please contact Lisa Amick, STRIDES RAC Leader, at [lisa.amick@uky.edu](mailto:lisa.amick@uky.edu).

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# RESEARCH PRESENTATIONS

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## Examining Equitable Participation in a Professional Learning Community using the EQUIP Tool

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### Abstract

This paper presents an analysis of how prospective secondary mathematics teachers (PSTs) examined and reflected on equitable participation in their mathematics classrooms. Data comes from an assignment in which PSTs used the EQUIP tool (Reinholz & Shah, 2018) to collect, analyze, share, and reflect on data from their practicum classrooms. Results indicated that PSTs saw benefits of the assignment including how the EQUIP allowed them to examine patterns of equitable participation, but they struggled to use the tool and to notice or suggest action steps related to the demographics of their classrooms. Implications for how the assignment can be improved to more effectively engage students in being more critical noticers are discussed.

### Background

According to the Association of Mathematics Teacher Educators (AMTE; 2017), “Ensuring the success of each and every learner requires a deep, integrated focus on equity in every program that prepares teachers of mathematics” (p. 1). Males, Sears, and Lawler (2020) describe how the preparation of secondary mathematics teachers currently “does not adequately attend to societal inequities and injustices” (p. 60). The authors stress the need for teacher preparation programs to prepare prospective secondary mathematics teachers (PSTs) to attend to equity and social justice issues. One critical area of work is developing resources and assignments to engage PSTs in analyzing their instructional practices. The EQUIP tool (Reinholz & Shah, 2018) was developed for teachers to collect and analyze participation. It “focuses on relatively low-inference dimensions of classroom discourse, which are cross-tabulated with demographic markers such as gender and race to identify patterns of more and less equitable participation within and across lessons” (Reinholz & Shah, p. 140). Preparation programs can use tools like this alongside qualitative approaches to support PSTs in noticing inequitable practices and to support them in providing better opportunities for students.

As mathematics teacher educators, we work to expose our PSTs to tools such as the EQUIP and to create assignments and experiences for our PSTs to attend to equity and social justice issues. In this paper, we describe an assignment that engaged our PSTs in analyzing, sharing, reflecting on, and making a plan to improve the opportunities they provide for equitable participation in their classrooms. In addition, we provide an analysis of the assignment by focusing on the following research questions:

1. What did PSTs attend to when analyzing opportunities for and generating action steps to improve opportunities for equitable participation in their classrooms?
2. What benefits and challenges of the assignment did PSTs name?

## Methods

### Context, Participants, and the Assignment

PSTs completed the assignment in the second of two teaching methods courses in an initial Grades 6–12 mathematics certification program taught by the second author. There were 18 PSTs enrolled in the course and an associated practicum that they attended every day in a middle or high school mathematics classroom. Thirteen students identified as males, and six identified as females. No males identified as a student of color, while three females identified as students of color. PSTs collected the data for this assignment in their practicum classrooms.

This assignment was one of the assignments we asked PSTs to complete to address issues of access and equity emphasized in Candidate C.4 and interwoven throughout the standards. Although we did not use the language Plan-Do-Study-Act (PDSA) explicitly with our PSTs, we engaged them in PDSA cycles (see Figure 1).

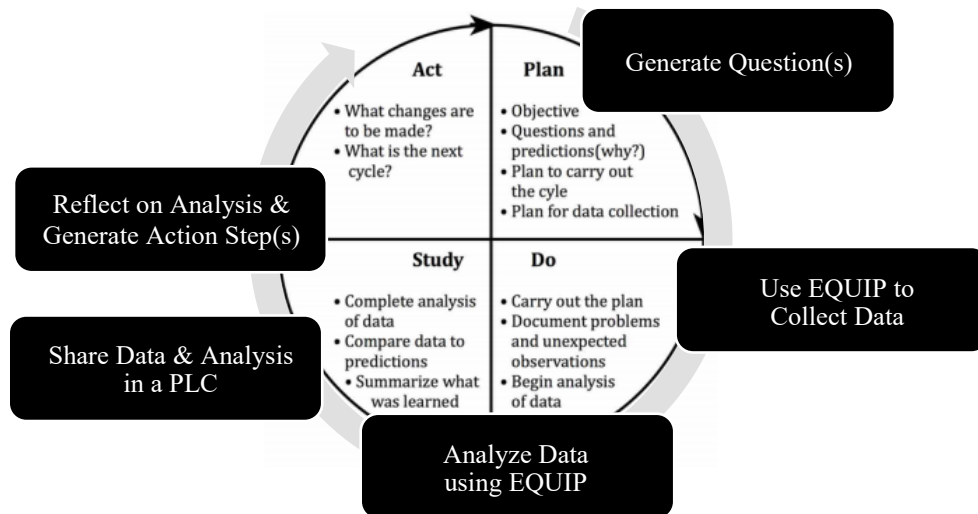


Figure 1. Components of assignment mapped onto Martin & Gobstein's (2018) PDSA cycle structure.

We asked PSTs to: (a) generate a question or questions to examine equitable participation, (b) use the EQUIP tool to collect data from 20 minutes of instruction, (c) analyze the data, (d) share data and analysis in a professional learning community (PLC) in methods, and (e) write a reflection (in October and December) that described steps for improving participation in their classroom.

### Data Collection and Analysis

We collected data in the form of two written reflections and written responses to an evaluation of the assignment. To analyze the data we individually read each reflection and took notes. We then organized the data into a spreadsheet with one row for each PST and columns labeled "Analysis Attention and Codes" and "Action Steps and Codes." The second author placed each PST's question or focus, as written, for each cycle, in a column called "Question/Focus." The first author then placed the words written by the PSTs in their reflection for each cycle, related to their analysis, as well as words related to any action steps they proposed in their respective Attention columns. We then collaboratively coded each PST's Analysis Attention and Action Steps Attention. We used the EQUIP demographics (e.g., race, gender) and discourse dimensions (e.g., teacher solicitation, wait time, solicitation methods, length of talk, student talk), while also being open to generating codes not captured explicitly



by demographics or the discourse dimensions available in EQUIP. One such code we decided to create was general practices, which captured aspects such as participation structures, roles, classrooms norm, and timing.

## Results and Discussion

### The Focus of PSTs Analysis and Action Steps

Table 1 illustrates the total number of each of our assigned codes across all PSTs.

**Table 1**

*Number of Codes Assigned by Discourse Dimension and Demographic Category*

	Attended to in Analysis					Attended to in Action Steps				
	Race	Gender	SpEd	ELL	None	Race	Gender	SpEd	ELL	None
Teacher Solicitation		1	1		2		1			6
Wait Time		2			1		3			
Solicitation Methods	2	5	1		6	1	3		1	10
Length of Talk			1		1					1
Student Talk	1	7		1			1			1
Number of Students			1		2					
General Practices					1				4	14

When analyzing, PSTs more frequently attended to solicitation methods and student talk, but did not often consider demographics. When they were considered, gender was the most frequently discussed demographic. PSTs rarely attended to race. When generating action steps, PSTs attended most frequently to general practices and solicitation methods and, once again, did not often address demographic information. Some PSTs mentioned gender and one PST discussed race, stating he needed to call on students “more evenly in terms of race and gender.”

Looking across PSTs’ analysis and action steps, we noticed that PSTs did not often align their action steps with their analysis. For example, those that mentioned something about the participation of special education students in their analysis did not mention special education students in their action steps. In addition, while we only coded one statement as general practices in PSTs’ analysis, we coded 18 statements as general practices when attending to action steps.

### Benefits and Challenges of the Assignment

PSTs named numerous benefits of the assignment. First, PSTs said the assignment supported their noticing of patterns related to equitable participation including revealing areas of needed improvement with respect to demographic factors such as gender and race. Second, PSTs mentioned that the EQUIP tool allowed them to track participation and provided specific details such as the equity score and reports that could support

their improvement in areas that they felt uncomfortable with. Finally, PSTs also mentioned general benefits, such as the usefulness of analyzing video and being able to learn from one's practice and from others in the PLC.

PSTs also named challenges. First, they had difficulties setting up and using the EQUIP tool, especially the first time they used it. Second, they had challenges designing their studies, with some students mentioning the difficulty they had generating a question or identifying a question that they could actually investigate by collecting data. PSTs also had difficulties deciding what data to collect and deciding how this data would contribute to answering their question(s). Finally, they described data collection difficulties including logging contributions while watching their video, classifying student talk, and general video issues (e.g., visibility).

### Summary and Next Steps

In summary, PSTs did see the benefits of the assignment including how it allowed them to examine patterns of equitable participation, but also had difficulties designing their study and using the EQUIP tool, especially at first. In addition, while PSTs were able to analyze their data and describe action steps, these did not often attend to the specific demographics of their practicum classrooms. PSTs also attended more to teacher-focused rather than student-focused dimensions (e.g., teacher solicitation, solicitation methods, instructional practices).

To support PSTs in focusing more on equitable participation by considering the specific students in their classrooms, we could require students to practice generating research questions and ask that these questions attend more explicitly to demographics. In addition, we can spend time discussing data collection methods and practice logging contributions together on the same video. To generate more critical noticers, we may also engage students in more than two cycles and during these cycles specify particular discourse dimensions, such as the more student-focused ones, and particular demographics such as race.

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## Mathematical Modeling Modules: Curriculum Material for Secondary Teacher Education

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### Abstract

This NSF-funded project, the Mathematics of Doing, Understanding, Learning, and Educating for Secondary Schools (MODULE(S<sup>2</sup>)), supports collaborative development of mathematical modeling modules that were first piloted around the country in 2019–2020 and will be eventually made available widely. This report provides an overview of the structure of the material, highlights several modeling tasks, describes the use of simulations of practice in the curriculum materials, and summarizes activities conducted with piloting faculty.

### Introduction

Mathematical modeling addresses complex social, economic, and scientific issues. Since the *Common Core State Standards of Mathematics* were issued about 10 years ago, modeling has gained prominence in the K–12 curriculum, even in states that did not adopt the Common Core. At the university level, mathematical modeling has been a course available at both the undergraduate and graduate levels. In fact, modeling is an area of research in the mathematical sciences in which one can earn a Ph.D. (e.g., [Rochester Institute of Technology](#) program). Yet, most teacher preparation programs do not require a mathematical modeling course, and in many cases, mathematics faculty are not familiar with approaches to teach modeling in K–12.

Mathematicians, engineers, social scientists, and many other people participate in mathematical modeling at the professional level in order to make predictions about the stock market, the weather, the efficacy of drugs under development, people’s behavior, and many other situations. Modeling may be done to address a local problem in a community, to understand natural phenomena, or in response to a crisis like the coronavirus pandemic. In the last few months, we have been bombarded with mathematical models related to coronavirus showing that different models predict different outcomes depending on the assumptions made ([NY Times, 2020](#)). When more information about the spread of the disease became available, the model predictions showed increased agreement. The weekly updates of the models provided a real-time example of the modeling process at work.

The modeling process is essentially the same at all levels. The approaches and the models might be more complex or more sophisticated, but the process is essentially the same. Additionally, many communities of engineers, students, scientists, and others hold viewpoints on mathematical modeling dependent on how they experience and work with it. We propose that the development of mathematical modeling teaching practices in K–12 can benefit from acknowledging and including the different communities. Such collaboration can provide purpose and context for the tasks and give insights into the competencies that need to be developed.

This process has implications in teacher education. Mathematical modeling is not a prescriptive process; it is creative and personal. We believe that teacher educators can benefit from doing mathematical modeling to experience it the way students do, and from becoming familiar to some degree with the research on teaching and

learning mathematical modeling. Both of these points provide appreciation for modeling and can inform ways in which teacher educators can guide pre-service teachers in the construction of their models and the modeling process itself.

### Overview of Mathematical Modeling Course Materials

Our curricular materials include three modules in mathematical modeling for pre-service teachers (PSTs). Module 1, *The Process and Purpose of Mathematical Modeling*, incorporates lessons that focus on understanding the elements of the mathematical modeling process or cycle. Module 2, *Incorporating Real Data in Mathematical Modeling*, includes lessons in which prospective teachers consider data for creating mathematical models. Module 3, *Diverse Perspectives in Mathematical Modeling*, focuses on topics in which issues of equity and social justice arise, with mathematical modeling serving to provide insight within the topics. At the end of each module, the curricular materials require PSTs to write a reflection on the mathematical modeling process to capture growth in their learning across the three modules. At the end of the third module, a culminating final project provides the opportunity for PSTs to create their own modeling problem appropriate for the secondary curriculum.

The common components of each lesson include an overview with specific goals, relevant content standards, concepts that are beyond the standards, and materials such as handouts, slides, and pertinent readings for students. In addition, the lessons provide instructors with mathematical, historical, and pedagogical notes, as well as technological tool options. The lessons are structured with an introduction, including background information on a specific topic, guided exploration of a task, and opportunities for students to present their solutions. Each lesson incorporates sample approaches and possible models to aid instructor preparation.

Below we present a sample modeling task from Module 1 on water conservation. Included in the lessons are guiding questions for instructors to pose as PSTs work on the problem to serve as a catalyst to stimulate thinking.

<p><i>Some say that showering uses less water than bathing. Others say that this is not true! Provide a method to determine if a shower or a bath uses more water and explain your approach. Keep in mind that older showerheads have a flow rate of up to 3.4 gallons/minute whereas energy-saving showerheads have a flow rate as low as 1.9 gallons/minute. Bathtubs also vary in size.</i></p>	<p>What information do we need?          Where do we find this information?          What do we do with information we need but we can't find?          How do we develop a procedure to determine which is better?          How do we present this procedure?          What mathematics might be relevant to use?          How do we know how accurate our results are?</p>
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Figure 1. Water conservation task and guiding questions.

In a Module 2 lesson, PSTs are prompted to come up with a model for the memorization process. Following a broader discussion of learning theory, they collect their own data to create, parameterize, and validate models that reflect their own experience and provide insight into a topic related to learning and teaching. A lesson in Module 3 addresses the reduction in Native American reservation lands. Examining several resources and historical documents, PSTs create models to determine areas of the Great Sioux Reservation in 1851 and 1876, as well as engage in discussions about the treatment of Native Americans in U.S. history.

Selected lessons in each module include a *simulation of practice* (SoP) activity that places prospective teachers in a position to plan class discussions and react or respond to students’ thinking, either through a written or video reflection. These SoP activities are intended to engage PSTs in practices of teaching (Grossman et al., 2009) and serve as tools within the modules for the instructor to gather information and provide feedback on the prospective teachers’ developing knowledge for teaching mathematical modeling. In a SoP associated with the water conservation task in Figure 1, we ask prospective teachers to describe how they would plan to facilitate an interactive discussion around this problem. The sample written SoP assignment (see Figure 2) includes a diagram of the mathematical modeling process.

<p>Assume that your students have worked on the water conservation modeling task. In 1-2 pages, describe how you would plan to facilitate a discussion with your students which will allow you to elicit student thinking about the modeling process while addressing the following questions:</p> <ul style="list-style-type: none"> <li>• What elements of the modeling process are prominent in this lesson? Explain your answer and give examples to support your argument.</li> <li>• How would you extend the task to promote further iterations of the modeling cycle?</li> </ul>	<p style="text-align: center;"><b>A Modeling Process</b></p>
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Figure 2. Example simulation of practice (SoP).

Our curricular materials include a rubric for instructors to provide feedback to the prospective teachers on their work in the SoP. Note that the descriptors in the rubric serve to help the prospective teachers and instructors focus on specific areas in the work of teaching mathematical modeling.

**Table 1.**

*Rubric for Feedback to Prospective Teachers on the Simulations of Practice (SoP)*

Descriptor	Meets Expectations	Does Not Meet Expectations
Central mathematical points	Central mathematical points are clearly defined.	Central mathematical points are missed or not clearly defined.
Appropriateness of questions	Questions posed help students advance their thinking.	No questions are included. Questions posed do not help students advance their thinking.
Relationship to modeling process	Discussion prompts address relationship to mathematical modeling process appropriately.	Discussion prompts do not address relationship to mathematical modeling process appropriately.
Advancing the understanding of the modeling process	The planned discussion is likely to advance student understanding of the modeling process.	The planned discussion is not focused and not likely to advance the modeling process.
Appropriateness of anticipated student responses	Anticipated student responses are appropriate.	Anticipated student responses are unreasonable, inappropriate, or not included.

### Teaching with the Mathematical Modeling Materials

The first pilots of the Mathematical Modeling modules were conducted in the 2019–2020 academic year. The five instructors recruited to participate came from various institutions in the Midwest and South and planned to implement the materials in a mix of different courses: mathematical modeling for future high school teachers, methods of mathematics teaching, and mathematical content courses for future middle school teachers. To prepare instructors to teach with the materials, we conducted a summer session with a focus on developing the key instructional practices for mathematics teacher educators that the materials aim to promote for PSTs, namely: (1) generating questions and discussion that promote students' mathematical explorations; and (2) learning about student understanding using their explanations, justifications, and representations. To share the vision of these practices in undergraduate teaching we used readings from the [MAA Instructional Practice Guide](#), and created videos of members of the MODULE(S<sup>2</sup>) team teaching mathematical modeling lessons.

The structure of professional development activities during the summer provided instructors with opportunities to analyze and prepare several specific lessons. Research indicates that reflection on instruction and on one's students' performance is likely to result in change when observations are strongly linked to specific future instructional actions (e.g., Horn et al., 2015). We began by engaging in a mathematical modeling task from a particular lesson to delve into the mathematics. Then, we observed and collectively analyzed a video of a classroom session that highlighted a key instructional practice. Next, pilots would read the instructor guide, create their own plan, and conduct a lesson rehearsal with other participants acting as PSTs in a simulation. We video recorded and collectively analyzed these lesson rehearsals.

During the academic year, instructors taught their courses and collected data for the project. They received support and gave feedback through discussion boards on Canvas, and enactments of key lessons in each module were videotaped. We held monthly online professional learning community meetings over Zoom, to collectively analyze short clips from their lessons and discuss instruction and PSTs' performances on modeling tasks and simulations of practice.

### Summary and Future Work

Mathematical modeling is in the unique position of being part of the K–12 curriculum, a topic in undergraduate mathematics, a technique used by professionals, and an active area of research. MODULE(S<sup>2</sup>) has sought to develop materials that target future teachers' experience *doing* modeling along with mathematical knowledge for *teaching* modeling. In our research, we plan to analyze the SoP responses to gain insight into the PSTs' development of mathematical knowledge for teaching specific to modeling. Data from the pilots will inform our revision of student and instructor materials in preparation for the next round, planned for 2021–2022.

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## Considering Mathematics Education Program Recruitment and Retention Through a Student-Centric Logic Model

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### Abstract

The Mathematics Teacher Education Partnership (MTE-Partnership) in the *Guiding Principles for Secondary Mathematics Teacher Preparation Programs* (2012, 2014) and the Association of Mathematics Teacher Educators (AMTE) in the *Standards for Preparing Teachers of Mathematics* (2017) underscore the importance of mathematics education programs attending to recruitment and retention efforts to increase the number of applicants and completers, including those representing diverse communities. Local and regional partnership teams from the MTE-Partnership that contribute to the Program Recruitment and Retention Research Action Cluster (PR<sup>2</sup> RAC) engage in planning, implementing, analyzing and sharing program recruitment and retention strategies and approaches, along with results for the continued improvement across MTE-Partnership institutions. This paper discusses the use of a tool—a student-centric logic model—to guide and analyze secondary mathematics teacher education program recruitment and/or retention planning from the perspectives of potential students. Three PR<sup>2</sup> RAC institutions share student-centric logic-models for their programs, one undergraduate, one post-baccalaureate, and one Master of Arts in teaching, and discuss the recruitment and retention strategies they are planning, implementing, and analyzing.

### Introduction

Throughout recent years, the United States has been faced with concerns about having an adequate number of well-prepared secondary mathematics teachers to meet demands (Banilower et. al., 2013; Ingersoll & Perda, 2010). In fact, Brainard (2007) reported that 30% of high school mathematics students in the U.S. were taught by teachers who did not major in the field in college or were not certified to teach mathematics. In 2010, the President's Council of Advisors on Science and Technology (PCAST) published an executive report highlighting the most important factor for STEM excellence in the U.S. was the need to recruit and prepare great STEM teachers; teachers “with both deep content knowledge in STEM subjects and mastery of the pedagogical skills required to teach these subjects well” (p. xi). At the same time, researchers and policy makers have emphasized the need for more racial and ethnic diversity in the teaching profession in ways that are more aligned with the students and population at large (D'Amico et al., 2017; U.S. Department of Education, 2016).

In an effort to increase the numbers of better-qualified and diverse secondary school mathematics teachers being recruited, retained, and graduating from institutions of higher education, the Program Recruitment and Retention Research Action Cluster (PR<sup>2</sup> RAC) was established as part of the larger MTE-Partnership (Martin et al., 2020). The PR<sup>2</sup> RAC is a consortium of institutions of higher education with secondary mathematics teacher education programs and their school partners (program teams) engaged in efforts to develop strategies and approaches for effective recruitment and program retention of secondary mathematics teacher education candidates. The work of the PR<sup>2</sup> RAC is grounded in improvement science (Byrk et al., 2015), including its evolution from the MATH RAC (Fernandez, 2020), and founded by the *Guiding Principles* (MTE-Partnership, 2012; 2014) and the AMTE Standards (2017). Both documents underscore the importance of mathematics teacher education programs attending to

recruitment and retention efforts to increase the number of applicants and completers, including those representing diverse communities. For the PR<sup>2</sup> programs and their school partners, the diversity of candidates has been sought in ways that closely align with the demographics of the communities that the programs serve (McNamara, Franz, & Fernandez, 2020). Thus, the demographics of secondary mathematics teacher candidates sought can vary depending on where the programs are located, the needs of their communities, and the communities served by their institutions.

### Student-Centric Logic Model for Program Recruitment and Retention

Logic models are graphical tools that can be used to map out program components and the processes that link them (McLaughlin & Jordan, 1999; Newton et al., 2013). Given the linkages presented among the components, a logic model can be used to present how a program will work to solve known problems. Such models can be used for program planning, implementation, and evaluation and should be revised periodically as changes in the context occur, lessons are learned, and obstacles are identified that lead to changes in program components.

Figure 1 contains a Student-Centric Logic Model used by PR<sup>2</sup> program teams to guide and analyze program efforts for recruitment and retention from the perspectives of their potential students. The programs seek to recruit, retain, and graduate well-prepared secondary mathematics teacher candidates from diverse backgrounds aligned with the communities each program serves. This logic model consists of the following elements: Needs, Objectives, Input, Activities, Output, and Outcomes. The Needs element captures why students attend the institution in which the program being represented is housed. This helps program teams think deeply about the students they are seeking to recruit and retain in their programs. The Objectives element denotes what are the goals of students a program is seeking to recruit while attending the higher education institution. The Input element depicts aspects of the environment and community that potential program students are exposed to as part of their consideration of and attendance at the institution. This element includes Inputs encountered before applying and being admitted to the program, once admitted, and during the program. The Activities element describes ways to engage students through their Inputs that are aligned with their needs and objectives for attending the institution and engaging in the program. The Output element provides expected results from engaging the students in the Activities. Finally, the Outcomes element provides measurable items to assess the success of the Activities based on the Outputs. The PR<sup>2</sup> program teams investigate the Activities through the use of Plan-Do-Study-Act (PDSA) cycles central to networked improvement communities (NICs; Byrk et al., 2015). Fernandez (2020) provides examples of PDSA cycles used for program recruitment.

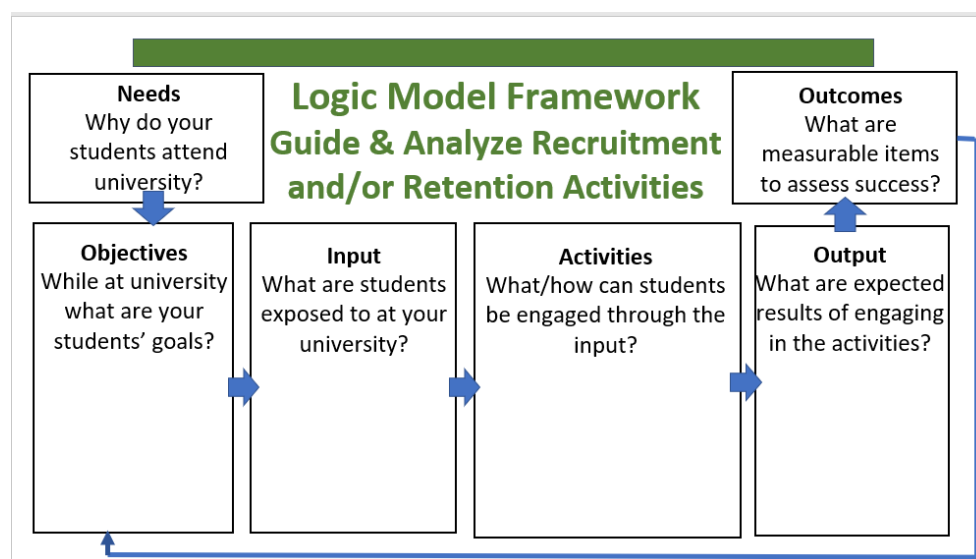


Figure 1. Student-centric logic model for Program Recruitment and Retention RAC.



### Implementation of Student-Centric Logic Model for Program Recruitment and Retention

In this section, we discuss the use of the Student-Centric Logic Model (see Figure 1) across three secondary mathematics teacher education programs whose program teams were part of the PR<sup>2</sup> RAC. The institutions include the following: Florida International University (FIU), California State University-East Bay (CSUEB), and University of Hawai'i at Hilo. The programs discussed include a bachelor's, post-baccalaureate, and Master of Arts in Teaching, respectively.

#### Florida International University's FIUteach Program

Figure 2 provides the Student-Centric Logic Model describing FIU's FIUteach undergraduate program for students majoring in a mathematics or science discipline with an endorsement for teacher certification in Florida. FIUteach was aligned with the UTeach model (Brainard, 2007). When considering the *needs* of the students, the MTE-Partnership FIU team considered students who were attending FIU to pursue the completion of a four-year degree for future employment and opportunities that can support themselves and their families. The *objectives* that they have for attending include finding a major they like, feeling a sense of community while completing their degree, and feeling successful in the choices they make. While attending FIU, students' objectives were met through multiple *inputs* directly related to *activities* they engaged in. For instance, they were helped in deciding on a major through attendance at FIU orientations; talking with program faculty and advisors at orientations and in introductory mathematics classes; engaging with peers including peer advisors and STEMteach, a student organization for mathematics and science education students; taking classes; and seeing visuals with program information within their environment, such as emails to FIU-accepted STEM students, flyers, and posters. The inputs with related activities also overlapped in meeting students' other objectives. For example, students feeling a sense of community was met through student organizations such as STEMteach and engaging with program faculty and staff as well as other program students. Feeling successful in their program choices was met through success in their classes and communications with and support from program faculty and staff, as well as through STEMteach, which offered workshops for successful completion of state teacher certification exams and collaboration for academic success. The outputs provide descriptions of the expected results, and the *outcomes* consist of the results-related measures to assess success from the activities. Activities are investigated through PDSA cycles (Byrk et al., 2015; Fernandez, 2020).

The FIU team has studied the outcomes of activities proposed. For example, the team found through surveys collected in program introductory STEM education classes and through the program website that students enrolling in these classes to trial teaching primarily heard of the program and introductory course through flyers shared by program faculty and staff including advisors at university orientations and through emails sent before their orientations. On the other hand, few reported hearing of the program through flyers physically mailed to their homes. At a point when the FIU team observed that students were leaving the program because they were not successfully completing the three required state certification exams (General Knowledge, Subject Area, and Professional Knowledge), the team added to the Logic Model, having the STEMteach student organization, along with a program faculty member, share materials and offer workshops for successful completion of the exams. The program tracked student completion of the exams as they proceeded through program classes and found an increase in numbers of students successfully completing the exams and, in turn, an increase in the number of program completers.

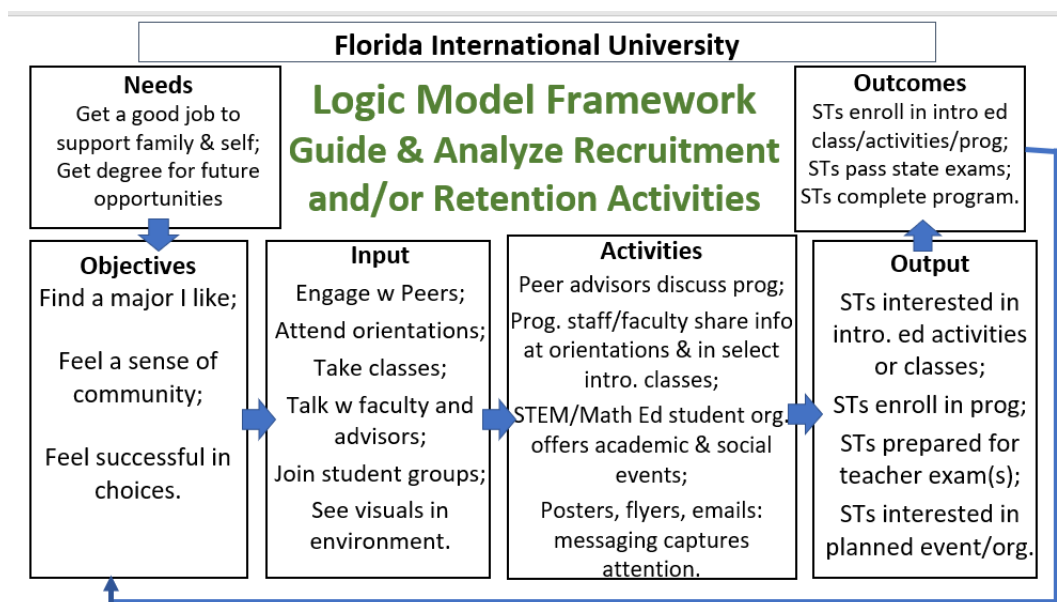


Figure 2. FIU's logic model for its undergraduate Program Recruitment and Retention.

### California State University-East Bay's Single Subject Credential Program

The CSUEB program is a one-year post-baccalaureate program similar to others across the California State University System. Much of the recruitment into the CSUEB program comes from their undergraduate students, who may or may not have already identified that they want to be teachers. Looking at CSUEB's Student-Centric Logic Model (see Figure 3), students attending the institution are seeking to satisfy the need to find a university considered to be a good value, that is nearby, and that can support their opportunity to find employment. Many of their students come from the local community. Students seeking additional opportunities beyond their bachelor's degree have Objectives to receive preliminary credentials and opportunities for local employment, including getting hired as a local teacher. Given the post-baccalaureate nature of the program, the Inputs are considered starting while potential students are undergraduates. These include students participating in university events such as those aimed at mathematics and science students interested in teaching, students connecting with peers with similar goals, students viewing flyers and electronic announcements about events, and students interacting with instructors that may nominate them as potential teachers for program events. One such event is "A Celebration of Teaching" during which attendees network and hear from current teachers, administrators, and others connected to the teaching profession. A Celebration of Teaching is supported across the state by the CSU Chancellor's Office. With respect to the Activities in the model, the Chancellor's Office provides financial support in addition to that of the institution and program. For example, the Chancellor's Office supports CSU EduCorps (<https://www2.calstate.edu/educorps>) and its' Teacher Toolkit (<http://diversitytools.csu-eppsp.org/>) for recruitment and retention of diverse students in becoming well-prepared teachers across the state. The Chancellor's Office also provides funding for scholarships in addition to the National Science Foundation's Robert Noyce Teacher Scholarships the program offers to support students completing their undergraduate degree in mathematics and the post-baccalaureate program to earn their teaching credential. Additionally, the students complete field experiences in local schools, which support their future employment in the local schools, meeting their Needs and Objectives for finding employment in the local community. The Activities also included helping students prepare for teaching prerequisite requirements, such as subject matter competency exams, field experiences, and navigating the teaching credential application process. As for the Outputs from the Activities, the students were expected to complete all requirements to be accepted into the program, enroll in the program, and obtain their preliminary credential and a position in the field. The Outcomes measured included the numbers of

candidates successfully completing program coursework and passing the licensure exam, obtaining of their teaching credential, and acquisition of a teaching position in the field.

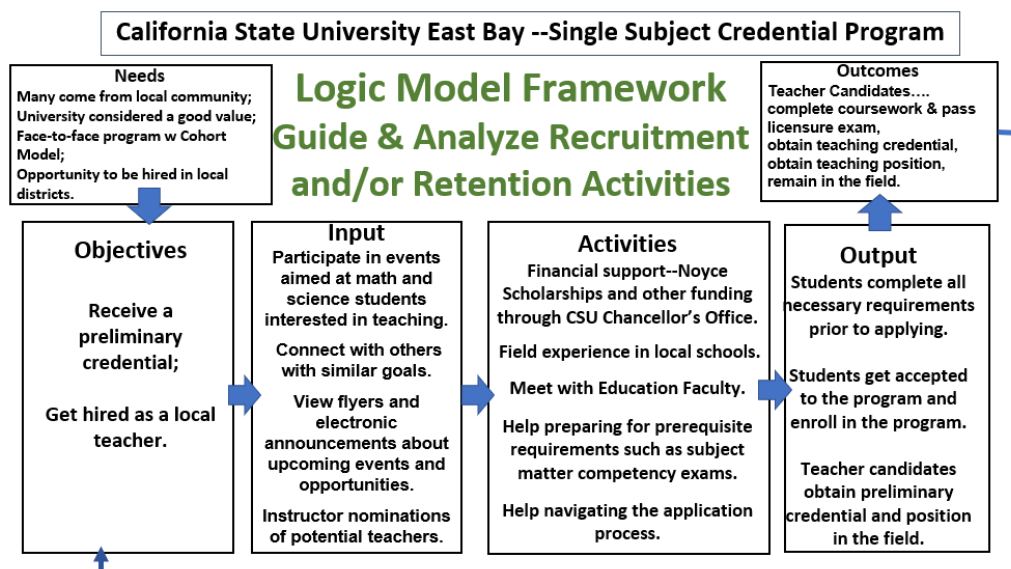


Figure 3. CSUEB's logic model for its post-baccalaureate's Program Recruitment and Retention.

#### University of Hawai'i at Hilo's Master of Arts in Teaching (MAT)

Hilo is a small town on the Big Island of Hawai'i and the University Hawai'i at Hilo and at Mānoa on the island of O'ahu are both part of the University of Hawai'i (UH) System and compose the MTE-Partnership Hui (a Hui is a club). These universities collaborate for the increased recruitment, retention, and graduation of well-prepared teachers with diverse backgrounds aligned with their communities. Figure 4 maps the Student-Centric Logic Model for the UH-Hilo MAT. With respect to Needs, their potential students are seeking a supportive educational environment, preparing them well for future employment without leaving town. Their Objectives include completing the necessary licensure requirements for employment and obtaining a local position. Several Inputs were identified that potential program students are exposed to as they consider selection and then attendance at UH-Hilo to meet their Objectives. Potential students engage with other interested students in courses including prerequisite undergraduate courses that can be completed as part of their undergraduate programs and count toward the MAT. They also have opportunities to talk with peer advisors and faculty. Additionally, they are exposed to program information in the community such as seeing flyers around campus and broader advertising. In regards to Activities aligned with the Inputs students engage in, the UH System has collaborated with local news media on mediums targeting teacher recruitment. UH-Hilo was able to collaborate with its local news media to create informational vehicles about the MAT for teacher recruitment containing program voices, including interviews with students that the program is able to post on its website. Also, the program participates in advertising through School of Education program open houses and program application workshops. The program faculty advise interested students explaining the flow of the program, as well as scholarship opportunities available from state funding such as Grow-Your-Own-Initiatives, and campus funding sought by the program through the institution's financial aid office. Such funding supports students' objectives and needs to get licensed while engaging in a supportive education without leaving town. Other Activities include providing students with extensive field experiences prior to applying for licensure, along with extensive mentoring in the field to support students in successfully completing the program and obtaining a position in a local district. The extensive field experiences and mentoring in the field have been found to be important for retention. As for Outputs, the program outlined the following: students completing all necessary requirements prior to applying, students getting accepted to

and enrolling in the program, and students remaining in the program and in the field. The related Outcomes measuring these results include the numbers of students from diverse backgrounds aligned with the community demographics completing the program and teacher candidates remaining in the profession.

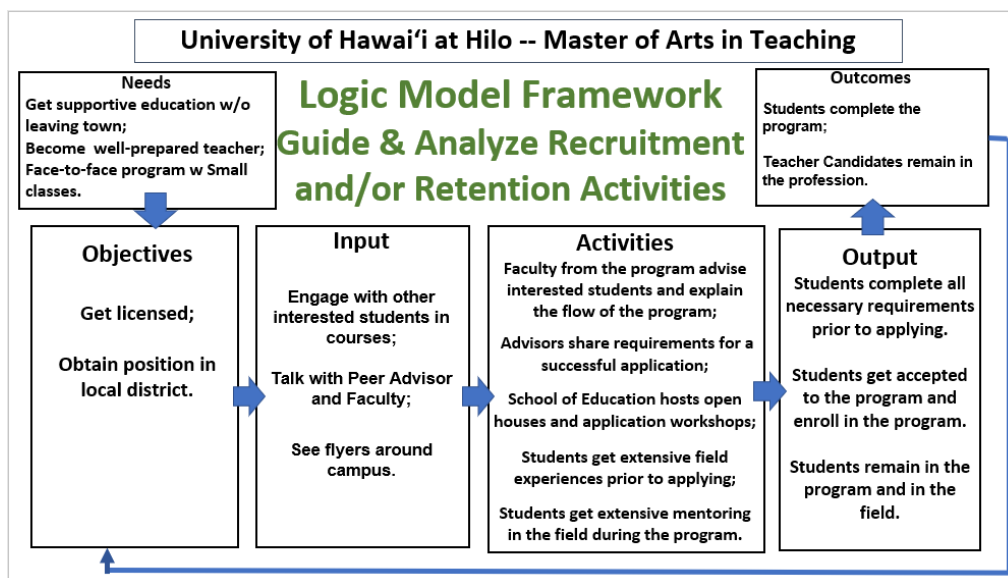


Figure 4. UH-Hilo's logic model for their Master of Arts in Teaching's Program Recruitment and Retention.

### Concluding Remarks

The completed and presented Student-Centric Logic Models for Program Recruitment and Retention of potential students into secondary mathematics teacher preparation represent three types of programs, a bachelor's degree, a post-baccalaureate program, and a Master of Arts in Teaching, across three different communities. One important observation is that the three logic models target program recruitment and retention in accord with the specific location and community served by their institutions and programs, drawing on local opportunities, resources, and collaborations both in and out of the institutions for support in recruiting (Fernandez, 2020) and retaining students. Institutions and programs are not uniform, and the diversity sought among teacher candidates varies depending on where the programs are located as well as the communities served, as suggested by McNamara, Franz, and Fernandez (2020). Through the use of the logic model—including reviewing the components for recruiting and retaining potential students and related outcomes—program faculty and staff, most advantageously in teams, can reflect on possible gaps, challenges, or areas in need of focus at their institutions and for their programs, contributing to continual improvement.

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## Development of a University-School Partnership for Secondary Mathematics Education

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### Abstract

Kennesaw State University (KSU) has developed a close partnership with one local high school with several goals in mind, serving both KSU and the school partner. At KSU, we pursued this opportunity to (1) provide teacher candidates a real context to examine instruction and become comfortable in new roles as teachers in an urban context; (2) to increase the relevance of instruction during the junior year coursework; (3) to create the opportunity for students to rehearse brief instructional routines with high school students; and (4) to create professional, mentoring relationships between certified teachers and our teacher candidates. The school welcomed us for two primary reasons: (1) to provide tutors and (2) to enhance professional learning opportunities of their mathematics faculty.

### Introduction

There is common agreement among mathematics teacher educators on the importance of creating learning opportunities for teacher candidates to develop pedagogical methods grounded in practice-based teaching within a clinical field experience (Forzani, 2014; Yow et al., 2018). Historically, there has been a divide between teacher education coursework and the field experience (Darling-Hammond, 2010; Turley & Stevens, 2015; Zeichner, 2010). However, more recently there has been a shift in teacher education programs from a focus on the knowledge teacher candidates' need for effective teaching to an increased emphasis on their use or implementation of that knowledge in practice (McDonald, Kazemi, & Kavanagh, 2013). In an effort to bridge the divide between theory and practice, some educator preparation programs across the country are beginning to look more closely at benefits associated with building university-school partnerships in ways that support the collaborative development of authentic practice-based teaching opportunities for teacher candidates.

This paper describes the process to establish a university-school partnership, the work to maintain, and aspirations for continued enhancements. The purpose of the university-school partnership is to build mutual trust and respect, shared responsibility and accountability, and to enable teacher candidates to develop contextualized knowledge of teaching and learning. We describe specific activities to enhance the yearlong methods course held at the school, for which we serve as instructors. We also present informal assessments of the impact of the collaboration, specifically the experiences of the teacher candidates.

### Background

Kennesaw State University (KSU) is a comprehensive university with approximately 38,000 students, 91% being undergraduates. The undergraduate mathematics teacher-education program is housed in the College of

Education with approximately 15 to 20 graduates in secondary mathematics education each year. Teacher candidates enrolled in the mathematics education program complete a practicum field experience throughout their junior year and a yearlong student teaching field experience during their senior year. The focus of this paper is on the practicum field experience that takes place during the junior year.

Teacher preparation programs are often structured into content courses, foundations and methods courses, and the field experience. This structure often presents a divide between teacher education coursework and the field experience (Darling-Hammond, 2010; Turley & Stevens, 2015; Zeichner, 2010). As a result, when teacher candidates enter the field experience, mentor teachers often complain that learning in methods courses is “too removed from the day-to-day work of teaching” (Putnam & Borko, 2000, p. 6). A number of research studies on teacher learning suggests that there are some crucial elements of teacher development that can only be learned in the context of a classroom under the guidance of a supportive mentor teacher (Baratz-Snowden, 2005; Darling-Hammond, 2010; Feiman-Nemser, 2012; Grossman, 2010; Howey, 2007). For example, this teacher development can be learned through in-the-moment coaching; assessment for promoting student learning; building relationships with students, families, and certified teachers; learning from scaffolded practice; and developing a teacher identity as it relates to redefining what it means to teach mathematics.

These developmental experiences can occur as a result of collaborative partnerships among a teacher preparation program and a local school district or individual schools (AMTE, 2017; CAEP, 2010; NCATE, 2010) provided the partnership provides a supportive environment in which teacher candidates engage in teaching practices early on in their preparation. In an effort to develop a high-quality, early field experience, KSU’s mathematics teacher education program sought to build a collaborative partnership with a local high-need high school. The partnership is a shared endeavor with a dual focus on: (1) improving the preparation of teachers coupled with increased student learning and (2) a commitment to developing a professional learning community among the school’s mathematics teachers and KSU’s teacher educators.

### **Structure of the Partnership**

The structure of the collaborative partnership between KSU and a local high-need high school is built upon a field experience embedded in each of two methods courses that occur during the fall and spring semesters of the junior year.

### **Purpose and Benefits of the Partnership**

The partnership affords our program an opportunity to provide teacher candidates: (a) a real urban context to examine instruction, (b) an increased relevance of instruction, (c) time to build professional mentoring relationships with certified teachers, (d) opportunities to rehearse instructional routines with high school students, and (e) increased comfort in new roles as teachers in an urban context. Further, benefits for our partner school included: (a) teacher candidates serve as tutors and mentors for high school students, (b) enhanced professional learning for the mathematics community, and (c) community, district, and national recognition for the partnership model. Table 1 outlines the organization and structure of the methods courses and early practicum field experience.

Within the college of education at KSU, there is generally a positive attitude toward building school partnerships and teaching at the high school site. Before this partnership began, the mathematics teacher education department chair, methods instructors, and program coordinator met with the school administrators to discuss both partners’ needs. Our aim was to establish a bidirectional partnership that was mutually beneficial, where communication flowed in both directions, and both partners had some share of decision-making, monitoring, and revisions of the model. Once agreements were made, there was a need to formalize the

relationship with a Memorandum of Understanding (MOU) outlining the partnership terms and details, including expectations and responsibilities of the university and high school. The MOU provided for a KSU faculty member to teach methods courses at the high school and for teacher candidates enrolled in these methods courses to serve as tutors in the school's Advancement Via Individual Determination program and to assist in a mathematics teacher's classroom. School administrators always had the opportunity to make suggestions and changes to the embedded field experience portions of the model as described in Table 1.

**Table 1**

*University-School Partnership Model*

<b>Secondary Mathematics Methods 1</b>	<b>Secondary Mathematics Methods 2</b>
Fall Semester, Junior Year, 2 credits	Spring Semester, Junior Year, 3 credits
<i>Course Content: Knowledge and Practice-based Learning</i>	
<ul style="list-style-type: none"> <li>• Establishing teacher identity</li> <li>• Building relationships with students, families, and teachers at the host school</li> <li>• Creating a different image of who they will be as teachers: manager of discourse rather than transmission of information</li> <li>• Introduction to instructional routines</li> <li>• Four of the 8 Math Teaching Practices (NCTM, 2014): developing conceptual understanding from procedural fluency, rich tasks, establish goal, questioning</li> <li>• Interactions with individual students</li> <li>• Fostering geometric thinking</li> </ul>	<ul style="list-style-type: none"> <li>• Rehearse small instructional routines (i.e., contemplate then calculate)</li> <li>• Approximations of practice</li> <li>• Half of the 8 Math Teaching Practices (NCTM, 2014): facilitate discourse, use and connect representations, productive struggle, elicit and use evidence</li> <li>• Complex Instruction (Horn, 2012)</li> <li>• Small group (vs. individual) interactions</li> <li>• Fostering algebraic thinking</li> <li>• Video critique of teaching</li> <li>• Lesson Planning/Learning Segment</li> </ul>
<i>Embedded Field Experience 1 day/week</i>	
<ul style="list-style-type: none"> <li>• 1 block – AVID Tutoring</li> <li>• 1 block – Mathematics Classroom</li> </ul>	<ul style="list-style-type: none"> <li>• 1 block – AVID Tutoring</li> <li>• 1 block – Mathematics Classroom</li> </ul>

The school welcomed our teacher candidates and methods instructor because of the support our candidates provided as tutors in the Advancement Via Individual Determination program. During the first year of the partnership, all stakeholders met at the end of each semester to reflect on the process, evaluate progress, and refine goals. The high school administrators, mathematics classroom teachers, and AVID coordinator are amazingly patient and supportive; they want our teacher candidates in their school. The teachers feel “special” in the way that they all are mentors, to some degree, to our candidates.

The majority of secondary mathematics teacher candidates at KSU are White people and middle class. The partnership with the high-need school affords them the opportunity to notice issues of equity, confront or reject deficit ideology, embrace and asset view of disadvantaged students and families, and build a sense of comfort in an unfamiliar environment. Further, teacher candidates have a direct link to view theory in practice at the high school site, as well as multiple opportunities to engage in more structured field experiences, observations, and more frequent and sustained supervision and feedback. The experiences for the teacher candidates have been invaluable in their preparation and growth toward becoming an effective teacher. Both the university and the



school partners believed that the primary beneficiaries of the partnership would be the high school students and teacher candidates.

### **Partnership Challenges and Recommendations**

While university-school partnerships provide great opportunities and benefits to both partners, they can also present challenges. However, any challenges encountered can be addressed as the partnership progresses during each semester. As you consider developing your own partnership with a local high-need school, there are a few recommendations to consider. Institutional support, or buy-in, is critical to preventing disconnect between competing faculty expectations and university priorities. Therefore, it is important to have university administrator (i.e., Dean and Chair) support. Every year, we have found it to be demanding to coordinate schedules for teacher candidates in their embedded field experience. Fortunately, our school partners have been patient and supportive when the lines of communication remain open.

Selecting a school-based mathematics teacher who can serve as a liaison can also assist with pairing teacher candidates with mathematics mentor teachers for purposes of collaboration and support. Clear communication in the context of a respectful and trusting relationship among key members of the partnership (for example, in our case: school principals, AVID lead teacher, mathematics teacher liaison, university program coordinator, university field experience coordinator, and methods instructor) can go a long way when conflicts arise, such as changes in an initially selected mentor teacher or available time in the school.

At the beginning of each school year, reach out to school administrators to get a better understanding of their needs. We are committed to developing a culture of professional learning with our partner school. However, we are also sensitive to existing demands on teachers' available time and energies. A continued commitment to nurturing the partnership by attending mathematics teachers' collaborative planning meetings to listen and provide support and resources is needed. As the methods instructors at the school site, we plan to continue to nurture the partnership in ways that will enable and support collegial activities such as course co-planning, co-teaching, and mentoring. Finally, be open and flexible to making changes based on reflections from all parties.

### **Conclusion**

We have had tremendous success at KSU in achieving a university-school partnership that serves to nurture the early development of our secondary mathematics teachers. The partnership provides our teacher candidates with (a) an urban context to examine mathematics instruction, (b) an increased relevance of the methods coursework, (c) mentoring relationships with certified teachers, (d) rehearsals of instructional routines, and (e) increased comfort in new roles as teachers in an urban context. Our partner school receives numerous benefits as well, including: (a) tutors and mentors for high-school students, (b) professional learning for the mathematics community, and (c) recognition for the partnership model.

A key element to both establishing the partnership and maintaining its success has been regular conversations, as well as collaborative design of the partnership with key stakeholders, from both the university and partner school. And, while this level of commitment to ongoing nurturing of the partnership is demanding, the benefits have proven to be tremendous, not only for the teacher candidates, students, and partner teachers but for us as well. We have found great joy in collectively working to improve the mathematics experiences for the high school students, teacher candidates, and teachers involved in the project. Furthermore, our close collaboration with the school partner has helped us bridge the so-called "divide" between the "theory" learned in university coursework and the "practice" teacher candidates experience in the field.

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## What's the Value? Measuring Value in Complex Social Learning Environments with Pre-service Mathematics Teachers

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### Abstract

At the national level, undergraduate mathematics teacher preparation programs are shifting to develop teachers who not only understand current research-informed instructional practices but also have firsthand experiences learning, teaching, and collaborating in student-centered environments (CBMS, 2016). Understanding the degree to which these experiences impact pre-service teachers' learning is challenging to measure. This paper describes the efforts of a Track 1 National Science Foundation (NSF) Robert Noyce Teacher Scholarship grant to recruit and provide wider professional experiences to develop high-quality secondary mathematics teacher candidates and how the research team utilizes a value framework (Wenger, Traynor, & de Laat, 2014) to study programmatic impact. The guiding questions for this research are: *To what extent do pre-service mathematics teachers value participation in extended programs to support their work as mathematicians and future teachers?* and *How can researchers and practitioners measure value as a construct?* This paper examines: (a) how we leverage the value framework in a variety of ways, (b) preliminary findings on what Noyce participants value and the experiences that led to their learning, and (c) implications for future work in pre-service mathematics teacher preparation programs.

### Introduction and Background

Teacher preparation programs, especially those focused on STEM education, are evolving to address a national shortage of highly qualified secondary STEM educators. In particular, teacher education programs are partnering with mathematics departments to coordinate course and field experiences that develop teacher candidates' content and pedagogical knowledge to accommodate this need. In 2013, the University of Nebraska at Omaha received a Track 1 Noyce grant from the NSF, with the aim of creating a dual-enrollment program through the mathematics and teacher education departments to recruit, develop, and retain highly qualified secondary mathematics teachers. Unlike many other collaborative teacher preparation programs, the NebraskaMath Omaha Noyce Partnership program (Omaha Noyce) provides not only scholarships and aid for undergraduate students, but also access to "wider professional experiences" (WPEs) that extend beyond traditional field experiences in schools and classrooms (Darling-Hammond & Bransford, 2005). These experiences include participants engaging in activities such as serving as learning assistants for undergraduate mathematics courses, providing mathematics tutoring services (both at the K–12 and university level), volunteering at local community and K–12 school STEM events, and hosting K–12 STEM math circles at the university.

Providing undergraduate pre-service teachers access to these sorts of WPEs requires coordination and commitment among participating university faculty members. Engaged faculty act as mentors and liaisons for students to gain access to WPEs through Omaha Noyce, the Omaha STEM-Ecosystem, Metropolitan Community

College, and local K–12 partnerships (MTE-P Guiding Principles 1 & 2). The Omaha Noyce program aims to identify what components of the program are most valuable in the development and retention of these future secondary mathematics teachers and how their WPEs might further inform how the educational community defines “highly qualified” teachers beyond traditional teacher preparation requirements. In this paper, we describe the research and evaluation methods of the Omaha Noyce program in terms of the complex construct of “value” in social learning, share preliminary findings on what Noyce participants value and what experiences led to their learning, and discuss future implications and next steps of this work.

### Social Learning and Value

Gathering and analyzing data involves social interactions among undergraduate students. Thus, the research team utilized situated learning theory (Lave & Wenger, 1991; Wenger, 1998), which posits that learning is an inherent part of participating in an organization, and learning goes beyond that which occurs in the traditional classroom setting to include shifting “toward full participation in the sociocultural practices of a community” (Lave & Wenger, 1991, p. 29). Through the Omaha Noyce program, “learning” occurs in a variety of contexts, cyclically and over time. The research team therefore grounded this study using Wenger, Traynor, and de Laat’s Value Framework (2011; 2014), which defines cycles of value creation ranging from “immediate” to “transformative” value (see Figure 1).

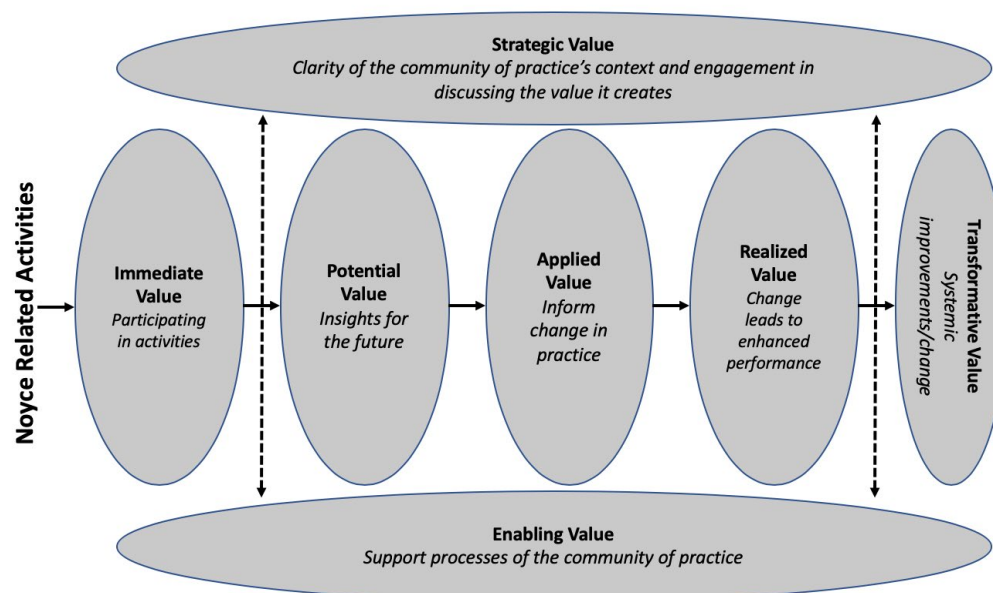


Figure 1. Seven Types of Value, adapted from Wenger-Trayner & Wenger-Trayner (2014) with permission.

The framework is not intended to be hierarchical in nature; rather, it is a fluid and interconnected process of developing and applying learning (Wenger et al., 2011). The “organization” in this case is the cohort of undergraduate students in the Omaha Noyce program, most of whom are interested in pursuing a career in secondary mathematics education.

### Measuring a Complex Construct

Participants of the Omaha Noyce program, and our study, included a total of 16 Interns, typically freshmen and sophomores who demonstrated an interest in STEM education, and 10 Scholars, typically juniors and

seniors who committed to completing a dual-degree program through the mathematics and teacher education departments as secondary mathematics teachers. Some overlap exists between Interns and Scholars, as some participants used the internship as a pipeline into the scholarship program. During the fall and spring semesters, participants completed weekly structured reflections on the WPEs in which they engaged. Additionally, participants completed a structured end of semester reflection examining their experiences holistically.

The research team analyzed three semesters of journal entries, from Fall 2018 to Fall 2019, to better understand the types of value students experienced through participation in WPEs. The team developed a codebook using each of the value types as *a priori* “parent codes,” and descriptive coding to create nested “sub-codes” based on the topical experiences within which participants found value (Saldaña, 2016). All journal entries were coded by two researchers, who discussed and reconciled coding to ensure the validity and reliability of the results. The researchers then utilized Nvivo12 software to run queries, focusing on the “immediate” and “potential” value that participants found engaging in WPEs. “Immediate” value indicates in the moment expressions of interest or learning, and “Potential” value refers to participant comments suggesting future use of a particular learning as a teacher.

### Preliminary Findings

Immediate and potential value parent and sub-codes were more frequently present in student reflections than other value codes. The frequency of coding might reflect the developmental level of these undergraduate students and their access—or lack thereof—to learning opportunities to realize, apply, or transform their understanding of mathematics teaching and learning. Their WPEs included activities like serving as teaching assistants and tutors, facilitating outreach events, and/or attending workshops. While these WPEs are all related to mathematics and teaching, oftentimes, they occur in isolation without explicit connections drawn among activities. This may have limited the cyclical opportunity for participants’ experiences to progress to applied, realized, and transformative value.

Another preliminary finding emerged in the intersection of immediate and potential value experiences. In these experiences, Noyce participants found not only value in the learning opportunity at hand, but also voiced implications for their future as a learner or teacher of mathematics. One intern stated,

In being a TA [teaching assistant], I realize I have to really know every step to working out problems. When students asked for help during class, I often caught myself from just telling them the answer. I thought back to when [a former Scholar] was my TA in Calculus and how he really encouraged me to learn the steps and be more independent with Calculus. Therefore, I have to step back and let the students be more confident in their work.

In this moment, the intern voiced concurrent immediate and potential value in not only deeply understanding mathematics and working alongside a learner but also how the experience informed future actions the intern might take supporting students in the future (MTE-P Guiding Principles 4 &5). A Scholar shared a similar immediate/potential value interaction while volunteering in a former Omaha Noyce participant’s classroom:

While tutoring in this (high school) class, I encountered something new. There was a student who did not realize that zero is greater than any negative number. This student was pretty far along in Algebra. I kept wondering how did this student make it this far without this knowledge? Also how many other students don’t know that zero is greater than any negative number? Encountering this just reaffirmed for me, how important it is to get qualified and enthusiastic math teachers in the classroom. Sometimes school and life can become overwhelming and then something like this comes along and makes you realize that all this hard work will be worth it in the end.

In this scenario, access to a real classroom and students led by an early-career teacher provided an opportunity for reflection about the diverse learning and social needs of high school students. While expressing immediate and potential value in the interaction, this opportunity also highlights the capacity building value of WPEs and how they offer Noyce participants unique and self-determined opportunities for realizations and affirmations about the importance of high-quality mathematics instruction for all students.

### Considerations for the Field and Next Steps

Utilizing the value framework (Wenger, et al., 2011; 2014) within the complex Omaha Noyce learning environment has opened doors to a variety of further research and evaluation considerations. The preliminary findings offer opportunities to follow these participants further into their early teaching careers, or otherwise chosen career field, to examine any sustained or evolving value stemming from their participation in the Omaha Noyce program. Additionally, the value framework has been a tool for reflection and refinement of the leadership team as Noyce participant reflections are leveraged to pinpoint “high impact” WPEs we want all participants to have access to exploring as an Intern and/or Scholar. Implications of better understanding what WPEs create the most value for Noyce participants can have broader implications to teacher preparation programs and also how we might increase recruitment and retention of secondary mathematics teachers. For example, we have found Noyce participants gain value in tutoring through increased understanding of teaching practices and how students learn. Investigating value as a construct has immense capacity to glean vital information not only about program participants but also programmatic structures that result in the greatest impact.

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## Publishing MTE-Partnership Work in the *Mathematics Teacher Educator Journal*

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### Introduction and Mission

The Mathematics Teacher Education Partnership (MTE-Partnership) is a collaboration of institutions across the nation with the goal of improving secondary mathematics teacher preparation programs (Martin, Lawler, Lischka, & Smith, 2020). The *Mathematics Teacher Educator* is a professional journal for practitioners in mathematics teacher education with the following mission: The journal

- will contribute to building a professional knowledge base for mathematics teacher educators that stems from, develops, and strengthens practitioner knowledge.
- is a means for practitioner knowledge to be shared but also verified and improved over time.
- is a tool to build the personal knowledge that mathematics educators gain from their practice into a trustworthy knowledge base that can be shared with the profession (Association of Mathematics Teacher Educators & National Council of Teachers of Mathematics, n.d.a.).

Given both MTE-Partnership and *Mathematics Teacher Educator* are committed to learning and sharing knowledge about mathematics teacher education, it seems both would benefit from MTE-Partnership members sharing results from their work with the *Mathematics Teacher Educator* audience. The journal's audience is broadly defined as anyone who contributes to the preparation and professional development of pre-K–12 pre-service and in-service teachers of mathematics. Mathematics teacher educators include mathematics educators, mathematicians, teacher leaders, school district mathematics experts, and others. (Association of Mathematics Teacher Educators & National Council of Teachers of Mathematics, n.d.a.).

In this paper, the authors offer examples of articles from *Mathematics Teacher Educator* that may inform the work of MTE-Partnership Research Action Clusters (RAC) and conclude with some suggestions for showcasing MTE-Partnership work in the *Mathematics Teacher Educator*.

### Article Examples for Each Research Area Cluster

To help potential MTE-Partnership *Mathematics Teacher Educator* authors think about how their work may benefit the *Mathematics Teacher Educator* audience and how articles may contribute to the work of the MTE-Partnership, the authors reviewed all article abstracts that appear in the 16 issues of *Mathematics Teacher Educator* published prior to July 31, 2020. A total of 91 articles (including editorials and commentaries) are currently published in *Mathematics Teacher Educator*. Of those 91 articles, the authors found 59 articles (65%) that may inform the work of the MTE-Partnership, with 30 of those 59 articles (51%) applying to more than one RAC. This section is organized around the current five RACs and two working groups. Each section includes at most two articles that may inform the work of each RAC. Select additional articles, where available, are also included after the Reference list organized by RACs.

### **RAC 1: Developing Effective Clinical Experiences**

The Developing Effective Clinical Experiences RAC focuses on developing strong methods courses and clinical experiences for teacher candidates. As such, CERAC proved to have the most applicable *Mathematics Teacher Educator* articles. For example, Spangler and Hallman-Thrasher's (2014) *Using Task Dialogues to Enhance Preservice Teachers' Abilities to Orchestrate Discourse* shared an activity where elementary teacher candidates created imaginary conversations between a child and teacher around a problem-solving task to practice teacher responses. Next, teacher candidates implement the task twice in a field experience. Spangler and Hallman-Thrasher (2014) then share what they learned as mathematics teacher educators about teacher candidate knowledge from the activity. Although this activity occurs with elementary teacher candidates, the activity can be modified to work with secondary teacher candidates and hence, may inform the work of the CERAC. Another article that may inform the work of the CERAC is Roller's (2019) *Noticing and Wondering: A Language Structure to Support Mentoring Conversations*. In this article, Roller (2019) shares results from a study using Smith's (2009) noticing and wondering language as a framework for guiding mentoring conversations between teacher candidates and mentor teachers to encourage a reflective rather than an evaluative nature in those conversations. This article may inform the work of the CERAC in offering a tool to incorporate in both methods and clinical experiences when reflecting on teacher experiences.

### **RAC 2: MODULE(S<sup>2</sup>): Mathematics of Doing, Understanding, Learning, and Educating for Secondary Schools**

The MODULE(S<sup>2</sup>) RAC attends to "developing mathematics knowledge and habits of mind for teaching prospective secondary mathematics teachers" (Mathematics Teacher Education Partnership, n.d.). One *Mathematics Teacher Educator* article that may inform the work of the MODULE(S<sup>2</sup>) RAC is Steele and Hillen's (2012) *The Content-Focused Methods Course: A Model for Integrating Pedagogy and Mathematics*. This article speaks to challenge of secondary mathematics teacher programs in authentically integrating content and methods courses. Steele and Hillen (2012) offered a model for a content-focused methods course. This article may inform the work of the MODULE(S<sup>2</sup>) by offering an example of a course that helps teacher candidates develop both mathematical content as well as habits of mind as secondary mathematics teachers. A second article that may be beneficial to the MODULE(S<sup>2</sup>) RAC is Conner's (2013) *Authentic Argumentation with Prospective Secondary Teachers: The Case of 0.999...*. Conner (2013) shares an example of engaging secondary mathematics teacher candidates in creating and critiquing mathematical arguments such as  $0.999... = 1$  that allows them both to engage in mathematical arguments as a student as well as thinking about how they may engage their own students in such argumentation. This article may be of value to the MODULE(S<sup>2</sup>) RAC in suggesting additional mathematical activities with which to involve teacher candidates.

### **RAC 3: Active Learning Mathematics**

The Active Learning Mathematics (ALM) RAC centers its work on improving college-level freshman and sophomore-level mathematics courses. Given that *Mathematics Teacher Educator* focuses on teacher candidates, and the ALM work may also include strictly mathematics content coursework, this RAC had only one article that may inform the work of the RAC. As will be further discussed in the Conclusion section, however, this lack of *Mathematics Teacher Educator* articles related to the work of the ALM RAC also presents an opportunity for the need for more articles that may address freshman and sophomore level content courses designed to improve secondary mathematics teacher candidate preparation. The one *Mathematics Teacher Educator* article currently published that may benefit the ALM RAC work is Boyle et al. (2015) *Transforming Perceptions of Proof: A Four-Part Instructional Sequence*. In this article, Boyle et al. (2015) share a "four-part instructional sequence designed to



broaden and deepen teachers' perception of the nature of proof" (p. 1). Their work may inform the work of this RAC by perhaps proposing a similar activity for implementation in freshman- and sophomore-level mathematics courses to allow students to also broaden and deepen their own perceptions of the nature of proof.

#### **RAC 4: Program Recruitment and Retention**

The Program Recruitment and Retention (PR<sup>2</sup>) RAC, as indicated by its name, attends to the work of recruiting and retaining high-quality, diverse teacher candidates to program completion. This RAC was the one RAC or working group for which no *Mathematics Teacher Educator* articles seemed to fit. The lack of applicable articles may be explained by the nature of the work of this RAC being not as easily connected to the mission of the journal. However, much like the limited articles found for RAC 3, this lack of articles also offers an opportunity for an area of publication in the journal, which will be further discussed in the Conclusion section.

#### **RAC 5: STRIDES: Secondary Teacher Retention and Induction in Diverse Educational Settings**

The STRIDES RAC works to develop "strategies to support new teachers as they begin their careers as secondary mathematics teachers" (MTE-Partnership, n.d.). The STRIDES RAC name also indicates that its work attends to supporting novice teachers in diverse educational settings. The two articles included in this section pertain more to the secondary teacher retention and induction focus than the diverse educational setting focus of the RAC, but three additional articles appear following the Reference list that may also inform the work of this RAC in that area. The authors chose to include the two articles in this section given the articles report studies directly working with teachers or novice teachers, whereas the subsequent three articles reported work with teacher candidates. The additional three articles also all pertain to working in diverse educational settings, which also offer important contributions to the work of this RAC and the larger MTE-Partnership community.

The first article, Milewski and Strickland's (2016) *(Toward) Developing a Common Language for Describing Instructional Practices of Responding: A Teacher-Generated Framework*, studies an analytical framework created by secondary mathematics teachers to record changes in their own instructional practices over time. One suggestion from the findings is the importance of collaborative work with teachers for the purpose of developing a common language with which to discuss instructional practices. This work may pertain to the work of the STRIDES RAC by sharing a collaborative tool for supporting induction teachers as they develop in educative ways that encourages them to remain in a professional they see as collaborative and supportive of their development. The second article, Baldinger, Selling, and Virmani's (2016) *Supporting Novice Teachers in Leading Discussions that Reach a Mathematical Point: Defining and Clarifying Mathematical Ideas*, acknowledges the challenges of leading large-group discussions. Baldinger, Selling, and Virmani (2016) share a sorting-task instructional activity to help novice teachers navigate whole class discussions while also staying focused on the larger mathematical idea. This article may be of benefit to the STRIDES RAC in providing a research-based task appropriate for use by secondary mathematics novice teachers.

#### **Working Group 1: Equity and Social Justice**

The Equity and Social Justice Working Group (ESJWG) was created to offer "a foundation for better incorporating equity work into the MTE-Partnership" (MTE-Partnership, n.d.). With this focus in mind, some articles that related to the diverse educational settings focus on RAC 5 would also provide insight to the ESJWG. One sample *Mathematics Teacher Educator* article that may inform the ESJWG work is Gallivan's (2017) *Supporting Prospective Middle School Teachers' Learning to Revise a High-Level Mathematics Task to be Culturally Relevant*. This article reports work in a middle school mathematics methods course where teacher candidates are supported

to learn about students' funds of knowledge and use that information to rework high-level mathematics tasks to be more culturally relevant to students. This work may inform the work of the ESJWG by offering an example of work completed in a methods class, which may be replicated in other MTE-Partnership work. A second article, Aguirre et al.'s (2019) *Engaging Teachers in the Powerful Combination of Mathematical Modeling and Social Justice: The Flint Water Task*, offers an example of merging meaningful mathematical content with socially minded work. The abstract reads, "The evidence suggests that integrating these 2 foci—by using mathematical modeling to investigate and analyze important social justice issues—can be a high-leverage practice for mathematics teacher educators committed to equity-based mathematics education" (Aguirre et al., 2019, p. 1). Similar to the first article, this article may offer concrete examples of research-based work by mathematics teacher educators committed to preparing high quality socially minded secondary mathematics teachers. In 2021, *Mathematics Teacher Educator* will be publishing a special focus issue on equity that will include additional articles relevant to this working group.

### **Working Group 2: Transformations**

Finally, the Transformations working group provides "a foundation for the MTE-Partnership's strategic focus on overall transformation of secondary mathematics teacher preparation programs" (Mathematics Teacher Education Partnership, n.d.). Given the wide-reaching focus on this working group, articles that tended to address multiple stakeholders in secondary mathematics teacher preparation were selected. For example, Carlson, Heaton, and Williams' (2017) *Translating Professional Development for Teachers Into Professional Development for Instructional Leaders* shared an experience of engaging coaches, principals, and teachers in studying mathematics teaching and learning and in the process, modified the professional development to better "focus instructional leaders' attention on the work of learning teaching" (p. 1). This work sheds light on the importance of collaborative, multi-stakeholder involvement in transforming mathematics teacher education. Secondly, Felton-Koestler and Koestler's (2017) *Should Mathematics Teacher Education Be Politically Neutral?* offers a commentary as to why teaching cannot be a politically neutral endeavor. This piece may inform the work of the Transformations working group in providing additional context through which to view the complex work of revolutionizing secondary mathematics teacher education.

### **Conclusion**

The work of the MTE-Partnership and *Mathematics Teacher Educator* are closely related in their work to encourage innovating, learning, and sharing practices to improve secondary mathematics teacher education. Due to space limitations, only a limited number of *Mathematics Teacher Educator* articles could be highlighted here that may inform the MTE-P work. Based on more closely aligned goals, there were more articles related to the work of the CERAC, MODULE(S<sup>2</sup>) RAC, STRIDES RAC, and ESJWG. Fewer articles were found related to the work of the ALM RAC, PR<sup>2</sup> RAC, and Transformations working group. Though it may be a bit more challenging to craft articles related to the work of these groups, it does offer areas of opportunity with which potential *Mathematics Teacher Educator* authors can communicate their important work with the larger *Mathematics Teacher Educator* audience. Helping larger audiences learn about the transformative work of the MTE-P is imperative – *Mathematics Teacher Educator* provides one avenue to do so.

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## High School to College Mathematics Pathways: Secondary Mathematics Teacher Preparation is Key

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**Watch the presentation:** <https://youtu.be/XvNZ9aHNbws>

### Abstract

This chapter addresses a critical problem in mathematics education in the United States: Too many students are not successfully completing the mathematics they need for their future success across Grades 11–14 (National Center for Educational Statistics [NCES], 2020). Moreover, this problem is more acute for some students on the basis of income, geography, race/ethnicity, and/or language (Aguirre et al., 2017). We begin by defining the problem, then discuss some of the current work being done in this arena, using the state of Alabama as an example, and wrap up with some ramifications for secondary mathematics teacher preparation.

### Defining the Problem

The lack of student success in mathematics from high school to postsecondary is particularly challenging due to its multidimensional nature. First, many students are not completing high school ready for credit-bearing, college-level coursework in mathematics. For example, 56% of those students entering two-year colleges and 31% of those entering four-year colleges (NCES, 2020, 2016) needed to take at least one remedial course in mathematics. This problem is particularly acute for students who have been historically underserved; for example, African American students are 60% more likely to be in remedial classes (Complete College America, 2016).

Second, students who enter postsecondary education unprepared to enroll in credit-bearing mathematics coursework are often required to complete a remedial program. Yet these programs all too frequently do not provide students the support they need to be able to complete an initial credit-bearing mathematics course. Remedial programs become an insurmountable barrier; only 20% of those entering a remedial course go on to earn a credit in an entry-level mathematics course (Complete College America, 2016).

Third, credit-bearing courses at the college level may not adequately address students' future mathematics needs. For example, College Algebra is the mathematics course required for many majors, yet the course largely duplicates the content students already had in second-year algebra in high school, likely decreasing its interest for many students. Moreover, the content has little to do with the mathematics students will actually use in their field. Many students would be better served by a course in statistics or other areas.

Finally, mathematical pathways between K–12 and higher education are not well-articulated, which further complicates students' progress in mathematics. There are a number of areas of misalignment. There may not be clear connections between the courses students take in high school and their initial postsecondary mathematics courses. In the example with College Algebra above, the content may be duplicated. In other cases, senior-level high school courses may be more focused on providing students with the credits they need to graduate than on ensuring they are ready for success after graduation. Another area of misalignment may occur in the amount of attention paid to developing mathematics processes and practices, a requirement in most state K–12 mathematics standards, as well as instructional methods based on the mathematics teaching practices

(National Council of Teachers of Mathematics, 2016), which emphasize problem-based or inquiry-based instruction. In contrast, introductory mathematics classes at the postsecondary level are often large lecture classes that emphasize learning facts and procedures—although a number of projects seek to address this issue (cf. Association of Public and Land-grant Universities, 2020).

### Addressing the Problem

To address the issues in ensuring clear pathways from high school to postsecondary mathematics, the Conference Board of Mathematical Sciences (CBMS), an umbrella organization consisting of 18 national professional societies related to the mathematical sciences, launched the Mathematics Pathways Initiative in 2019. This initiative seeks to assist states in forming task forces to coordinate efforts across Grades 11–14 that will lead states to create policies and practices for mathematics instruction that contribute to successful completion without reducing quality. Twenty-two states (including Alabama) were selected to participate in the initiative.

CBMS set forth a two-year process to engage the states, as summarized in the following timeline:

- Spring/Summer 2019: Assessment of background data
- September 2019: Three-day forum of all 22 state teams.
- September 2019–September 2020: Quarterly meetings across teams.
- October 2020: Second forum of state teams to be held virtually
- October 2020: State team’s final set of recommendations to be completed.
- Following October 2020: Advocate for the recommendations.

Alabama dubbed its task force the Strategic Task Force to Accelerate Mathematics Pathways or STAMP (STAMP, 2020). The task force was launched by a leadership team consisting of two K–12 representatives, two community college mathematics instructors, two four-year/university mathematics instructors, and two mathematics teacher educators. This leadership team meets biweekly to facilitate the activities. The taskforce itself includes 14 additional people representing a broader slice of entities, including state initiatives and commissions, mathematics-related organizations, workforce groups, K–12 and higher education administrators, and K–12 counselors. This taskforce meets quarterly, although the May 2020 meeting was delayed due to COVID-19. In addition, a convening of about 50 persons representing a broader set of stakeholders met in November 2019 to provide additional input.

STAMP identified four initial areas of work to address issues related to mathematics pathways in Alabama, as outlined in the following:

- **Resources**
  - Increase the number of certified teachers in mathematics and special education (focused on mathematics)
  - Increase focus on academic counseling
  - Increase access to professional learning and technology to support student success
- **Beliefs and values**
  - Build mindsets that understand the value of mathematics cradle to grave across all stakeholders including communities and families
  - Dispel stereotypes and beliefs that hinder the success of all students
- **Vision**
  - Establish a coherent vision for what counts as mathematics and what experiences student should be having



- **Alignment**

- Align pathways from K–12 with both college and careers, ensuring they are flexible to meet changing needs.

The task force subsequently drafted a set of five more specific recommendations as follows: (1) create a statewide organization to extend the work of STAMP; (2) improve teachers’ mathematical content knowledge relevant to teaching (pre-service and in-service); (3) promote understanding of and communication about the impact of cut scores and placement practices in entry-level postsecondary mathematics courses; (4) aggregate resources to improve mindsets about learning mathematics across multiple stakeholder groups, and (5) develop and disseminate information about curriculum pathways from K–12 through higher education. Each recommendation follows a common template. An example recommendation is shown in the Figure 1.

<b>Recommendation #2:</b> Facilitators: (omitted)	Improve teachers’ mathematics content knowledge relevant to teaching	
<ul style="list-style-type: none"> <li>• Provide a baseline of teachers’ content and pedagogical knowledge based on the AMTE Standards.</li> <li>• Assess what content and pedagogical needs are and plan mechanisms to meet them.</li> </ul>		
<b>Why does this recommendation need to be implemented?</b>		
<ul style="list-style-type: none"> <li>• Better-prepared teachers ensure that students are prepared to succeed in mathematics. Developing a better understanding of this issue will help us to determine how to improve teacher preparation and in-service education to positively affect K–12 instruction.</li> </ul>		
<b>Who needs to do what?</b>		
<ul style="list-style-type: none"> <li>• Collect background data: preservice students, program requirements, distribution of underprepared teachers</li> <li>• Form a subgroup to analyze the data and determine next steps</li> </ul>		
<b>Deadline for Completion:</b>	Ongoing, partial completion by August 2020	
<b>Assignments</b>		
<i>What</i>	<i>Who</i>	<i>When</i>
(omitted)		

Figure 1. Recommended template from the Strategic Task Force to Accelerate Mathematics Pathways (STAMP).

In June 2020, STAMP formed working groups to refine the plans for each of the recommendations and begin initial work. The full task force will convene virtually in late August 2020 to provide further feedback on the set of recommendations as a whole, and a draft report will be presented to CBMS at the virtual conference in October 2020. The task force also will develop a plan for disseminating the recommendations and connecting with related organizations.

## The Role of Mathematics Teacher Preparation

Mathematics teacher preparation plays a critical role in improving the high school to postsecondary mathematics pipeline. The importance of having an adequate number of *well-prepared* mathematics teachers is threaded throughout STAMP’s recommendations. In fact, mathematics teacher preparation is an important part not only of the STAMP agenda but of almost every state team with whom we have interacted. Moreover, mathematics teacher educators can play a critical role in these discussions, since they are engaged in both K–12 and higher education.

We propose the following questions for Program NICs and MTE-Partnership Teams to consider as they plan their activities:

- How can MTE-Partnership Teams and Program NICs more effectively engage in and leverage the work that is being done on mathematics pathways? In particular,
  - How can we promote a positive mindset toward learning mathematics across not just teachers and students but also families and the community?
  - How can we inspire a broader view of mathematics as more than a tool for the sciences?
  - How can mathematics teacher educators effectively contribute to discussions around pathways?
  - How can K–12 and postsecondary mathematics educators collaborate to create more coherent pathways?

In closing, we encourage MTE-Partnership participants to learn more about the work around mathematics pathways, including the CBMS Pathways Initiative. And, if there is a task force in your state, explore how you might engage with it.

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# **PRESENTATION ABSTRACTS**

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## Effects of a Co-Teaching Residency for Secondary Preservice Mathematics Teachers

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This session looked at teaching practices for first- and second-year secondary mathematics teachers who were prepared using a yearlong co-teaching residency in rural schools. We collected information on teaching practices through three data sources: (1) a survey of the mathematics teachers' students, (2) interviews with principals, and (3) a standardized classroom observation. These instruments were used to evaluate (1) quality of instruction, (2) assessment and feedback, (3) classroom management and teacher/student relations, and (4) variation by subgroup.

**Watch the presentation:** <https://youtu.be/ESxEcb3MLrE>

**Discussion questions:**

- What other information should we be considering when thinking about long-term teacher effects?
- How are other institutions tracking long-term teacher effect over time?

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## Fostering Competent, Collaborative, Reflective, and Caring Beginning Mathematics Teachers via Paired Placements

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Members of the Paired Placement sub-Research Action Cluster of the Clinical Experiences Research Action Cluster reported on how the paired placement model helps to foster competent, collaborative, reflective, and caring beginning mathematics teachers. In the paired placement model, two prospective teachers are paired with a single mentor teacher, allowing the mentor teacher to provide purposeful coaching and mentoring and the two teacher candidates to offer each other feedback, mentoring, and support (Leatham & Peterson, 2010). Sub-RAC members shared how they have used Plan-Do-Study-Act Cycles and the network improvement community to improve the implementation of the paired placement model for over six years. In addition, members shared case studies of beginning teachers who have participated in the paired placement model. The Sub-RAC is answering the following research question: *How does a continuum of collaborative and student-focused clinical experiences, including co-planning/co-teaching and paired placement fieldwork models, impact pre-service teachers' equitable implementation of the Mathematics Teaching Practices (NCTM, 2014) across institutional contexts?*

**Watch the presentation:** <https://youtu.be/MOPVIHe1Jek>

**Discussion questions:**

- What plans do you have for implementing the paired placement model? What did you learn from the presentation that you had not thought about related to the model?
- What stood out the most to you as we discussed the affordances of implementing the model?
- What barriers do you have related to implementing the model? Explain.
- In what ways might you modify the paired placement model to reflect your contextual realities?
- What questions do you have about the tools/tips provided on the website?

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## Instructors' Attention to Instructional Interactions during Professional Development for MODULE(S<sup>2</sup>) Materials

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The MODULE(S<sup>2</sup>) RAC has developed curricular materials to be used in mathematics content courses intended to encourage the development of mathematical knowledge for teaching in prospective secondary teachers. Instructors piloting these materials are supported with professional development opportunities, one of which is a series of teaching rehearsals and respective debriefs of those rehearsals. We examine the ways in which piloting instructors engage in these teaching rehearsal debriefs included in the professional development (PD) to answer the question: *To what instructional interactions do instructors of mathematics content courses attend during rehearsal debriefs enacted in PD?* Findings show that mathematics instructors attend to all types of interactions but attention is influenced by instructors' mathematical knowledge.

**Watch the presentation:** <https://youtu.be/5CEcYtj2SB4>

Discussion questions:

- What do you wonder about the collected data? Which types of questions might you want answered using the data collected in this study?
- In the video that is shared in the presentation, when are you noticing the focus of the speaker shifting? Which of the instructional relationships are you noticing?
- When viewing the segmented bar graphs in the presentation slides, what do you notice? What do you wonder?
- How can changes in course instruction support teacher-preparation program transformation?

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## Utilizing Student Work Artifacts to Develop both Subject Matter and Pedagogical Content Knowledge

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The MODULE(S<sup>2</sup>) project's teacher education curriculum materials aim to develop PSMTs' mathematical knowledge for teaching in their upper-level content courses. As authors of the statistics curriculum materials for this project, we have intentionally tried to develop PSMTs' knowledge of statistics simultaneously with their pedagogical knowledge for teaching statistics. We have found that activities centered on student work artifacts (including written student work and videos of students) have been effective at developing both aspects of teacher knowledge. In this session, you will be able to engage in and analyze a sample of these activities and learn about results from implementation of the materials regarding their effectiveness at developing both subject matter and pedagogical content knowledge.

**Watch the presentation:** <https://www.youtube.com/watch?v=KDloQILPeVk>

**Discussion questions:**

Set 1:

- 1a. Drawing from Jared's circling of a portion of the graph and his written answer for part (A), how can a box plot be visually confusing for a beginner?
- 1b. In part (B), Jared says that "I also think Test 4 was too hard because the highest grade was an outlier." Assess the validity of Jared's claim that the highest grade on Test 4 was an outlier.
- 1c. What subject matter knowledge did you draw upon when completing this activity?
- 1d. What pedagogical content knowledge did you draw upon when completing this activity?

Set 2:

- 2a. What was her approach for placing the line?
- 2b. Potential reasons/sources for approach
- 2c. Is the approach generalizable (i.e., would the approach work for other data sets with a linear trend)? If not, draw/describe at least one counter example (a scatterplot and/or trend line that will produce a poor line of best fit using the student's approach along with the line).
- 2d. Describe in detail your response to Maggie as her teacher. Be specific when describing this, writing exactly what you would say and/or draw in your response.
- 2e. What subject matter knowledge did you draw upon when completing this activity?
- 2f. What pedagogical content knowledge did you draw upon when completing this activity?

Set 3:

What has worked for you in using student work artifacts in mathematics teacher preparation? We invite suggestions for the authors as well as other conference attendees.

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## Active Learning in Online Environments

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The Research Action Cluster on active learning has been a great success in making mathematics classrooms across the nation more engaging. In this session, we aimed to examine if a similar movement could happen in online learning environments. Many master's programs for practicing mathematics teachers are held in these online environments (for both content and pedagogy courses). We wished to work on transforming secondary mathematics education by examining these online environments. This session focused on the following discussion questions: (a) how can we make more active online learning environments, (b) what work has been done to examine online learning environments for mathematics education, and (c) what does active learning look like in an online learning environment for mathematics teachers?

**Watch the presentation:** <https://youtu.be/n548avFsh6I>

**Discussion questions:**

- What challenges exist in engaging students in an online environment?
- What advantages are there to engaging students in an online environment?
- How are each of these challenges/advantages unique to learning either mathematics or mathematics education?



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## Navigating the Tides of Technology in a Mathematics Classroom

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Teaching mathematics can be overwhelming to new and seasoned teachers alike, and can be especially true when they are being asked to also incorporate technology into their classrooms. How can we, as mathematics educators, prevent mathematics teachers from being overwhelmed by all of the technology options (or the technologies they are required to use in their classrooms)? In this session, we brainstormed ideas and examine the pedagogies behind technology integration in mathematics classes. We guided the audience through some of the first steps to finding free/available technologies that are useful in the mathematics classroom, but we also invite others to share what they use (and bring questions on how to use their current technologies in more engaging ways). We also discussed ways to teach our teachers to incorporate useful and interactive video into mathematics classes to promote engagement, understanding, and motivation. We hoped that this session would reach a wide audience so that we can promote engaging math + technology pedagogies in the classroom.

**Watch the presentation:** <https://youtu.be/LENMIVY8jU>

**Discussion questions:**

- Discuss ways to teach our teachers to incorporate useful and interactive video into mathematics classes to promote engagement, understanding, and motivation.
- What technologies have you used in your classroom? How are you defining use? Are you putting the technology in the hands of the students?
- How have you overcome some of the challenges we listed?

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## Developing Relationships Between Early-Career Teachers and Their Principals: An Intervention Scaling Dilemma

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In a recent report by the Learning Policy Institute that synthesized data from a nationally representative sample of teachers across the United States (Carver-Thomas & Darling-Hammond, 2017), lack of administrative support was listed as the second highest reason for teachers transferring to another school or leaving the profession of teaching entirely. The MTE-P Secondary Teacher Retention and Induction in Diverse Educational Settings (STRIDES) Administration sub-Research Action Cluster (RAC) is continuing their investigation on the extent that interventions involving early-career secondary mathematics teachers and their principals affects perceptions of support. Based upon data from a series of increasingly detailed surveys administered to early-career secondary mathematics teachers in MTEP institutions between 2015 and 2017, the STRIDES Administration sub-RAC implemented a pilot intervention that investigated the degree that a 10-minute meeting involving teachers and their principals had on perceptions of support. Results from this limited study showed that participating teachers reported an overall increase in perceived levels of support, relative to control participants at the same schools. Scaling to a sample set with approximately one hundred times the number of participants has presented unique challenges to the research team. This presentation outlines these challenges and encourages discussion about related methodological and practical issues.

**Watch the presentation:** <https://app.vidgrid.com/view/ixwmvvmJc4GN/?sr=DPyNBr>

**Discussion questions:**

- How do you navigate multi-site interventions, especially with IRB?
- What recruitment strategies have been successful for similar interventions?
- How do you engage 1st-year teachers in research without adding an extra layer of stress?
- What funding options might be available for this type of intervention?
- What avenues (publications/conferences/policy forums) would suit reporting of results?
- How to best administer the study under COVID-19 school conditions?

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## Transforming Secondary Mathematics Teacher Preparation across a State: Promises and Challenges

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This discussion is about the promises and challenges associated with attempts to transform the preparation of secondary mathematics teachers across a team, region, and/or state. Participants were asked to share their promises and challenges in an effort to develop better strategies for this transformation work at a larger scale. Speakers compiled and shared these promises and challenges with participants and the larger MTE-P community.

The following questions guided our discussion:

- What are some of the challenges and successes you have experienced when trying to work together to transform secondary mathematics teacher preparation in a team, region, and/or state:
  - across different departments within one teacher preparation program?
  - across different teacher preparation programs?
  - across regional service units?
  - across school districts?
  - with the department of education?

We invited attendees to respond to these questions, pose their own questions, respond to one another, and generally interact to share and learn more about transformation partnerships.

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## Using Measures for Leveraging Program Change and Transformation

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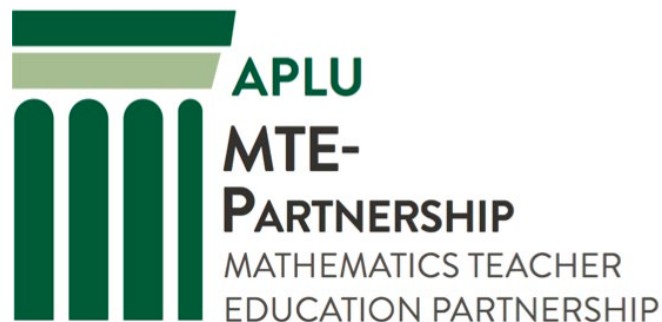
CBMS MET2, NCTM SPA, AMTE, and MTE-Partnership span many recommendations for ideal or minimum expectations of program components for secondary mathematics teacher preparation. This session will focus on using specific measures as a means to leverage change that can or should ultimately impact teacher candidate development and performance to achieve well-prepared graduates. Multiple measures and prior experiences are shared and discussed.

**Watch the presentation:** <https://youtu.be/832lhr2mjV0>

**Discussion questions:**

- What are your top three transformational changes you see as needed for your secondary math preparation program(s)?
- What roadblock(s) exists to instituting these transformational change(s)?
- What measures may or would allow for instituting such transformational change(s)?

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