From Improvement to Transformation

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The event of the Fifth Annual Mathematics Teacher Education Partnership (MTE-P) conference is a reasonable time to reflect upon MTE-P efforts to transform secondary mathematics teacher preparation programs in the United States, assess current initiatives, and determine potential actions that can and should be attempted in the near future. MTE-P has steadily moved from forming action plans and partnerships, to testing interventions, to implementing transformational efforts involving multiple institutions in multiple states. This year's conference focused on learning how to make MTE-P work transformative by using the innovations developed by multiple RACs at multiple sites to leverage meaningful change in both local partnership programs, and in the larger system of secondary mathematics teacher preparation.

Guiding Principles

One of MTE-P's initial efforts was to create a set Guiding Principles (revised: MTE-P, 2014) that described and established a shared vision for secondary mathematics teacher preparation, a vision necessary for the overall continuity and direction of our local and networked efforts. Moreover, this vision was expected to be a living document, to be explored and refined by MTE-P members as well as others involved in preparing secondary mathematics teachers by:

1. building a national consensus on what effective secondary mathematics teacher preparation programs need to do in order to develop teacher candidates who promote mathematical excellence in their future students;
2. enhancing communication among the partners involved in a secondary mathematics teacher preparation program in order to clarify program goals, to assess the effectiveness of the program, and to guide program development and revision;
3. serving as the framework for an emerging national research and development agenda related to secondary teacher mathematics preparation; and

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4. helping to organize the identification, development, and dissemination of resources supporting effective secondary mathematics teacher preparation programs.

At present, MTE-P has ten Guiding Principles that must be considered in the effort to address the identified problem, the reform of secondary mathematics teacher preparation programs. The Guiding Principles are organized into three sections: Partnerships; Teacher Candidate Knowledge, Skills, and Dispositions; and Program Structures. Each of these areas are critical influences on programs; however, their interactions may be even more important. The manner in which these Guiding Principles interact is evidenced in MTE-P's primary driver diagram, a representation of the working theory of practice improvement. This driver diagram, Figure 1, serves to create a common language among the community and directs the efforts to solve this shared problem.

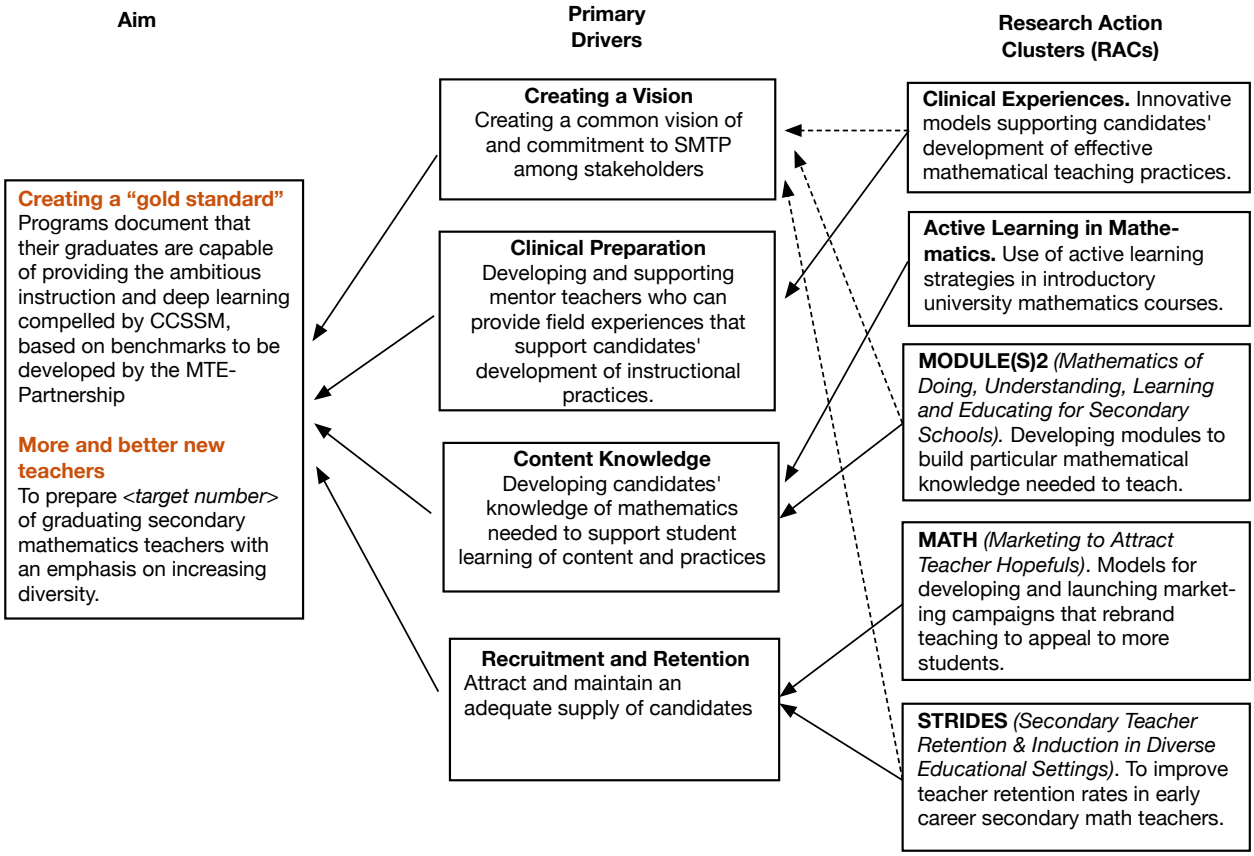

Figure 1. The driver diagram of the MTE-Partnership.

Vision

These principles led to the development of two aims: (1) Create a "gold standard" in which programs document that their graduates are capable of providing the ambitious instruction and deep learning compelled by Common Core State Standards for Mathematics and other college and career-ready standards, based on benchmarks to be developed by MTE-

P; and (2) produce more and better teachers, specifically increasing the quantity of well-prepared candidates by 40% by the year 2020. To achieve those aims, four primary drivers were identified: creating a vision, clinical preparation, content knowledge, and recruitment and retention. Research Action Clusters (RACs) formed to begin to study the issues raised in the Guiding Principles, with the aims in mind for the work.

From tweaking to transformation

That history of work in the MTE-Partnership has created a fervent of tinkering, studying, revising, and re-implementing as members of the RACs carry out Plan-Do-Study-Act (PDSA) cycles. Which brings us to the present opportunity to refocus on the charge of the MTE-Partnership, to transform secondary mathematics teacher preparation programs in the United States. This conference launches the project into a fifth year of work on this transformation. The gathering served as an opportunity to step back and share out what the community is learning as it tinkers, tweaks, and studies its efforts. But also the community was redirected to consider the theory underlying and measures that indicate success with the transformation of secondary mathematics teacher preparation (consider Figure 2). Having looked back, we hope to examine the activity of this fifth conference and consider what may be next steps for the MTE-Partnership.

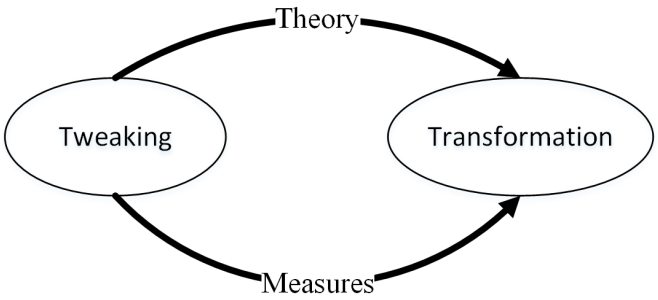

Figure 2. A model to support consistent, continuous classroom change.

The MTE-Partnership today

One strength of the MTE-Partnership is the number of local teams that form the overall partnership; it is a networked improvement community (NIC). This network permits efforts in multiple areas to be shared and replicated in a collaborative, controlled, cyclic process that offers both breadth and depth—a foundational element of improvement science (Bryk et al., 2015).

Networked Improvement Communities and Improvement Science

The MTE-Partnership follows the principles of improvement science to accelerate how the field of mathematics education learns to improve. The core principles of improvement science are: make the work problem-specific and user-centered; variation in performance is the

core problem to address; see the system that produces the current outcomes; we cannot improve at scale what we cannot measure; anchor practice improvement in disciplined inquiry; and accelerate improvements through networked communities.

MTE-P is organized as networked improvement community in alignment with improvement science, and is a key construct for involving practitioners in both the implementation and the research of the innovation targeted by the vision and action plans. NICs offer channels of communication that provide built-in opportunities to leverage local repeated studies of disciplined inquiry (e.g., Plan-Do-Study-Act Cycles) into state-wide or nation-wide impact. Scaling up the innovation is the next automatic step as additional partnerships decide to test the innovation for themselves and share the results.

Partnerships

The MTE-Partnership project is a relationship-focused enterprise, in which several types are partnerships are prevalent. The formation of local teams, consisting of at least one university with a secondary mathematics teacher preparation program, one school district, and one additional member (open educational category). MTE-P benefits in two ways from this structure: (1) partnerships between university programs and K-12 schools contains the most important stakeholders in the process of secondary mathematics teacher preparation, and (2) having an open category for local partners resulted in a wide range of stakeholders in the overall MTE-P membership. These two benefits are both well-aligned to the first NIC principle, making the work problem-specific and user-centered.

A second type of partnership is carried out among individuals who participate in Research Action Clusters (RACs). Five active RACs are working to address various components of the Guiding Principles. Collectively these efforts have the potential to form a clear and compelling set of pathways for teaching and teacher preparation that will be shared by many institutions and states.

For example, twelve partner institutions are involved in the Active Learning Mathematics (ALM) RAC, bringing different local contexts to the effort. ALM aims to improve student success in undergraduate mathematics courses, especially Pre-calculus through Calculus 2, by changing the way undergraduate mathematics is taught, shifting from a passive to an active role for the learner. This set of partner institutions share a common vision of transforming undergraduate mathematics teaching and learning through the use of active learning, although each local team may approach the problem differently. Common measures, used to document each program's progress, offer meaningful comparisons of efforts among the different programs and allow the MTE-Partnership to judge collective impact.

The Marketing to Attract Teacher Hopefuls (MATH) RAC has also responded to the Guiding Principles, and specifically the recruitment challenge in the primary drivers. MATH

developed a Secondary Mathematics Teacher Recruitment Campaign Guide www.surveymonkey.com/r/MATHImplGuide, which is now being implemented and evaluated by 14 different local teams. The results and products of PDSA cycles conducted over the past two years by teams within this RAC are documented at padlet.com/ed_dickey/vhle4gisbq82.

Each of the three other RACS, Clinical Experiences, MODULE(S)^2, and STRIDES are examining other elements of the programmatic effort to prepare and retain more secondary mathematics teachers. The RAC structure is the driving force for the MTE-Partnership, each formed by and representing multiple partnerships. This structure creates working teams small enough to be efficient in planning and implementing innovations but with built-in connections to make scaling-up those initiatives seamless and informative. Each RAC is a NIC in and of themselves and collectively they form a larger nation-wide NIC.

State of affairs

Improvement science is a user- and problem-centered approached to improving education, explicitly designed to accelerate learning-by-doing. At present, much productive work has been accomplished in the "learning-by-doing" spirit amid the vast MTE-Partnership. It has proven to be an organization capable of learning and improving, embracing change and valuing the previously invisible problems as they emerge.

Looking forward

The editors of the conference proceedings had the opportunity to closely review the numerous activities reported out at the conference, be challenged by the presentations of the plenary sessions, and examine the new ideas generated by the RACs while there wish to close with thoughts about and challenges regarding the future direction of the MTE-Partnership.

Guiding Principles

In revisiting the Guiding Principles, driver diagram, and work of the RACs, we were intrigued to notice the MTE-Partnership currently has RACs that respond strongly to 61% (20 of 33) of the Indicators of the ten Guiding Principles. We recognize this limited focus was necessary and intentional from the beginning of the project as participants recognized the complexity of the task and realized not everything could be done at once. Working groups set priorities for their areas based on what they thought could be addressed had the most potential to leverage change. RACs were formed from these discussions which helped focus the work and achieve completed products over the first few years.

There are several Indicators of the Guiding Principles that have not been strongly or explicitly addressed by the current RACS, listed in Table 1. For example, the notion of shared engagement and responsibility (1C) can be found in found in elements of the work of some RACs. The Clinical Experiences RAC relies on strong partnerships between schools and colleges

of education, collectively designing and sharing responsibility for success. However, not all constituents are actively engaged to the degree found in Guiding Principles. To date, this level of commitment of the site-level partners across all RACs remains a challenge. This challenge is closely tied to Guiding Principle 2 and its Indicators.

Table 1.

Specific Indicators of the MTE-P Guiding Principles not currently addressed by RACs.

#	Guiding Principle and Indicators
1.	*Partnerships as the Foundation*
	1.C. Shared Engagement and Responsibility
2.	*Commitments by Institutions of Higher Education*
	2.A. Institutional Focus
	2.D. Institutional Support for Faculty
4.	*Candidates' Knowledge and Use of Mathematics*
	4.D. Nature of Mathematics
5.	*Candidates' Knowledge and Use of Educational Practices*
	5.A. Design of Instruction
	5.B. Instructional Methods
	5.C. Assessment and Reflection
	5.D. Use of Instructional Technology
	5.E. Attention to Diversity
6.	*Professionalism, Advocacy, and Leadership*
	6.A. Integrity
	6.B. Intellectual Spirit
	6.C. Sense of Justice
	6.D. Stewardship and Leadership

Guiding Principles 4 and 5 allude to content and pedagogical content knowledge. The Active Learning Mathematics and MODULE(S^2) RACs are intentional about creating a more robust understanding of the content of the discipline, mathematical habits of mind, and the specialized knowledge of Mathematics necessary for teaching. However, there is no specific effort to ensure "teacher candidates understand, and are able to convey to their students that mathematics is a living and evolving human endeavor that relies on logic and creativity, and it is valuable for citizenship, for the workplace, as well as for its intrinsic interest" (MTE-P, 2014, p. 4). The focus on student's learning educational practices, especially those specific to secondary mathematics instruction is not yet addressed by the MTE-Partnership. We do recognize a fundamental element of the Clinical Practices RAC is to provide preservice teachers opportunities to practice and receive feedback on educational practices, which greatly contributes to learning. On the other hand, the Clinical Practices RAC addresses a small, but essential, part of mathematics teacher education programs.

An attention to the development of a sense of social justice, including equitable pedagogy and attention to diversity, has not yet received the direct and concentrated attention these challenges call for—this is evidenced by the strong interest and requests that emerged from the diversity and equity session of the conference. More broadly, the partnership does not yet have a research cluster that attends to the development of professionalism, advocacy, and leadership. As STRIDES begins to mature, we suspect they are likely to take up some of the issues identified in the Indicators.

Taking stock of where MTE-P is successful and where there remains goals yet to be addressed should help define next priorities of the partnership. Does MTE-P have an explicit, commonly understood plan of when and how and when MTE-P will address additional indicators of the Guiding Principles? Are some of these indicators critical for RACs and/or local team effectiveness? What supports do local teams need to address this set of indicators? How can the MTE-Partnership answer these questions and monitor its progress on addressing the Guiding Principles?

As evidenced by the conference goals, several indicators that have yet to receive explicit, focused attention point toward issues of equity, social justice, and advocacy as well as the challenges of institutional change, an underlying element of program reform. These are long-term targets for change. We are hopeful the work of the MTE-P RACs as shared in this set of proceedings may set the stage so efforts can be launched to successfully address those targets in the near future.

Equity, Social Justice, and Advocacy

MTE-Partnership members recognized that although a number of the RACs included issues of equity and social justice in their planning, the resultant activities and strategies that might impact this construct have been less than clear. As such, one goal for the Fifth Annual MTE-Partnership Conference was to, "make equity and social justice more explicit as an essential component of the partnership aim." Part of the time set aside for work at this conference was dedicated to addressing *equity and social justice* and the advocacy for it. At the beginning of the conference a work session on Equity and Social Justice was held and open to all participants; the results of this work session can be found in these proceedings. Additionally, the RACs were asked to explicitly address equity and social justice in their individual working sessions. At the end of the conference each RAC included in their reports the results of their focused conversations and connections to Equity and Social Justice. If the Guiding Principles are to continue to direct the work, it seems the challenges and questions that emerged in both the work session and RAC meetings must be followed upon.

Transformation

Review of the Guiding Principles made evident that numerous elements of the MTE-Partnership charge point directly to the complexity of program transformation. Several elements of transformation are flourishing at present. RACs are engaged in efforts to expand their work to additional partnerships through Plan-Do-Study-Act cycles, testing and evaluating the products and materials that have been developed. As they continue to refine their innovations and scale-up their influence the larger MTE-Partnership Network Improvement Community is poised to support and connect their work. For example, the MTE-P Hub helps to showcase the work of the RACs, provides funding to help with face-to-face RAC meetings, serves as a repository for RAC materials, and hosts and supports events such as this conference.

Yet sustainability of the RACs must continue to receive priority; pursuit of funding in support of the work is one element of the challenge. Much of the efforts of RAC members are volunteer and can cause stress and undue pressure over time. Many have submitted grant proposals and some have received funding. But the question still looms as to how the RACs can be transformed into more sustainable networks? How can the MTE-Partnership help universities, especially the administrators under which the MTE-P faculty serve, understand the impact improvement science has made on their campuses?

How can MTE-Partnership make the work of the RACs more visible and desirable? Much of this has been left up to the individual partnerships, but there may be a key role for the RACs and the MTE-Partnership Hub. How are RACs perceived at the local sites? How can the Hub help with visibility, persuasion, in implementation, and evaluation at the local levels? Various forms of presentations do share Plan-Do-Study-Act cycles, but the details how of the Networked Improvement Communities fold into the process are scarce. Suzanne Wilson's model of tweaking our way to transformation through theory and meaningful measures (Figure 2) seems to fit the MTE-P process well. But it leaves us with the challenge to learn how program transformation can take place. The fifth conference concluded with an emerging working group on Program Transformation—clearly a next needed consideration.

Improvement science continues to be a perfect match to this challenge. It allows the MTE-Partnership to engage in an iterative process over considerable periods of time. Further, the goal of program transformation is not about a final state, but to welcome and engage in continuous improvement. The overall goal is to develop the necessary knowledge-base and action steps for the reform of secondary mathematics teacher preparation to spread effectively within and beyond the MTE-Partnership.

Summary

MTE-P has come a long way in five years. Starting with vague hazy ideas about changing teacher education, MTE-P has managed to develop common vision across hundreds of

individuals representing 30 states. With RACs as a driving force, this project has evolved from inspiration to innovation to action. Although MTE-P can point to many significant and important accomplishments over five years, the work is just beginning. Changing secondary mathematics teacher programs seems to be a herculean task that has resisted past efforts of significant change. On the other hand, MTE-P is a special group, in terms of size, scope, and dedication, that has a chance to make a much-needed difference.

At this point in its evolution, MTE-P has four mature RACs (MATH, ALM, CERAC, and MODULE(S^2), with STRIDES in a nascent state), that have created products that can be used by any of the partnerships. Wilson (2011) identified a "downward cycle" in considering the challenges to effective mathematics teacher preparation (modified by Martin & Strutchens, Figure 3). The RACs of the MTE-Partnership may be beginning to reverse this downward trend. At this phase of development MTE-P has evolved to begin to determine which combination of these innovations are capable of helping any partnership team contribute to MTE-P's twin aims, to create a "gold standard" for secondary mathematics teacher preparation, and to produce more and better teachers. Perhaps materials from all the RACs must be implemented with a high degree of fidelity to achieve a measurable effect on these two aims. On the other hand, the requirements for making a difference could be less stringent. The current move from innovation to transformation sets the stage to answer questions of this nature.

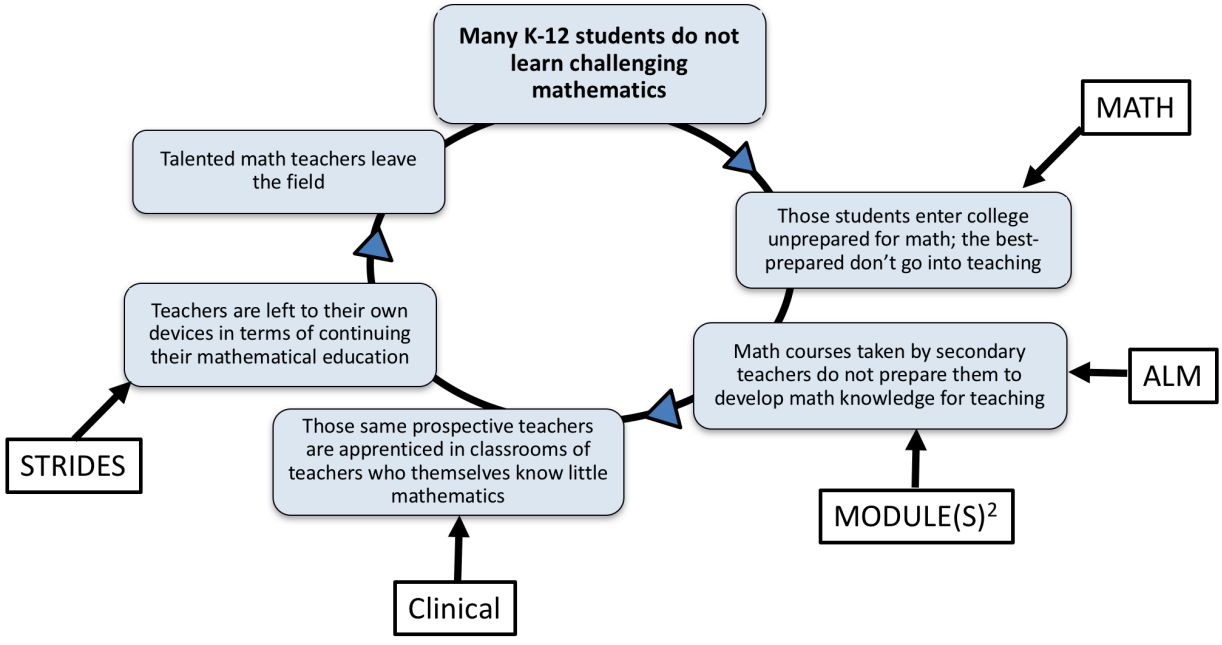

Figure 3: Reversing the "downward cycle in mathematics teacher preparation" (Martin & Strutchens, in press).

The MTE-Partnership Networked Improvement Community provides a structure in which individual efforts of transforming local mathematics teacher preparation through

integrating multiple sets of RAC materials into their programs contribute to a nationwide study that has the potential power to provide answers to questions about complex issues. As the community makes progress toward its aims through rapid tests of change, it also learns much about the detail and complexity of the problem. Our efforts for improvement are grounded in a purposeful fraternity of expertise, creating, sharing, and building on the hard work of one another. The MTE-Partnership has placed us in a unique position that offers the opportunity to create evidence that justifies meaningful change.

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