# CENTER FOR MATHEMATICS ACHIEVEMENT
# Lesley University

**Building Partnerships for Change**

School districts seeking improved mathematics performance for students and teachers have the opportunity to engage with experts in mathematics and professional development who can provide needed support for long term systems change.

The Center for Mathematics Achievement, in partnership with district leaders, provides schools with in-depth professional learning and success that ensures continuous growth.

This report presents outcomes from three recent Center and district collaborations.

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> *". . . We needed a strategy from* [The Center] *to be able to involve a really large number of teachers in a professional development model that addressed our priorities: depth of knowledge, social/emotional learning and inclusion. They didn't have to address all three but depth of knowledge was not enough . . . All three priorities were included in our relationship. The Center provided us with resources that fit our needs."*
>
> Comment from Collaborating District Administrator – Fall 2017

This report draws on data gathered and analyzed over the course of the Center for Mathematics Achievement's most recent district partnerships. These collaborations resulted in teachers acquiring a greater understanding of mathematics, and using that knowledge along with more effective teaching strategies to assess student learning and engage students in their classrooms. Most importantly, these practices led to improved student performance and equity of opportunity to learn. The partnerships were undertaken by Lesley University's Center for Mathematics Achievement funded by the Massachusetts Mathematics and Science Partnership (MMSP) program and aimed at improving student math and science performance. Over the life of these collaborative projects, independent evaluators gathered data using a variety of qualitative and quantitative tools, including surveys, interviews and focus groups; classroom, course and coaching observations; and pre- and post-tests of teacher and student math knowledge. The evidence gathered demonstrated success on many levels. The collaborations resulted in teachers acquiring a greater understanding of mathematics, and the ability to use that knowledge, along with more effective teaching strategies, to assess student learning and engage students.

Embedded in the design of these collaborations was the inherent definition of success drawn from federal and state legislation that calls for higher levels of excellence of teacher competence and higher levels of performance in mathematics for all students. Success was measured in terms of excellence related to enhancing teachers' knowledge of mathematics, ability to effectively teach all students, and to obtain higher levels of performance for all students. Measures of teacher knowledge acquisition, performance in classroom teaching, and student performance on local assessments

and standardized tests provided the data to sustain claims of high program quality. The standards for defining the program's success were based on statistically significant and important gains in these measurable areas. The following report provides the rationale, evidence and opportunities for school district leadership to consider in planning for continuous district and school improvement that will lead to higher levels of performance and the equity of student outcomes that are the birthright of every American student.

# Center for Mathematics Achievement

## *Collaborative Framework*

The Lesley University Center for Mathematics Achievement has demonstrated that it has the experience and resources to empower school districts to implement long term change in the way mathematics is taught and the extent to which all students learn mathematics. Involvement of district professionals with Center staff at all levels in the development and implementation phases of a collaborative partnership between the university and the district is essential for success. The Center's planning process was developed with its partner districts through ten years of collaborative work on MMSP projects funded by the U.S Department of Education. Planning and development of professional learning focused on mathematics content and pedagogy in the context of courses, workshops, and teacher coaching to form the basis for a change process that joins the partners in three to five years of collaborative work.

The Center's approach to implementation of mathematics professional development uses the best of implementation science supported by recent research. As Penuel and colleagues (2011)[1] have observed in their article on design-based implementation research, four elements of a collaborative approach to school and district change are common to successful systemic change efforts that involve researchers and practitioners:

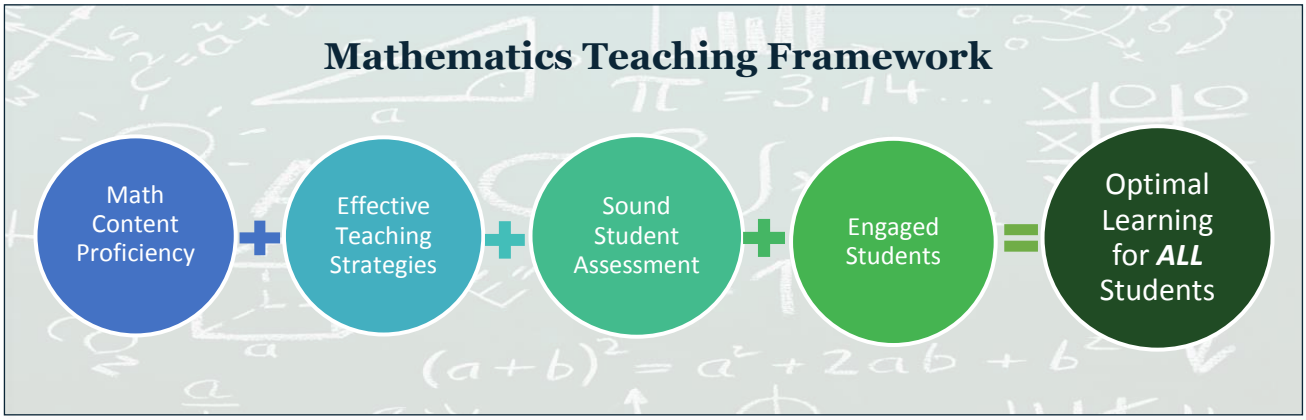
- a focus on persistent problems of practice from multiple stakeholders' perspectives;
- a commitment to iterative, collaborative design;
- a concern with developing theory related to both classroom learning and implementation through systematic inquiry; and
- a concern with developing capacity for sustaining change in systems.

[1]William R. Penuel, Barry J. Fishman, Britte Haugan Cheng, Nora Sabelli. *Organizing Research and Development at the Intersection of Learning, Implementation, and Design*. EDUCATIONAL RESEARCHER October 2011 vol. 40 no. 7 331-337

By creating partnerships with school districts that involve administrators, teachers, and students in activity that supports each of these elements, a goal based and data driven implementation plan develops. Periodic review of progress towards the goals of optimum mathematics learning for all students informs new actions that modify and adjust professional learning and system change.

## *Vision and Goals*

The Center's vision is that all teachers of mathematics become highly qualified in their mathematics content knowledge and use effective teaching strategies; that they be proficient in assessing student growth through gathering, interpreting, and analyzing evidence of student learning; and that they adapt their instructional practices to better engage their students in doing meaningful mathematics, science, technology, and engineering. This teaching framework, pictured below, combines best practices for optimal student learning for ***all*** students.




## *Most Recent Collaborative Projects*

Lesley's Center for Mathematics Achievement has engaged five separate districts in its three most recent collaborative partnerships, the earliest beginning in 2014, funded by the Massachusetts Department of Education Math and Science Partnership programs. Each partnership included course work, follow-up activities, and coaching.

These collaborations were funded for periods of two to three years, and regular classroom teachers from the elementary grades through high school, as well as special educators, ELL teachers, and other instructional personnel who support science and

math teaching participated. In addition to teachers from the partner districts, teachers from surrounding districts participated in the courses offered through the partnerships.

Modeling Math through Mathematical Practices (***MMTMP***), a partnership with Springfield and Easthampton Public Schools in western Massachusetts, offered 9 separate courses with total enrollments of 213 (81 unique participants) from May 2014 through August 2016.

STEM Standards through Inquiry and Problem Solving (***SSTIPS***), a partnership with Brockton and Weymouth Public Schools in eastern Massachusetts, offered 17 separate courses with total enrollments of 314 (176 unique participants) from January 2015 through August of 2017.

A Rational Approach to Proficiency (***RAP***), a partnership with West Springfield, Holyoke and Easthampton in western Massachusetts, has offered 9 courses as of the spring of 2018 with 163 enrollments. This project began in May of 2016 and ends August of 2018.

While each partnership emphasized math content knowledge, effective teaching strategies and student assessment, consistent with the Center's framework and goals, each also had unique aspects. ***MMTMP*** emphasized the creation and piloting of District Determined Measures (DDM's). ***SSTIPS*** incorporated progress monitoring in its courses and follow-up activities, and the strategies that teachers would use to gather and analyze evidence of student learning in real time. At the request of district leaders, this partnership included science and engineering courses in addition to the focus on mathematics. ***RAP*** focused on fraction as number, fraction as ratio, and ratio and proportional reasoning with an emphasis on using accurate models in teaching.

# Evidence of Effectiveness

## *Teacher Math Content Proficiency*

The old adage "teachers can't teach the content that they do not know" is particularly relevant in fields of study that have grown in depth and complexity. Mathematics, supported by a long-debated and changing set of national standards and published curriculums that require higher levels of teacher understanding, continues to grow and change to meet the evolving demands of preparation in science, technology and engineering. Elementary and middle level teachers prepared even a decade ago are often not equipped to guide today's students.

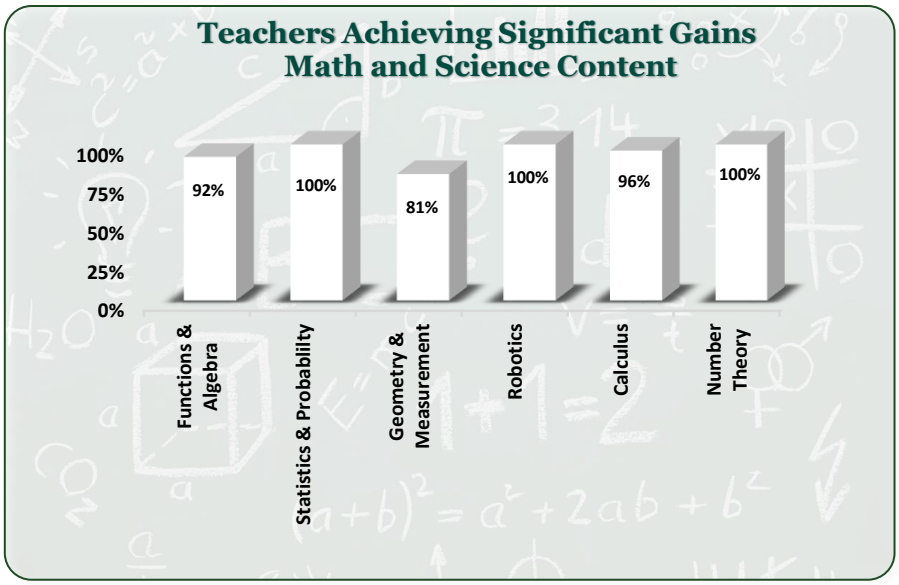
The emphasis in all the Center's mathematics and science partnerships has been the foundation knowledge essential for current mathematics classrooms.

Eleven essential teacher development courses, drawn where applicable from the Common Core Standards, form the basis for a comprehensive knowledge base designed to support the most challenging mathematics curriculums:

- *Number and Operations,*
- *Number Theory,*
- *Fractions as Numbers,*
- *Expressions and Equations,*
- *Functions and Algebra (I and II),*
- *Geometry and Measurement (I and II),*
- *Ratio, Rate and Proportion,*
- *Statistics and Probability, and*
- *Calculus.*

Participating teachers thoroughly study and acquire knowledge needed to navigate and successfully teach modern mathematics. The Center and its collaborating school districts know that teachers gain proficiency in these subjects when they engage in the Center's courses and coaching because each teacher's proficiency is measured summatively through pre- and post-course evaluations and teachers also provide their personal assessment of the knowledge they gained.

For the three collaborative programs that are the subject of this report, pre- and post-measurement of the teachers' math and science knowledge in each course, using valid and reliable measures, showed a consistent pattern of statistically significant increases. The following chart, taken from the final year's courses for the ***SSTIPS*** collaboration, illustrates this. The percentage of teachers showing statistically significant gains in math and science content for that year ranged from 81 to 100 percent for the six courses offered. Results were similar across projects.



Gains in knowledge were also reflected in teachers' personal assessments of the knowledge they gained. For example, in the ***MMTMP*** project, responses to the teacher survey indicated that the vast majority of respondents (91%) also reported that participation in the courses offered deepened their understanding of mathematics, and that it also deepened their understanding of the Massachusetts state standards for mathematics**.** Most reported having used "somewhat" or "very much" of the content knowledge or material gained through the courses in their own teaching, and most also reported the belief, in varying degrees, that changes in their understanding of mathematics have influenced their ability to help students meet or exceed mathematics standards.

Having taken math courses in college, most entered the Center's courses fairly confident in their own content knowledge, expecting the focus to be primarily on pedagogy. For some, the amount of their content learning through the courses was a surprise. In the words of one teacher:

> *"I thought it was going to be a course about teaching statistics and probability, and it wasn't. It was a full on math course and there were times when I was completely overwhelmed and actually quite humbled. I didn't know quite a bit of stuff, or it was hard for me. And I definitely came away with a stronger background in the stuff I need to teach."*
>
> Program Participant Interview – Summer 2017

## *Effective Teaching Strategies*

The evidence for improving teaching strategies was gathered over time from all three collaborations. In each of the projects classroom observations, teacher surveys, and interviews were used to establish evidence of effective teaching strategies by teachers.

### Classroom Observations

The observers used 14 indicators or criteria from the Math/Science version of the *Diagnostic Classroom Observation Tool (DCO)* developed by Nicole Saginor ( 2008)[2]. DCO was initially developed at The Vermont Institutes and subsequently validated by that organization, Mathematica, Inc. and the Northwest Regional Labs in 2006-2007. The

[2] Nicole Saginor, *Diagnostic Classroom Observation: Moving Beyond Best Practice,* (Thousand Oaks, CA: Corwin Press, 2008)

indicators are divided into two categories: Implementation and Content. The implementation criteria focus on how the teacher implements the planned instruction and how successfully the students are engaged in productive learning. The content criteria emphasize the teacher's content knowledge, how the lesson is designed to articulate the lesson's concepts, and how well the teacher can anticipate and handle student misconceptions. Taken together, extensive use of the criteria is seen as producing high quality teaching and learning. The DCO is based on the following assumptions, as articulated in *Diagnostic Classroom Observation: Moving Beyond Best Practice (Saginor, 2008, pp. 3-9)*[3]:

- The best instruction happens in an active, investigative environment.
- Content and process do not eclipse each other: both are needed and work together for sound instruction.
- Learning is an interactive process enriched by dialogue and social interaction.
- Properly implemented and supported, technology can enhance instruction.

Each indicator was rated on a scale of 1 to 5 (no evidence to extensive evidence). Field notes were also used to inform findings.

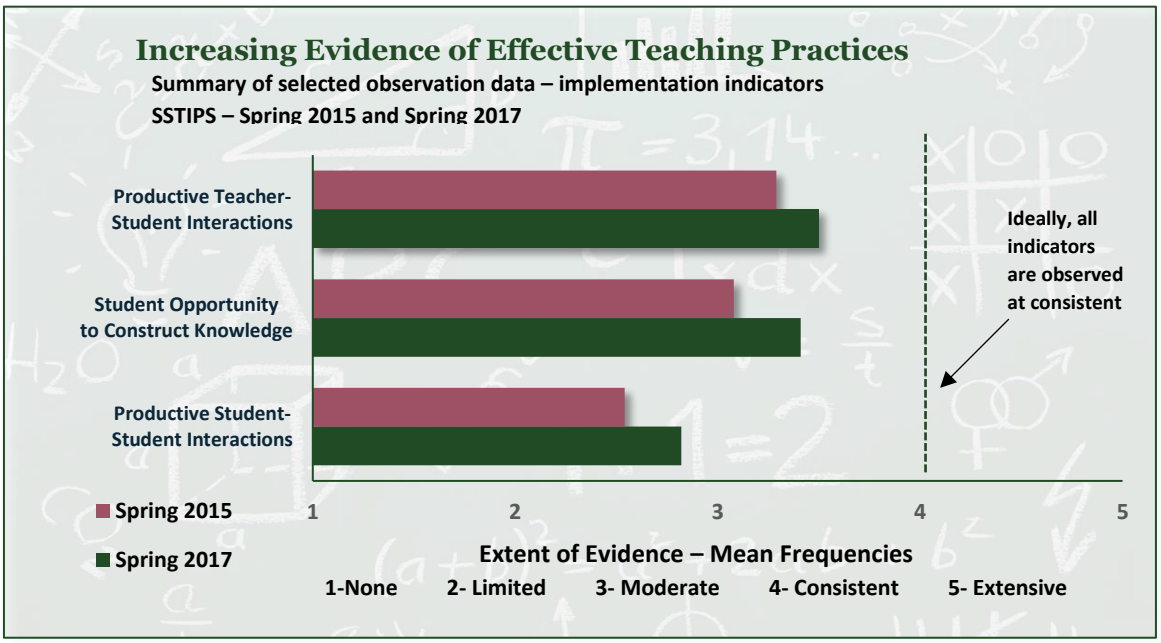
Classroom observations in all three collaborations showed that teachers became increasingly proficient in utilizing new strategies and concepts obtained from the courses.

Throughout the ***SSTIPS*** collaboration in eastern Massachusetts, for example, an average of 24 participants welcomed external evaluators into their classrooms for periodic observation of mathematics teaching and learning. Over the course of two years, observers noted shifts in teaching practices. Three focus areas with the most growth were: probing and substantive teacher-student interactions, student opportunity to construct knowledge, and productive student-student interactions as seen in the chart on the next page. By the end of the collaboration, teachers were less likely to pose questions in search of one "right" answer, and were more likely to probe student thinking about the problem structure, solution strategies, alternative ways of modeling their thinking, and connections to prior learning or other content. Teachers were also more likely to encourage students to work in small groups to talk through problem solutions, and to rely on each other's knowledge and expertise. These are aspects of instruction highlighted in the Center's courses. In fact, some of the observed teachers seemed to

[3] Ibid., 6.

be explicitly modeling their instruction on what they had experienced in the courses. This was especially the case in the school where math teachers worked closely with Center coaches to shift from teacher-driven instruction toward more student-centered instruction that emphasizes discovery and student discourse.

The chart below shows positive shifts, and that there is room for continued growth. Change in practice takes time. School level factors also likely impacted the degree to which participating teachers were able to implement changes in their instruction to align with their learning experiences in the Center courses. In some of the schools, observers noticed that student behaviors and interactions are strictly prescribed and include the expectation that the teacher is the center of attention at all times. Such policies can limit instructional choices and productive student interactions.



The Center supports teachers in implementing a student-centered approach to teaching mathematics that incorporates mathematical habits of mind, such as the Common Core Standards for Mathematical Practice. Mathematical content knowledge for teaching requires not only deep understanding of mathematics, but also skill with helping students develop conceptual understanding, procedural fluency, and a broad range of problem-solving strategies. Evidence from observations of teacher classroom practice and their reflections during interviews and in online surveys collected during program evaluations of the Center's recent collaborations, indicates that participating teachers' classroom practices shifted in a positive direction over time.

**Common Core Standards for Mathematical Practice**
http://corestandards.org/Math/Practice/

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make use of structure.
- Look for and express regulatory in repeated reasoning.

## Interviews

Center courses and classroom coaching model inquiry-based instruction, often centered on solving authentic problems. This approach is dramatically different from how many current teachers learned mathematics as K-12, and even college, students. During interviews, many participants at a partner school in eastern Massachusetts shared that when they began teaching, they taught math in the ways that they had learned it – primarily through direct instruction and worksheets to support memorization of formulas and algorithms. According to these teachers, the courses were powerful in part because they provided the experiential learning through inquiry and problem-solving in small groups. Center course instructors also modeled teacher-student interactions that facilitated rather than directed learning. It took teachers some time to get used to the fact that instructors usually responded to their questions with a question, rather than an answer, designed to help them find their own way through a problem, and thereby develop deeper conceptual understanding.

> *"I began learning how to talk to students - with more probing questions as opposed to hand holding questions . . . when I was a student, you asked a question and the teacher showed you how to do it. As opposed to a response like . . . OK, where does the problem arise, what steps did you follow . . . Making the students think about it."*
>
> Program Participant Interview – Summer 2017

### Surveys

Participants in the ***SSTIPS*** eastern Massachusetts collaboration also completed annual online surveys that included questions about changes in their classroom practice as a result of engaging with the Center for Mathematics Achievement. Respondents reported ongoing efforts to shift from a direct instruction model to one that includes inquiry and rigorous problem solving. New instructional strategies include encouraging student collaboration and discourse, use of formative assessment, and sharing of multiple solution strategies.

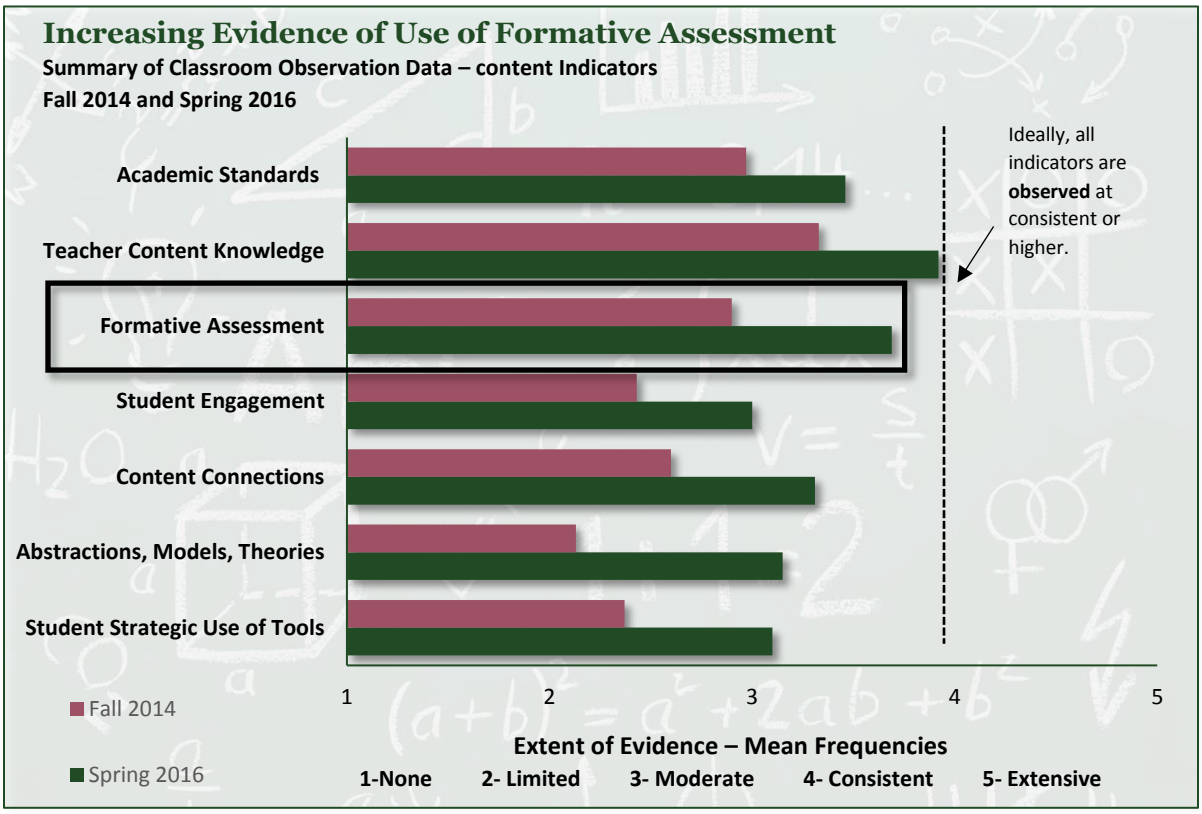
> *"Prior to taking Lesley courses, I did much more direct instruction with note taking off of the board. Now, I allow the students to try to work through a real world problem on the concept I plan on teaching that day to use their prior knowledge and problem solving skills through facilitation. After they have had the opportunity to work through a difficult problem, we report out. Once every group has had a chance to share their information, I go back and do some direct instruction on the material. Most of the time, students use a correct process in solving problems before even knowing the concept."*
>
> Participant Survey Response –May 2016

## *Sound Student Assessment*

Both formative and summative assessment of student performance are essential ingredients of an effective school and district improvement process. Teacher development and school improvement projects are rightly assessed by the extent to which they are related to improvement in student performance. The Center projects included pre- and post-measurement and reporting of student performance that described results of not only the summative state assessment (MCAS) but also district developed formative measures of student performance (DDM's), classroom observation of student engagement, and student surveys of opportunities to learn.

When teachers pre-assess student baseline learning and follow up with a post assessment of learning outcomes they are in a good position to improve subsequent instruction. Classroom observations and survey responses of teachers participating in the ***MMTMP*** collaboration in western Massachusetts point to shifts in this use of sound assessment strategies.

As shown in the chart below, by the end of the project, participating teachers were approaching consistent use of formative assessment in their classrooms.




The observers used 14 indicators from the Math/Science version of the Diagnostic Classroom Observation Tool (DCO) developed by Nicole Saginor (Corwin Press, 2008). Each indicator was rated on a scale of 1 to 5 (no evidence to extensive evidence). Field notes taken during the observations are also used to inform findings.

Observation findings related to formative assessment are supported by teacher responses to a June 2016 online survey. All 23 responding teachers reported using formative assessment "somewhat" or "very much."

## *Engaged Students*

From student surveys, classroom observation, teacher surveys, and interviews, evidence that students become increasingly engaged in learning mathematics is abundant in the Center's collaborative programs of professional development.

For example, at the Easthampton site in the ***RAP*** program from 2015 through 2017 a formal evaluation of Opportunity to Learn (OTL) mathematics was conducted on the entire school. Mathematics OTL was measured by a pre- and post-program evaluation student questionnaire that had established validity and reliability of measurement. The

summary finding for the comparison of scores on the OTL questionnaire from 2015 to 2017 was that overall, matched pairs of students who completed the OTL Questionnaire showed an increase in positive attitude about their opportunities to learn mathematics. In addition to changes in overall OTL scores for all students from 2014 to 2017, scores on individual items for groups of students formed by gender, income status (free or reduced lunch eligibility), and special needs eligibility were also disaggregated. Females, while generally scoring higher than males, increased their positive views of teachers asking about work and feeling safe in the classroom. Males generally scored lower than females but increased their scores on all of the scales related to teachers asking about work, feeling safe, talking with family about school, understanding real world applications of math and expecting to earn a higher level of education. Perhaps the most noteworthy finding of the changes in scores for low income students was that they significantly increased their scores on scales related to completing homework, understanding new material, and family expectations of their performance in mathematics. Students who were eligible for IEPs reported that their teachers enabled them to work on class projects more in 2017 than in 2015. Similar gains were made in IEP students' perceptions of the importance of their courses, their teachers' interest in them, understanding of new reading material, and their expectations for completing higher levels of education. Most important, students who were more engaged in mathematics learning also performed better on performance assessments.

Classroom observations focused on student engagement clearly showed that teachers were "particularly effective at questioning to help students build their own understanding of key mathematical concepts," and that "more students (than at the baseline observation) were highly engaged in their learning."

Teacher surveys conducted online showed that teachers reported "that their students are more enthusiastic and engaged and have a better grasp of concepts and ability to demonstrate and explain their understanding (of mathematics.)"

Teachers who participated in the ***SSTIPS*** collaboration reported in an online survey that, as a result of their engagement with the program, their students are more actively involved in their own learning.

> *I have seen some students take more ownership in their learning. I've seen some students make connections between math and other areas of their life where they previously thought math was only something they had to do at school.*
>
> *It is very exciting and encouraging to observe my students question how a peer arrived at an answer or which strategy was used to determine an answer. My students are much more adept at "talking math" during class discussions.*
>
> – Teacher Online Survey – May 2016

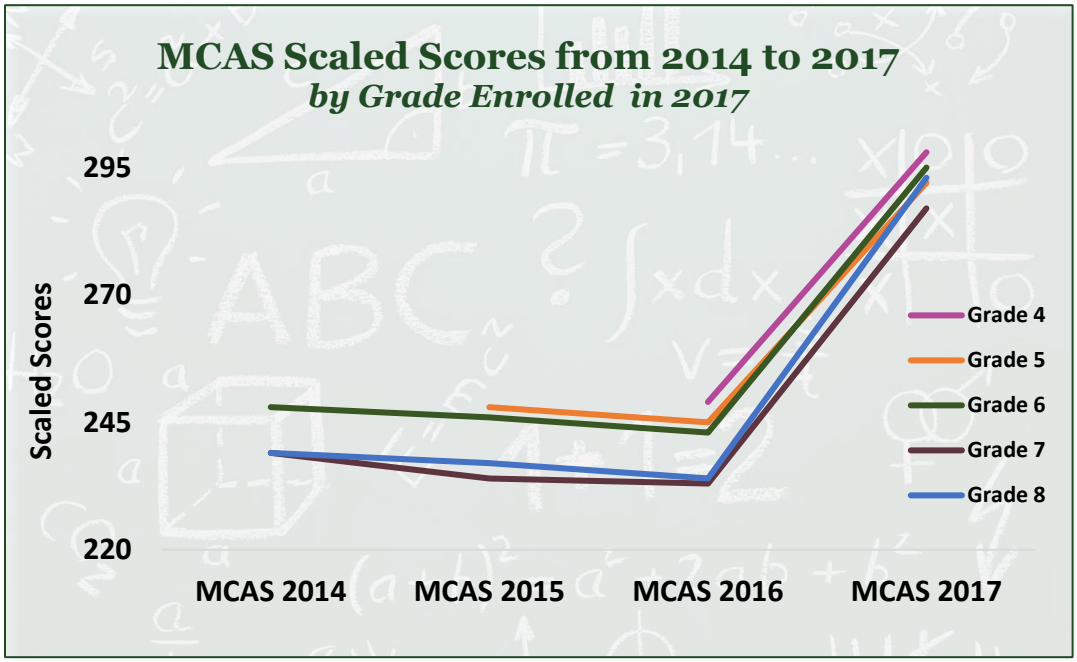
## *Student Performance: Optimal Learning for ALL Students*

Two measures of student performance, the statewide tests of mathematics knowledge and application and the district developed measures of student performance linked directly to instruction, provided evidence that students learned more mathematics from teachers enrolled in the Center's collaborative professional development programs than from teachers not enrolled in the Center's collaborative professional development programs.

### Results of Statewide Testing of Student Mathematics Knowledge

When applied to the evaluation of the ***RAP*** program described earlier, during the years 2014 through 2017, results of statewide testing showed that grade level cohort groups of students increased their mathematics knowledge and performance significantly from 2016 to 2017 as teachers completed the professional courses and students reported increases in opportunities to learn.

The chart below shows how students increased performance on the MCAS Mathematics Test from 2014 to 2017 following teachers' enrollment in the Center's programs.




## Results of District Developed Measures of Student Performance

The ***SSTIPS*** program provided a unique opportunity to examine the relationship between professional development and student performance on local measures. In the first year of the project, in response to the Massachusetts initiative encouraging districts to develop independent measures of student performance, one of the project schools successfully demonstrated through reliable measures that students significantly increased their level of performance from pre- to post-assessment. In the ***MMTMP*** project, six teachers developed district measures for mathematics performance. All six teachers obtained statistically significant gains from the pre- and post-assessments completed by students in 2015. In 2016, seven teachers developed twenty-seven district determined measures and obtained statistically significant gains from pre- to post-assessment on all twenty-seven assessments.

# Quality of Program Delivery

Collaborative school development programs that depend upon successful professional development are in turn dependent upon formative evaluation of the implementation challenges and successes in order to adapt to changing conditions of teacher and student needs. Most of the Center's professional development occurred in the form of on-site graduate-level courses and classroom coaching. Formative evaluation of the Center's courses and coaching has been an essential strategy to ensure high program quality. Questionnaires, interviews with administrators and teachers, and observation of professional development courses and coaching provided the Center and district partners with suggestions for program improvement.

Embedded in the design for program quality was the definition of consistency of content and student-centered, inquiry-based experiences of the content and methods of teaching expected to transfer from the professional courses to teachers' classroom application.

Consistency in the measurement of the quality of instruction of the professional courses, as well as the measurement of the quality of teaching by teachers in their classrooms, was provided by using the same instrument for evaluating professors' courses as was used to evaluate teachers' classroom instruction. Observations once again utilized a modified version of the Diagnostic Classroom Observation Tool (DCO) with the underlying assumptions that:

- The best instruction happens in an active, investigative environment.
- Content and process do not eclipse each other: both are needed and work together for sound instruction.
- Learning is an interactive process enriched by dialogue and social interaction.
- Properly implemented and supported, technology can enhance instruction.

Coaching was evaluated with a framework that applied a theory-to-practice model of training transfer adapted from *Student Achievement through Staff Development (Bruce Joyce and Beverly Showers, 2002).*[4] Data was gathered and analyzed from interviews that included both the coaches and teachers who were coached.

Evidence from formative evaluation was communicated to Center and district partners by a team of evaluators. In the ***RAP*** project, for example, recommended changes included course performance and instructional practices such as the timing of feedback to students (both courses and coaching) and enhancing student collaboration on class projects. Sequencing mathematics content so as to provide examples of scaffolding to be used by teachers was also recommended. Adjustments were made to course content and instructional methodologies on the basis of on-going feedback to both instructors and project staff. Interim reports from classroom observations were shared with project leadership. These reports led to improvement in course design and increased transfer of learning to the classroom. Each of the projects followed this procedure to improve professional development.

[4] Bruce Joyce and Beverly Showers, *Student Achievement through Staff Development,* (Alexandria, VA: Association for Supervision and Curriculum Development, 2002)

# *Quality of Courses*

## Course Observations

The ***SSTIPS*** collaboration provides a good illustration of the quality of the Center's course. Evaluators observed sessions of each of 17 math and science courses offer between 2015 and 2017 and found consistent to extensive evidence of high quality learning environments across the offerings.

### *SSTIPS* Observation of Professional Development (17 Courses)

### 2015 - 2017

| Implementation Indicators | Mean Rating – Extent of Evidence |
|---|---|
| Instructor Confidence | 4.94 |
| Substantive Teacher-Student Interactions | 4.59 |
| Effective Instructional Choices | 4.76 |
| Participant Opportunity to Construct Knowledge | 4.71 |
| Pacing | 4.18 |
| Productive Participant-Participant Interactions | 4.24 |
| Instructor Models Technology Integration | 4.06 |
| **Content Indicators** | **Mean Rating – Extent of Evidence** |
| Academic Standards Central | 3.47 |
| Instructor Understanding of Content and Concepts | 4.94 |
| Formative Assessment | 3.88 |
| Participant Intellectual Engagement | 4.35 |
| Connections | 4.53 |
| Abstractions, Models, Theories | 4.76 |
| Participants Use Appropriate Tools Strategically | 4.13 |

The observers used the above 14 indicators from the Math/Science version of the Diagnostic Classroom Observation Tool (DCO) developed by Nicole Saginor (Corwin Press, 2008). Each indicator was rated on a scale of 1 to 5 (no evidence to extensive evidence).

## Participant Feedback

At the end of each Center course, participants completed course evaluation forms. Questions distinguished between the course and the instruction. The overwhelming majority of participants gave high ratings to both the courses and the instructors. The courses enriched their understanding of mathematics in a collaborative environment through exploration and problem-solving.

The following is a summary of participant evaluation from the ***SSTIPS*** collaboration in eastern Massachusetts.

### Questions Relating to the Course of Study

All participants rated the overall quality of the courses as high/almost always high. Comments about the strengths of the courses included:

- Challenging – pushed beyond comfort zone
- Use of manipulatives
- Applications to the classroom
- Diversity of assignments
- Well-organized instruction and materials
- Discussions
- Instructor knowledge and preparation
- Engaging
- Working in groups and collaboration
- Multiple approaches to problem solving

### Questions Relating to the Instructor

All participants also rated the overall quality of instruction as high/almost always high. Comments about the instruction included:

- Instructors were amazing, high-energy, excellent, organized, supportive, encouraging, knowledgeable, open, and approachable
- Well organized
- Good pairing of instructors and facilitators
- Connection of course material to recent research
- Great ability to work with the range of participant math background
- Clear expectations

## *Quality of Classroom Coaching*

Classroom coaching is an extension of learning through the Center's courses. Coaches and participants described courses as pathways for deepening understanding of mathematics and experiencing new modes of instruction. As one of the coaches described it, the overall value of coaching is in giving formative information to teachers in the moment they need it most.

> *"I think that the most crucial part of this program is the coordination of the content courses with the coaching so that the teachers themselves are getting immediate feedback on what they are doing that is working well, and constructive critical friends… We're not condemning or condoning anything that is going on. Rather, we are making suggestions in a timely manner, right then and there, to improve their practice. Just the way they need to be doing for their students."*
>
> Coach Interview – Summer 2017

Those who have been in coaching relationships as part of the Center's collaborations with school systems report that the process helped improve their practice. Deeper content knowledge, more inquiry-based instruction, new questioning techniques, and new approaches to student engagement are examples they offer of growth through such a personalized learning opportunity.

> *"I think it's a peer relationship with the understanding that this person has such a wealth of knowledge that I could hopefully tap into. I didn't feel like anyone was looking at me and judging me or anything like that. I felt like we are on the same level. We're educators, but knowing that these people have a wealth of knowledge that it would be beneficial for me to have."*
>
> Participant Coaching Interview – Summer 2017

Several of the participants talked about how their relationships with the coaches evolved from that of expert and learner to the point where they and the coaches were either co-creating instructional materials or collaborating around a specific instructional problem identified by the participant.

Most participants framed their description of the coaching relationship in similar terms.

Consistent work with mathematics education coaches has great potential to extend learning from the Center courses and help strengthen transfer of that learning to change in teacher classroom practice.

# Collaborations' Support of District Initiatives

Interviews with district leadership in all three projects revealed the extent to which the Center's program design was fitted to existing district school improvement initiatives. For example, administrators cited the high quality of the instruction of the ***RAP*** courses as the enabler of a legacy of professional development making it easier to recruit teachers for new professional development. In Easthampton, the high quality of coaching was cited as contributing to the high level of enlisted penetration of the program (nearly all teachers in the school have now been enrolled and successful in the Center's programs). The design of the program that embedded mathematics concepts and pedagogy in classroom practice, with direct observation linked to district goals, provided vertical integration of professional development. The program was perceived as an important resource for districts to respond to the emerging new standards in science and mathematics. District administrators identified several indicators of program quality that have added value to district development:

- **Reputational:** The program is known for high-quality professional development, embedded systems change for a whole school, widespread change in teacher knowledge of content and methods of teaching, and increasing student participation and engagement. Administrators have described the advantages of the program to their colleagues at regional meetings.

- **Effects:** It is evident in the districts that loyal and trusting relationships, teacher perceptions that students are learning more and in better ways (inquiry, for example) and student engagement have increased for all students, including low income and students with disabilities. Teachers speak of the trust they have in their colleagues' new abilities and within their own abilities.

- **Student perceptions:** In Easthampton, students have reported on the OTL survey that they are more engaged and that their families are more engaged in school. Overall, the program has been transparent to students who may not have noticed the gradual transformation of curriculum. However, students have noticed changes in opportunities to learn.

- **Embedded changes:** Changes to curriculum as a result of the Center's programs were cited by district administrators as having been embedded in the fabric and organization of the school. These changes will persist despite the loss of professional development funding.

- **Developmental change expected in the future:** Administrators cited the expectation that schools will continue to improve curriculum, methods of teaching, and student engagement as a residual of the Center's model. In Easthampton, the legacy of coaching and co-teaching was particularly cited as a major strength of the change process.

Looking back over two years of a district's relationship with the Center, one district leader had this to say:

> *"We needed help with integrating content and process of learning; and, we needed partners like the Center to come to us with a proposal for using our federal and state dollars for professional development that was systemic in nature… For example, we needed a strategy from them to be able to involve a really large number of teachers in a professional development model that addressed our priorities: Depth of Knowledge, Social/Emotional Learning and Inclusion. They didn't have to address all three but depth of knowledge was not enough… All three priorities were included in our relationship. The Center provided us with resources that fit our needs."*
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> District Leader Interview – Fall 2017

Another district leader observed:

> *"The engagement in curricular change coupled with the introduction of new content and methods through the courses and integrated coaching has resulted in a deeper level of implementation that was expected from the design of the program… Nearly every teacher on our staff has completed the Center's program and has seen the results in the performance of their students."*
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> District Leader Interview – Fall 2017