Wisconsin Mathematics & Science Partnership

THE LEARNING NETWORK CONFERENCE

2015

Meeting the Challenge

WISCONSIN DEPARTMENT OF PUBLIC INSTRUCTION

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Elementary and Secondary Education Act: Title II, Part B: Mathematics and Science Partnership Program

2012-2015	2013-2016	2014-2017
Wausau/UW-Marathon (mathematics) UW-River Falls/Rice Lake (mathematics) UW-Oshkosh/Racine and Fond du Lack (science) UW-LaCrosse	UW-Milwaukee/Cudahy (mathematics) Weston/UW-Platteville (Science) Adams Friendship/Marian University (mathematics)	UW-Eau Claire/Clayton (mathematics UW-Eau Claire/Cornell (mathematics) UW-Oshkosh/Mondovi (mathematics) UW-Parkside/Kenosha (mathematics)

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Introduction

The reauthorization of the Elementary and Secondary Schools Act in January of 2002 (also known as the No Child Left Behind Act, NCLB) introduced the Improving Teacher Quality Grant Programs (Title IIB). These programs encourage scientifically-based professional development, as a means for improving student academic performance, in all 50 states.

Each state's department of education is responsible for administering the program on a competitive basis. The program is a formula grant program, with each state's funding determined by student population and poverty rates. The program is commonly known as the Mathematics and Science Partnership Program (MSP).

Wisconsin's MSP *strives to improve teacher quality* through partnerships between state education agencies, institutions of higher education, local and regional education agencies, and school districts; for the purpose of increasing *student academic achievement in mathematics and science*. The program supports partnerships between one or more of Wisconsin's high-need Local Educational Agencies (LEA) and at least one institution of higher education department of science, mathematics, and/or engineering.

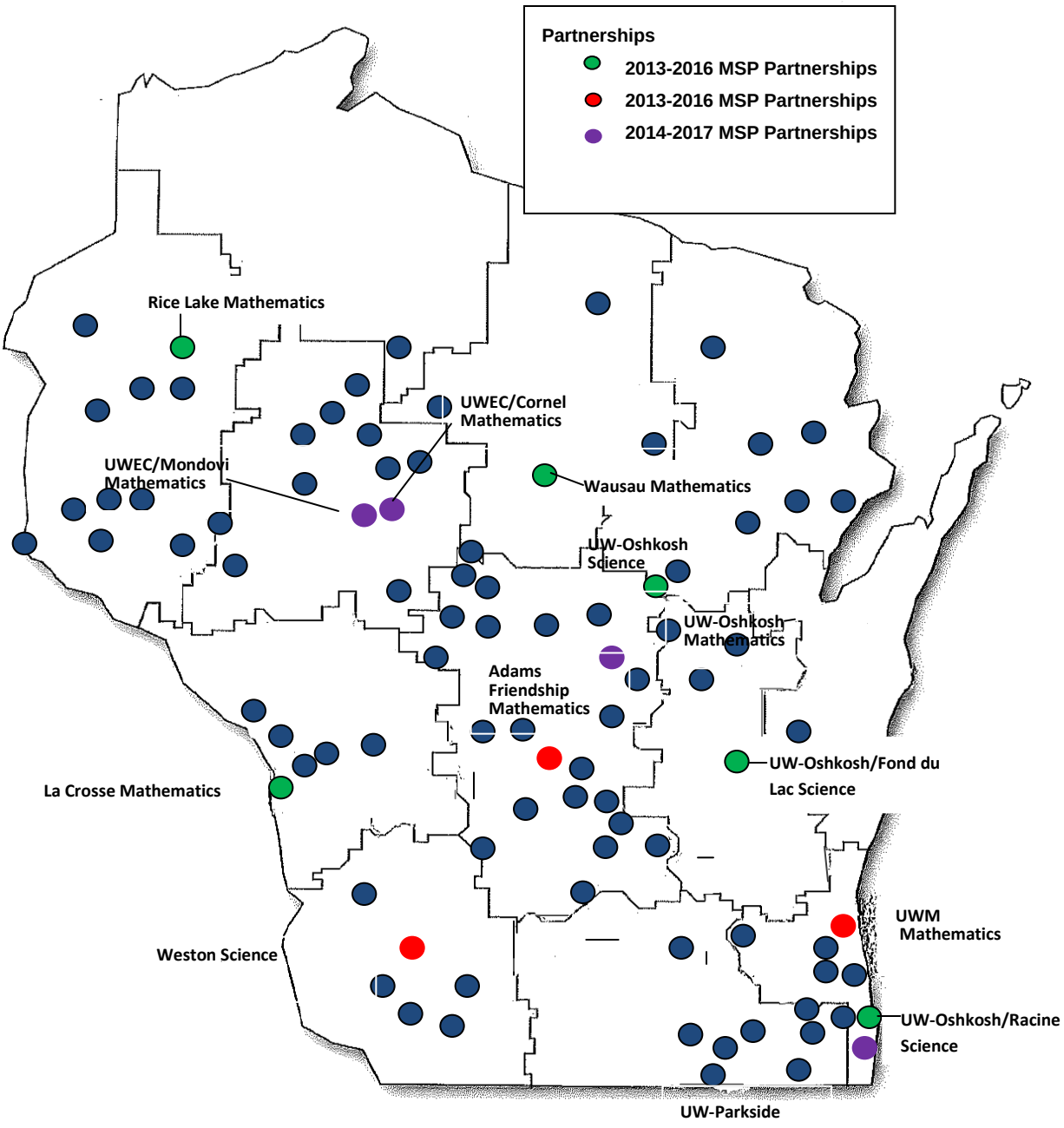
Partnerships between these high-need school districts and the science, technology, engineering, and mathematics (STEM) faculty in institutions of higher education, are at the core of each MSP. Each individual partnership focuses on increasing and enhancing the content knowledge and teaching skills of classroom teachers of mathematics and science. Partnerships are typically two to three years in duration, and include face-to-face instruction and continual electronic dialog between participants.

A high need LEA is any district where mathematics or science student proficiency scores do not exceed 65 percent, based on disaggregated scores, and where there is no currently active Title II, Part B grant, in the same content area, and one of the following:

1. At least 10 percent of the student population is from families with income below the poverty line as identified by the Census 2013, or
2. Schools/districts having Rural Education Achievement Program (REAP) or meeting local codes of 6,7, or 8

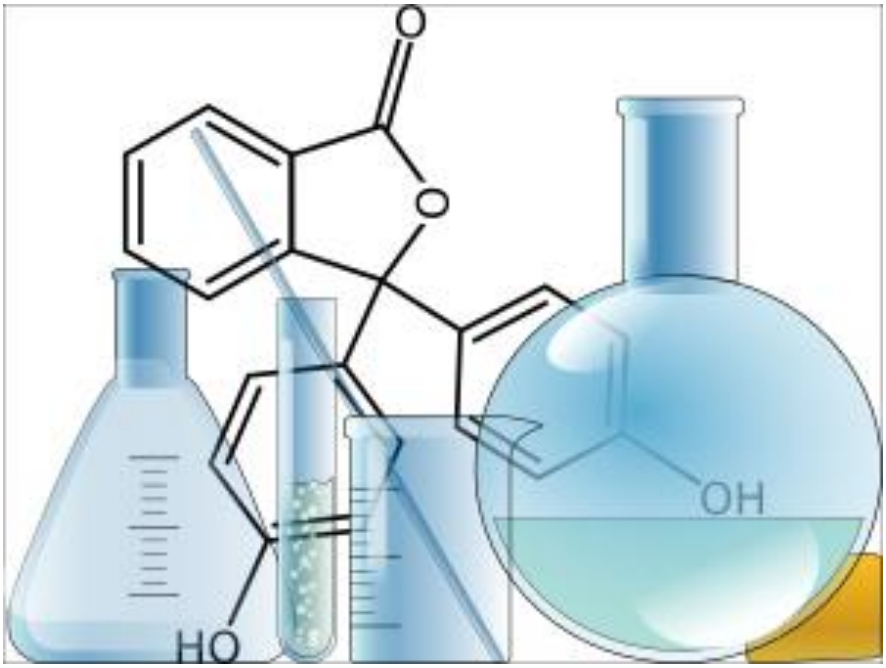
MSP Program Locations

Mathematics and Science Partnership Program



Mathematics & Science Partnerships

2012-2015 Projects



Wausau/UW-Marathon

(Mathematics)

UW-River Falls/Rice Lake

(Mathematics)

UW-Oshkosh/Racine and Fond du Lack

(Science)

UW-La Crosse/Tigerton

(Mathematics)

Project Title: Wisconsin Core Mathematics Initiative
Principle Investigator: Jenni McCool
High Need LEA: Tigerton School District
Higher Education Institute: UW La Crosse
Project Leaders: Jenni McCool
Total Funding: $613,445
Teacher served: 26

Abstract: The Wisconsin Core Mathematics Initiative (WCMI), a partnership between the University of Wisconsin-La Crosse (UW-L) and 16 LEAs in the CESA 4 and CESA 8 regions, seeks to enhance student academic achievement as it supports the implementation of the Common Core State Standards for Mathematics (CCSSM), with a particular focus on grades 4-8. This project develops the mathematical content knowledge and professional practices among teachers that have been shown to enhance student learning. The three-year project has achieved these goals by engaging 50 teachers from two CESA regions in an on-going professional development program to improve pedagogical content knowledge in the following three domains of the CCSSM: Ratios and Proportional Relationships, Geometry, and Statistics and Probability. Preliminary results show significant differences in learning gains tests indicating an increase in knowledge for participants.

Introduction: Each year, the project team comprised of math education faculty from UW-L and 11 teacher leaders from participating school districts work with fifty 4th - 8th grade teachers in both two-week summer academies (80 hours of contact time) and academic year follow-up sessions (32 hours of contact time). The development of content and pedagogical content knowledge for this professional development experience focused on the pathways along which students are expected to achieve proficiency. Categorizing student strategies along successive progressions and identifying appropriate tasks and instructional moves to support learning at all levels was emphasized. The participants applied this new knowledge during the academic year and during the academic follow-up sessions they shared the results of their action research projects and their analysis of student learning data.

Goals and Objectives: Based on state and local needs analysis, the project goals, objectives, and activities were collaboratively planned. The WCMI goals included:
Goal 1 (Capacity): Further extend the capacity for leadership and collaboration among all K-16 partners through the establishment of a sustainable professional learning community focused on the implementation of the CCSSM.
Goal 2 (Teacher Knowledge): Improve participating teachers' core content knowledge and mathematical knowledge for teaching by providing on-going professional development focused on three CCSSM domains.

Goal 3 (Teacher Practice): Improve instructional practices through sustained effective use of the CCSSM Learning Progressions and Trajectories that link assessment and instruction.
Goal 4 (Student Learning): Enhance students' core mathematical concepts in grades 4-8 and reduce discrepancies in disaggregated mathematics achievement data through teacher application of project activities.

Program Plan: IHE mathematics education faculty Jenni McCool, Jennifer Kosiak and Matt Chedister developed and delivered the PD. The PD was delivered to two different sites. One group of teachers was onsite and the other group received the PD simultaneously through distance technology. Both groups were able to discuss content and pedagogical strategies using this technology. PD sessions were held for two weeks in the summer and four days during the academic year.
The PD was structured to focus on the development of content knowledge of the mathematics as well as evidence-based teaching practices. We modeled effective teaching by engaging participants in the CCSSM Standards for Mathematical Practice, using formative assessments and focusing on understanding through effective questioning techniques. The content focused academic year activities included critically examining the 6-8 CCSSM and understanding student thinking through video analysis, student generated work samples and the use of Learning Trajectories as well as the CCSSM Standards Progressions. The content focused summer activities included critically examining the 6-8 CCSSM and understanding student thinking through student generated work samples and the use of Learning Trajectories and the CCSSM Standards Progressions.
To enhance the sustainability of WCMI, the project built leadership capacity in participating school districts by supporting the development of 11 teacher leaders who assisted in the facilitation of the PD sessions. These leaders also worked with participants in grade level Professional Learning Communities (PLCs) as well as across grade level PLCs. Leaders also collaborated with PLC members on the development of pre/post assessments, student interview questions and lessons. Participants were then observed by their leader when the lesson was taught. The leader provided feedback through the lens of the CCSSM Standards for Mathematical Practice.

Evaluation and Reflection: The external evaluation of the project used mixed-methods approaches using pre-existing and project-developed qualitative and quantitative instruments. The evaluation plan followed a quasi-experimental pre- and post-test non-matched control group design with teacher and student data collected from both the experimental group (n = 50) teachers receiving professional development) and a non-matched comparison group (n = 15). To assess teacher learning and practice measurable outcomes, both formative and summative evaluation tools were used. These tools include the Learning Mathematics for Teaching (LMT) Instrument, project-developed content tests, the Survey of Enacted Curriculum Survey,

classroom observations conducted by teacher leaders, reflective journals, and self-report surveys. Student achievement data from both the experimental and control groups included WKCE proficiency scores, and data from teacher action research plans. These data points provided an indicator of changes in teacher content knowledge and practices, as well as the project's impact on student learning. Below are results from the first two years of the program.

In 2013, scores for the Ratios and Proportions LMT comparison were significantly higher ($t(35)=2.72$, $p<.01$) from pre to post with scores from the content exam also showing a significant difference ($t(31) =-12.18$, $p < .001$) in a pre-post comparison. In 2014, scores for the Geometry LTM comparison were significantly higher ($t(34) =-4.595$, $p < .001$) from pre to post with scores on the Geometry content exam also showing significant differences ($t(39) =-7.136$, $p < .001$) in a pre-post comparison.

Reflection: The evaluation of years one and two of the MSP grant have had successes and challenges. As with any large-scale longitudinal project, there were unforeseen variables that affected the timeline of the evaluation activities. Given the scope of the project and the number of evaluation activities planned, the overall evaluation of year one can be deemed successful.

One success of the evaluation was the relative smoothness of the LMT completion process. For the most part, participant and control teachers understood the process for logging on and completing the LMT. The process by which teachers were provided with the link and their ID code to enter on the TKAS website was an innovative use of the Qualtrics software, although there are a few minor kinks to work out. In year 2, the Qualtrics system continued to support the LMT process by providing the link to the test to the teachers in an organized and methodical way. The teachers received the information they were supposed to receive in a manner that allowed the external evaluator to track respondents effectively.

Another success was the participating teacher diligence to complete the many evaluation tools administered to them in both years 1 and 2. They received several tools to assess their content knowledge and instructional practices and the majority of teachers were diligent in making sure they had completed all of the assessment tools. This allowed the evaluator to acquire a sufficient amount of data given the relatively small sample size of the participant group. This data will enable inferences to be made about the effectiveness of the professional development activities on enhancing teacher content knowledge and pedagogy.

The working relationship between the evaluator and the primary investigators was also successful. Communication between the evaluator and PI’s was frequent and the PI’s ensure that the roles of the stakeholders were clear prior to the beginning of the project. This clarity allowed the evaluator to narrow his focus on and ensure he was working on his responsibilities. The evaluator also communicated frequently with the PI’s and was sure to ask questions. The optimal

communication levels allowed the evaluation to progress smoothly. This solid foundation will only serve to better the project moving into the final year. All parties are on the same page and know fully what to expect from each other. A strong relationship has been established here.

A major challenge in the evaluation of year one of the MSP was in acquiring responses on the LMT and local content exams from control teachers. Since these teachers do not meet there were no opportunities to administer this exam at a common time and ensure that teachers were responding. Instead, the exam was sent to these instructors via email and they were asked to do extra work by scanning the exams in and emailing them to project leadership. The team is working to identify a way to elicit more responses and increase timeliness of control teacher responses. A review of techniques to encourage control participation will be undertaken and ideas identified at the national MSP conference in October will likely be included. For example, controls teachers who are incentivized with a stipend could be provided $25 to take pre tests and encouraged to return to take the post with a larger incentive of $75 for a total of $100. Weighting the incentives to encourage participation later in the process should help to encourage continued efforts throughout the process. However, our biggest challenge really is in recruiting control teachers to begin with. Continued relationship building with principals and district administrators encouraging them to encourage their staff to participate will likely help. Further incentives will be reviewed as motivation to recruit and retain a meaningful control group. Our initial plan to attain a well-matched control group from the participating schools was hindered by a number of factors but will receive renewed attention moving into our final year.

Attrition was another challenge to the evaluation, specifically for the LMT data. Several participating teachers who completed the LMT before the June professional development session dropped out for various reasons before the second professional development session in 2013. There were also several teachers who did not complete the pre-LMT but did complete the post-LMT. This limited the amount of usable responses for pre-post gain score analysis. Year 2014 also saw its share of attrition. As with recruitment and retention identified above, strategies discussed at the national MSP conference will be reviewed in an attempt to sure up the participants' continued participation throughout the entire process.

Another challenge was in collecting pre and post data from all participants on the project’s original timeline. For example, some participants began the project in week two due to the fact that they were late hires by participating districts. We also lost participants due to a variety of facts including change in teaching roles for the upcoming school year and a family issue. As we realize professional development is ongoing, we will continuously recruit teachers. Another challenge related to data collection was the use of online assessments that required multiple login/password information. This caused stress for some participants when accessing assessments from home. Our external evaluator is working to develop a more streamlined process for retrieving passwords in a timely manner.

Project Title: Math Transition into the Common Core Era
Principle Investigator: Erick Hofacker, UW River Falls
Main High Need LEA: Rice Lake School District
Main Higher Education Institute: UW River Falls
Project Leaders: Erick Hofacker, Kathryn Ernie, UWRF & Sherrie Serros, UW Eau Claire
Evaluator: Barbara Bennie, UW La Crosse
Total Funding: $473,917
Number of Teacher served: 33

Abstract: The Math Transition into the Common Core Era is a partnership of the University of Wisconsin – River Falls, the Rice Lake Public Schools, University of Wisconsin – Eau Claire, and 15 additional school districts in Western Wisconsin. Middle school and high school mathematics teachers are engaged in intense training to increase their pedagogical content knowledge as it pertains to both the content and practice standards as defined in the Common Core Mathematics Standards and Wisconsin's Six Principles for Teaching and Learning. This project has provided a learning community, which stretches over 120 miles, for math teachers to work and discuss relevant teaching and learning with teachers in other districts. An emphasis has been placed on mathematical modeling and exploring problems that are dependent on the need to make assumptions in order to answer. These types of problems provide a need for students to engage in habits of mind and focus on reasoning and sense making. The mathematics is explored from both a theoretical view, as well as math set within a contextual situation. Participants have also examined the coherence of the mathematics throughout the grade levels. Problem solving strategies provided techniques and representations that participants learned to assist in addressing the practice standards in their classrooms. Participants have constructed and adapted tasks that have been implemented into their classes and observed by the principal investigators. Data has been collected on the participant group, and a control group of teachers, in the areas of: teacher content knowledge, teacher knowledge of standards, and student data on performances connected with the tasks.

Introduction: Our project finds support in the research of Hill, Rowan, and Ball (2005). Their 2005 study found that the specialized mathematics knowledge of teachers is significantly related to student achievement. Our project's intensive activities are focused on mathematical knowledge not imparted by lecture or walk through, but rather obtained through mathematics investigated and modeled by the teachers themselves in active inquiry and problem solving.

The conceptual foundation of our project is a research based Core Conceptual Framework Desimone (2009). Critical components of effective professional development have been identified that reflect consensus on characteristics that are crucial to increasing teacher

knowledge and practice, and thereby increasing student achievement. This project is based on the five Core Features and Conceptual Framework for Teacher Learning, Desimone (2009).

- Content Focus
- Active Learning
- Coherence
- Duration
- Collective Participation

Goals and Objectives:

- Increase teachers' pedagogical content knowledge in mathematics.
- Increase teachers' ability to differentiate instruction through different forms of questioning techniques, and reasoning and sense making activities.
- Increase the focus in teaching to include the modeling and solution of applications.
- Establish effective ways to evaluate student achievement in content domains of the Common Core.
- Increase professional development in an underserved region of our state.
- Increase collaboration and discussion around the integration of the Common Core standards, providing a support network

Program Plan: Our three-year project focuses on teachers actively engaged in doing mathematics grounded in the Common Core Standards and Practices as they prepare to impart this knowledge and experience to their own students.

Mathematics Content Focus by Year

Algebra and Function (Year 1)

Statistics and Probability (Year 2)

Geometry, Number and Quantity (Year 3)

***Modeling throughout each Year

Scope of the Project – Each Year

Practice Sessions (weekends)

Problem Solving & Practice Sessions

Showcase Events (with each teacher during the academic year)

School Visits - Observing Lessons & Sharing Artifacts

Intense Training (two weeks in summer)

Focus on Teacher Pedagogical Content Knowledge of Mathematics

Teacher Implementation of Meaningful Tasks (throughout academic year)

Aligned with Standards within Units & Data Collection

Evaluation and Reflection

Teacher Content knowledge Year One Results

HS – Functions & Modeling (Applied) June 2013

Mean score of the participants showed a 23% increase when compared to the control group.

HS – Algebra (Theoretical) July 2013

Mean score of the participating teachers was 13% greater than that of the control group.

Average Gains in Content Knowledge Summer 2013

6-8 Ratio, proportion, & Function June 2013, Significant gains (73% of the Middle School (MS) teachers)

6-8 Expressions & Equations July 2013, Significant gains (91% of the Middle School teachers)

9-12 Functions & Modeling June 2013, Significant gains (76% of the High School (HS) teachers)

9-12 Algebra July 2013, Significant gains (52% of the High School teachers)

Most comparisons between the control group teachers and the participating teachers are made using descriptive statistics and qualitative observations (smaller control group sample size).

When possible, appropriate non-parametric statistical procedures were used to test for differences (Wilcoxon rank-sum test, Wilcoxon signed rank test, and Fisher's exact test).

Expertise and Confidence of the 8 Math Practice (MP) Standards - HS & MS together

Statistical significant gains in median scores for expertise related to MP standards 1 & 3-7.

Confidence related to MP standards 1-7. (2014)

Teacher Content knowledge Year Two Results

6-8 Statistics June 2014

Artist Suite Multiple Choice: Significant gains (73% of the Middle School teachers)

Open Response: Significant gains (91% of the Middle School teachers)

Significant gains in median expertise related to 13 of the 16 content standards. Significant gains in median confidence related to all 16 content standards.

6-8 Probability July 2014

Multiple Choice: Significant gains (67% of the Middle School teachers)

Open Response: Significant gains (89% of the Middle School teachers)

Significant gains in median expertise and confidence related to 8 of the 10 content standards.

9-12 Statistics June 2014

Artist Suite Multiple Choice: Significant gains (72% of the High School teachers)

Open Response: Significant gains (84% of the High School teachers)

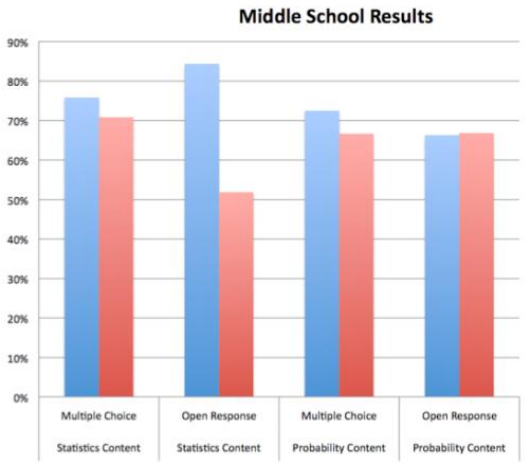
Significant gains in median expertise related to 13 of the 17 content standards. Significant gains in median confidence related to 15 of the 17 content standards.

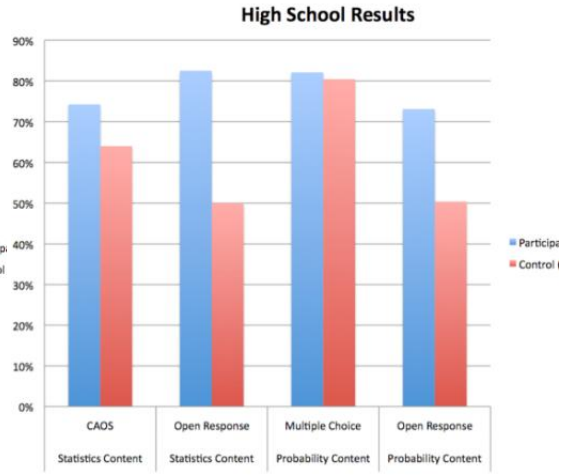
9-12 Probability July 2014

Multiple Choice: Significant gains (54% of the High School teachers)

Open Response: Significant gains (93% of the High School teachers)

Significant gains in median expertise and confidence related to all 22 content standards.





Evaluator Observation Year 2: Teacher Knowledge Gains 2014 "The observed growth in conceptual understanding, computational proficiency, and general confidence related to statistics and probability over the short time span of the summer workshops was remarkable."

"Teacher participants:

1. Gained ability to move between various representations for data.
2. Grew to recognize when and how to apply the binomial probability distribution.
3. Gained experience with computer simulation tools that can be used to explore & estimate probabilities."

Reflection regarding teacher content pedagogy:

1) Teachers' expectations of students

Moving from strictly practice to providing problems in context.

Perseverance - Prepare them for struggle. More control to the student.

Moving away from giving each step with sub-problems - less scaffolding.

Acceptance of open-ended problems where assumptions may need to be made.

2) Teachers' approaches to problem solving

Moving from "What is the answer?" to "Explain your reasoning?

Challenge each other's reasoning." And

"How did others approach this, how did you start, what did you learn?"

3) Teachers' understanding of rich mathematical tasks

Moving from activities to meaningful tasks that emphasize reasoning and modeling.

Using virtual or hands-on materials: algebra tiles, rods.

4) Teachers new focus on Standards of Mathematical Practice

Starting with a focus on specific content standards to beginning to address the habits of mind in their teaching and materials. Increase in teacher expertise and confidence.

**All our high needs districts participating in the 3 years of our grant are no longer identified as on the high needs list. (Many factors including mathematics achievement.)

Student Data Collected During 2013-14

Mean percentage point gain					
	Task				
	Algebra I*	Algebra II	Grade 7	Grade 8*	Precalculus*
Control	1	20	-	4	8
Particip	18	14	25	16	42

*Denotes a statistically significant difference between participants and control. Highlight denotes a statistically significant change in mean score from pre to post assessment.

Student Data - WKCE (2014) Grade Level % of Students Scoring at or above Proficient

7th	41.5%
8th	43.6%
10th	43.6%

Partners: UW-River Falls, UW-Eau Claire, UW-La Crosse (evaluation)

Rice Lake School District, Barron School District, Osseo - Fairchild School District

Luck School District, Eau Claire School District, Chippewa Falls School District

Mondovi School District, Elk Mound School District, Baldwin Woodville School District

Ellsworth School District, River Falls School District, Menomonie School District

Prairie Farm School District, Prescott School District, Bruce School District

Hudson School District

Project Title: STEM for the Future
Principle Investigator: Jason Myers (WSD)
High Need LEA: Wausau School District
Higher Education Institute: UW-Marathon County
Project Leaders: Nathan Thome (WSD) and Jason Myers (WSD)
Total Funding: $439,542
Number of Teacher served: 26

Abstract: We recently concluded the second year of our STEM for the FUTURE! grant. Our project is a joint venture between the Wausau and Rhinelander School Districts targeting 4,118 grades 1-12 students and 34 math and science teachers in north-central Wisconsin. Both the Wausau and Rhinelander Districts have been classified as high-need LEAs. We have strategically utilized our higher education partner, the University of Wisconsin-Marathon County, our Statewide Cooperative Educational Service Agencies (CESA), and other education leaders in our state to provide professional development activities that address STEM specific content knowledge, pedagogical content knowledge, instructional strategies, and assessment & grading practices. The charge of our STEM for the FUTURE project is to provide an intensive, sustained, and content-specific professional development program that inter-weaves curriculum, instruction, and assessment practices to promote both teacher and student understanding of mathematics content, as well as science, technology, and engineering.

Introduction: Each of our three STEM conferences held during the 2013-2014 school year were organized to expand upon the guided inquiry focus of our initial STEM for the Future summer institute in 2013. These three conferences provided our grant participants with a more in-depth understanding of quality formative assessment; hands-on experience with robust STEM related tasks, and instruction on how to provide high quality feedback to students.

Our 34 grant participants consist of 15 math teachers spanning grades 6-12 and 19 science teachers spanning grades 1-12. Our grant coordinators have worked hard to organize professional development activities that take into consideration the diversity of this group of participants. It should be noted that the coordinators of this grant came to the realization during year one of our grant that our science-focused participants had a stronger understanding of standards based instruction and assessment than that of our math-focused participants. We believe that this disparity can be attributed to training and experiences the science-focused participants were engaged in prior to participating in our STEM for the Future! grant. As a result if this disparity, our 2014 two week long summer institute provided separate opportunities for professional development for our math and science participants. This opportunity to differentiate our training has minimized the disparity between the two groups and will provide us with a more consistent foundation for future training opportunities.

The math teachers spent time working with Kevin Anderson from CESA 2 developing an

understanding of the foundations of standards based instruction and assessment via a guided inquiry model, discussing classroom strategies to promote a growth mindset, and creating quality tasks for the purpose of gathering data to support Student Learning Objectives (SLO's). The math participants also spent time engaged in the Wisconsin Statewide Mathematics Initiative (WSMI) training. This training provided participants with a thorough understanding of the progression of a single domain of the Common Core State Standards for mathematics across a grade band with special attention given to the Standards for Mathematical Practice.

The science teachers spent time working with Chad Janowski. Mr. Janowski is one of the leading experts in the state of WI on science inquiry and NGSS implementation. The science teachers worked with Mr. Janowski to further develop their understanding of inquiry based science instruction. Participants were immersed into three separate activities. The first activity focused on guided inquiry, the second was a hybrid between guided and open inquiry, and the third type was self guided open inquiry. Mr. Janowski also spent time investigating the components of the NGSS Science & Engineering Practices. These investigations eventually led to the discovery of how the NGSS practices are related to science inquiry instruction. The science teachers spent the final portion of our institute working with the Wisconsin K-12 Energy Education Program (KEEP). This program is affiliated with UW-Stevens Point's Environmental and Energy Education Department. KEEP provided our participants with several valuable resources and teaching techniques related to STEM education. The KEEP instructors also taught participants how to integrate hands-on STEM topics within their current energy education curriculum. In addition, they trained our participants on the engineering design process and allowed participants to put those elements in action using K-12 activities related to NASA.

Goals and Objectives:

The Goals of the project are as follows:

GOAL 1: STUDENT ACHIEVEMENT - To improve the academic achievement of students in Science, Technology, Engineering, and Math (STEM) in grades 1-12.

GOAL 2: STEM CONTENT - To enhance the STEM content knowledge and teaching skills of classroom teachers of STEM fields in grades 1 through 12 by providing high-quality training that infuses major concepts of STEM and 21st Century Learning skills.

GOAL 3: PEDAGOGY – To increase participant's inquiry-based, contextualized, constructivist pedagogy knowledge. GOAL 4: LEARNING PLANS – Develop and disseminate math and science learning plans that are aligned to state Common Core Standards for Math and the Next Generation Science Standards.

Program Plan: Early in year 1 of our MSP Grant we unfortunately had several of our 35 original grant participants request to drop from the grant. At the conclusion of year 1 we had 26 teachers participating. During year 2 we brought on 8 new participants including 2 elementary science specialists, 1 middle school science teacher, 1 middle school math teacher, 1 high school

science teacher, and 3 high school math teachers. This boosted our roster of participants up to 34. We believe that this increase in participation is a testament to the quality of professional development being provided to our participants via our MSP Grant.

Having a grant that includes both math and science teachers across a span of grades 1-12 continues to be an obstacle that challenges our steering committee. This summer we integrated training that effectively segregated our math and science teachers. Although both sub-groups were immersed in STEM content, they each have individualized needs that we deemed could best be served in separate trainings. The feedback we received from these two sub-groups was even more positive than the feedback collected at the conclusion of our 2013 summer institute. I have personally had the privilege of observing our participants in the classroom and witnessing the integration of tasks and practices they either developed or refined during our professional development opportunities. These observations provide an incredible motive for the continued development of high quality professional development activities.

Evaluation and Reflection: Data from the Reformed Teaching Observation Protocol (RTOP) Analysis has revealed that significant gains in demonstrated teaching practice have been made over the course of this grant program. Ratings of teaching have increased each year of the grant. Due to the small sample size and the lack of a control group, it is impossible to state definitively that grant activities have been the sole contributor to these gains, but it is reasonable to conclude that it had a significant impact.

In particular, significant changes have been made in these teachers' professional practice. STEM for the Future teachers are consistently connecting learning to students' prior knowledge. Their lessons address fundamental concepts and are taught in a climate of mutual respect, valuing student participation. The teachers demonstrate strong content understanding and patience with their students. In addition, important strides have been made in some key characteristics of reformed teaching. Student exploration is preceding explanations. Constructive criticism and challenging of ideas by students is valued. Classrooms are increasingly becoming places where the teacher is a resource person, supporting student learning in a social constructivist model; rather than as the expert, as in a transmission model of learning.

GOAL 1: STUDENT ACHIEVEMENT - The data show that the teachers are showing significant improvements in content knowledge and pedagogy, and little by little these increases will manifest themselves in improved student scores.

GOAL 2: STEM CONTENT KNOWLEDGE - Pre- and Post-tests were administered at the beginning and ending of the 2014 Summer Institute via online survey. 100% of participants eventually completed the surveys. Using the Wilcoxon signed ranks test (85% certainty), significant changes were noted for 9 of 16 math teachers (W=1,81, p= 0.04) and for 12 of 16 science teachers (W=2.56, p=0.005). DTAMS testing was planned to occur prior to the first

Summer Institute participation and after the final Summer Institute participation, so results will not be available until next year.

GOAL 3: PEDAGOGICAL KNOWLEDGE – Pedagogy has been assessed through self-report teacher efficacy questionnaires (MTEBI and STEBI), as well as through impartial observations using the RTOP. Little change has been shown in the teacher efficacy ratings, as one might expect. It is likely that any professionals' self-rating of efficacy would be high and this was clearly the case with these teachers. The RTOP observations provided a much clearer picture of teacher practice. Baseline ratings were done by rating submitted lesson plans, rather than observations so a few of the characteristics were impossible to include in the baseline. Even with this limitation, significant differences between baseline and year one RTOP scores were found ($p < 0.01$). Math and Science teachers showed no performance differences by group from one another.

GOAL 4: LEARNING PLANS – Participant learning goals have been measured by their self-reported satisfaction with the professional development components of the grant using a survey based on Guskey's model for levels of professional development. This survey has been used each time the participants meet and results of this will guide future programming. During the past school year, grant related activities have been very highly rated (99.5% of ratings have been either agree or strongly agree). Teachers are satisfied with the opportunities provided and most importantly, they show enthusiasm for implementing new ideas in their classrooms.

Project Title: K-5 STEM
Principle Investigator: Eric Brunsell
High Need LEA: Racine Unified School District
Higher Education Institute: University of Wisconsin-Oshkosh
Project Leaders: Eric Brunsell (UWO), John Surendonk (Racine Unified School District)
Total Funding: $910,421
Teacher served: 67

Abstract: The K-5 STEM project is a partnership between the University of Wisconsin Oshkosh and five school districts to develop both science and math content knowledge. The project serves more than 60 elementary teachers. Evaluations in year one and two have shown statistically significant growth in teacher content knowledge related to physical science, science and engineering practices, and mathematical practices.

Introduction: More than 60 elementary teachers from five districts are participating in the K-5 STEM Project. These teachers participate in two weeks of summer instruction and multiple school-year workshops. The professional development experiences are led by science education faculty, science faculty, and mathematics faculty from the University of Wisconsin Oshkosh. Teachers are expected to implement what they have learned in their classrooms.

Sixty-seven teachers initially participated in year one. Attrition from retirements and job position changes has led to sixty-one participants in year three.

Goals and Objectives:

1. To improve student understanding of STEM content.
2. To improve elementary educators' knowledge and understanding of standards-based STEM content.
3. To improve elementary educators' pedagogical understanding of how to integrate STEM content using project-based learning techniques.

Program Plan: The goals and objectives for this project will be met by forming a partnership between the University of Wisconsin – Oshkosh (UWO), Racine Unified School District (RUSD), Kenosha School District, Fond du Lac School District, Oshkosh Area School District (OASD), and Menasha Joint School District. The partnership will serve 60 elementary teachers (K-5) for three years.

Each year, teachers participate in three academic year seminars, online support sessions, and ten days of summer institutes for a total of 130 hours of professional development. Participants are organized into northern (Fond du Lac, Oshkosh, Menasha) and southern (Racine, Kenosha) cohorts of approximately 30 teachers each. Academic year seminars are held for both northern and southern cohorts. The combined cohort of 60 teachers participate together in the summer institutes (One week held at a northern site and the second week held at a southern site). This will provide opportunities for developing strong regional communities of practice.

The first year of the project focused on physical science concepts and mathematical concepts related to number and operation. The second your of the project focused on Earth and space science concepts and mathematical concepts related to problem solving and data analysis. The third year is focusing on life science concepts and a continued focus on mathematical problem solving.

Evaluation and Reflection: The UWO K-5 STEM MSP project utilized four assessments to gauge efficacy for and comfort level with math and science teaching. The Math Teaching Efficacy Belief Instrument (MTEBI), the Science Teaching Efficacy Belief Instrument (STEBI), a Mathematics Practices Survey, and a Science Practices Survey were administered to participants in February of 2013, August of 2013, and again in August of 2014.

Statistical analysis indicates that across all assessments except the LMT (El.PFA), participant scores increased after attending the summer institute sessions. With the exception of the LMT (El.PFA), each aggregate score was statistically different with medium and large effect sizes, indicating that practical differences exist between pre and post scores.

The strength of the program is demonstrated in the high level of participant retention. In year one, 67 teachers were selected to participate. Of these, 62 have successfully completed year two. One teacher retired and three took positions in schools outside of the partnering districts. One participant left the program due to concerns about increased workload at school. The pre- and post- evaluation data shows growth in teacher content knowledge in science, increased efficacy in teaching math and science, and increased comfort in using both the Common Core State Standards for Mathematics Standards for Mathematical Practice and the Next Generation Science Standards Science and Engineering Practices.

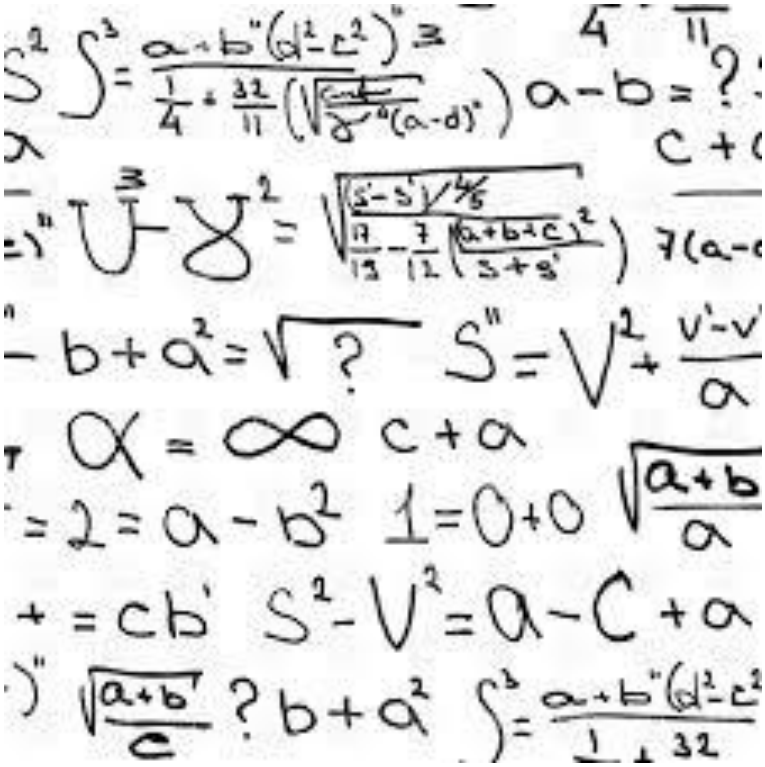
This project is having an impact on partnering organizations beyond the impact on individual teachers and their classrooms. Lessons learned from the K-5 STEM project are transforming the preparation of elementary teachers at the institution in multiple ways. First, connections developed with administrators in one of the partnering districts (OASD) has led to the creation of family oriented STEM Nights at each middle school in the district. These family STEM nights are operated primarily with volunteer students from the elementary teacher education program. Second, the model activities developed for the K-5 STEM project are being used in the

elementary science methods course. Third, the UWO College of Education and Human Services is working towards establishing a STEM Education Certificate for students in the teacher education program. This certificate program is influenced by the K-5 STEM project and will include content coursework, field experiences in schools and industry, and additional teaching methodology courses in engineering and applied technology. We expect to complete the proposal for faculty governance approvals later this fall with the goal of starting implementation in the spring of 2016.

The K-5 STEM project has had a positive impact on science and math education leadership in the partner K-12 school districts. Four of the participants in the project have moved into leadership roles as math coaches / interventionists. Additionally, one district has hired a K-8 STEM Coach. Two districts have newly established STEM-focused elementary schools and one district is in the process of establishing a STEM-focused elementary school. Wisconsin has not adopted the Next Generation Science Standards. However, one school district has already adopted NGSS and two more will begin the process next year. Teachers participating in the K-5 STEM project are working closely with teams in those three districts on math and science reform efforts.

Mathematics & Science Partnerships

2013-2016 Projects



UW-Milwaukee/Cudahy

(Mathematics)

Weston/UW-Platteville

(Science)

Adams Friendship/Marian University

(Mathematics)

Project Title: Professional Math Learners Initiative
Principle Investigator: Tanya Kotlowski
High Need LEA: Adams Friendship School District
Higher Education Institute: Marian University
Project Leaders: Sandi Jarvis, Deb Kneser, Tanya Kotlowski, Michael Herrick
Total Funding: $300,210
Teacher served: 23

Abstract: The Adams-Friendship Area School District (AFASD), Wautoma Area School District (WASD), faculty from Marian University and Herrick Research Inc. have joined as an exemplary partnership to implement the Professional Math Learners Initiative (PMLI). This partnership will work to increase student achievement and college and career readiness by providing intensive professional development to grades 6-12 teachers of mathematics and grades 6-12 special education teachers. The focus on intensive professional development is to improve the academic achievement of all students in math across grades 6-12 by improving the skills, knowledge, and effectiveness of Math teachers across grades 6-12.

Introduction: Poverty plagues our schools where an average of 70% of our students participate in free and reduced lunch, nearly twice the statewide average of 41%. Each considered a "high need LEA," a comprehensive needs assessment process found that students were struggling to meet proficiency on state standardized tests in Math. In fact, student achievement and college and career readiness within the consortium lag behind statewide averages as per results on the Wisconsin Student Assessment System (WSAS), college placement tests, and plans for higher educational pursuits. Our project will target 1,620 students and 27 teachers in grades 6-12. To do so, our program will unveil a comprehensive professional development program Year one will focus on the practical application of the eight Mathematical Practice Standards from the CCSS. In year two teachers will learn how to unpack the CCSS, and cross-walk the standards with course objectives.

Goals and Objectives:

Project Goals:

- To improve the academic achievement of all students in math across grades 6-12.
- To improve the skills, knowledge, and effectiveness of Math teachers across grades 6-12.

Program Plan:

Professional Development

Instructional Rounds: Facilitated observations during the school year focusing on an identified practice each month. While participating in instructional rounds, educators look at classroom instruction in a focused, systematic, purposeful, and collective way.

Instructional Coaching: A math coach has been visiting the middle and high schools of both Adams-Friendship and Wautoma School Districts to provide in-class support around the mathematical practices of the CCSS. The work has prioritized practices that increase "student engagement."

Summer Programming Design:

27 mathematics teachers and special education teachers from the participating schools will receive 80 hours of professional development (each summer 2014 and 2015) facilitated by Marian University faculty on core mathematics concepts and on the use of pedagogical instructional strategies so they will:

- gain a strong understanding of mathematics content;
- build a deeper understanding of what the Common Core Standards look like in practice;
- have a strong understanding of diverse learning needs of students of mathematics;
- be able to design and implement mathematics instruction using varied strategies of instruction;
- be able to create formative and summative assessments to guide instruction; and
- be able to create Student Learning Objectives (SLO) for mathematics and use the collected data to drive student learning.

Evaluation and Reflection: As of this date, the only data to report is pretest data from the Math Science Partnership (MSP) teachers and students and from the control group teachers. Pretest data was obtained from math teachers participating in the MSP program at Adams-Friendship and Wautoma high school and middle school in the summer, 2014. Pretest data was also obtained from control group math teachers. Math knowledge tests were administered to MSP teachers during their summer workshops, so no treatment or professional development (PD) was experienced by these teachers prior to the pretest. The control group for this evaluation was identified in the spring, 2014. The control group consisted of middle school and high school math teachers from Mauston School District who choose to participate for a specified honorarium. Seven school districts in CESA 5 were contacted for participation as control group members in the evaluation. These seven districts have demographics closely aligned to the demographics of Adams-Friendship and Wautoma. However, only one district, Mauston, agreed to participate by encouraging secondary math teachers to take the math test and survey and by furnishing WKCE math scores in 8th and 10th grades.

The teacher pretest data consists of a math knowledge test and a pedagogy survey designed for teachers. The MSP math consultant and the evaluator created a 35-item math test internally. Creating an internal test was necessary because no acceptable math test at the secondary level for the MSP evaluation was available.

With the aid of the professional developers, an internally developed secondary teacher math assessment was created. "Retired" secondary math items from various sources, including 12th grade NAEP items were initially selected, after which the math professional developers weeded out those items that didn't align to the PD. Those math knowledge test items were administered to a group of math teachers not associated with the project. The results of this pilot study were analyzed on an item analysis program in order to eliminate items that had poor item statistics.

This proved to be very successful since the test is as valid for this population of teachers as it can get, given its sensitivity to the professional development. The final test included 25 multiple-choice items and 10 constructed response items.

A teacher pedagogy survey was also administered to teachers as a pretest measure of instructional methods. The survey, called "Am I an Inquiry Teacher Survey", has been successfully used in other MSP project in Wisconsin. Therefore, the survey was adopted for this evaluation. The survey includes 26 statements about inquiry teaching, or what strategies teachers might use to generate inquiry in students. Respondents indicate the degree to which they use these inquiry strategies on a 4-point scale from "Regularly Use" to "Seldom Use". The higher the score on the survey the more they use inquiry strategies.

In addition, an evaluation of student performance will be conducted using the math test results from WKCE each year. This report presents the results of the 2013-14 WKCE math scores for 8th and 10th graders in the school participating in this MSP program.

The results of the pretest are presented and discussed below. There were 26 middle school and high school MSP program teachers at Adams-Friendship and Wautoma who took the pretest measures. Of these 26 teachers, 14 were regular education teachers and 12 were special education teachers. There were 6 control group middle school and high school teachers at Mauston who agreed to participate as control teachers. Of these 6 teachers, 4 were regular education teachers and 2 were special education teachers.

The control teachers from Mauston outperformed the MSP teachers from Adams-Friendship and Wautoma on the math assessment. Out of a total score of 35 on the teacher knowledge math test, the mean score for the MSP teachers was 21.03 and 29.56 for the control teachers.

The teacher pedagogy survey on inquiry teaching shows only minor differences in mean scores of the MSP teachers and the control teachers. Out of a total mean score of 4, the MSP teachers scored 1.9 and the control teachers scored 2.2. Again, a t-test was calculated and determined that the difference between the two groups was not statistically significant.

When the data is disaggregated by regular education and special education, the results are similar. The test score means for MSP teachers clearly show the middle school teachers have less knowledge of math than high school teachers. Plus, MSP high school special education teachers have less math knowledge than high school regular education teachers, and MSP middle school special education teachers have less math knowledge than middle school regular education teachers. The highest MSP mean test score is 28.5 for regular education high school teachers and the lowest MSP mean test score is 10.85 for special education middle school

teachers. When conducting an analysis of statistical significance for both MSP regular education and special education teachers, we find that the difference in math knowledge between the high school regular education and the middle school regular education teachers is not statistically different. However, the difference between the high school special education teachers and the middle school special education teachers is statistically different @ $p \leq .01$.

The Control Group scores in show higher math knowledge scores across each disaggregated group than those same disaggregated groups of MSP teachers. However, like the MSP data, the highest math knowledge score in the control group of 31.66 was for regular education high school teachers. Interpretation of this data should be done cautiously since the N count is very low for the control group.

The teacher pedagogy survey mean scores are similar between MSP and the Control Groups, as well as for disaggregated groups within MSP teacher and control teacher groups. The highest survey score of 2.3 was for special education teachers in the control group and the lowest survey mean score was 1.7 for regular education MSP teachers. Again the N count for the control group is very small, and there are no teachers who are middle school special education teachers in the Control Group.

Project Title: Core Mathematics Partnership: Building Mathematical Knowledge and High-Leverage Instruction for Student Success

Principle Investigator: Dr. DeAnn Huinker, University of Wisconsin-Milwaukee

High Need LEA: School District of Cudahy

Higher Education Institute: University of Wisconsin-Milwaukee

Total Funding: $684,934

Teacher served: 45

Project Leaders:

Dr. DeAnn Huinker, Professor, Department of Curriculum and Instruction

Dr. Kevin McLeod, Associate Professor, Department of Mathematical Sciences

Karen Ebbers, Director of Instruction, School District of Cudahy

Amy Paladino, Mathematics Specialist, School District of Cudahy

Dina Mendola, Mathematics Specialist, School District of Cudahy

Beth Schefelker, Mathematics Specialist, School District of South Milwaukee

Joe Giera, Mathematics Specialist, School District of South Milwaukee

Abstract: The "Core Math Partnership: Building Mathematical Knowledge and High-Leverage Instruction for Student Success" engages K-8 teachers across three school districts as a model of collective efforts in moving to common practice with the *Common Core State Standards for Mathematics* (CCSSM). The lead partners include the School District of Cudahy, a high-need LEA, and the University of Wisconsin-Milwaukee, with additional partners of the School District of South Milwaukee and the Milwaukee Public Schools. The project aims to: (1) deepen teachers' mathematical knowledge and understanding of content learning progressions; (2) strengthen teachers' instruction through the use of high-leverage teaching practices; and (3) increase teacher collaboration within and across schools for mathematics. Participants attend a series of UW-Milwaukee courses over three years, including three summer institutes (80 hours each) and two school-year programs (27 hours each). Each summer institute targets a specific focus area: Year 1 Operations, Algebraic Reasoning, and Number and Operations in Base Ten; Year 2 Fractions, Ratios, Proportional Relationships (RP); and Year 3 Geometry and Measurement. The courses are led by IHE faculty in mathematics and mathematics education and co-taught with master teachers. Participants earn 13 UWM graduate credits, along with receiving professional memberships to the National Council of Teachers of Mathematics and the Wisconsin Mathematics Council.

Introduction: The "Core Math Partnership: Building Mathematical Knowledge and High-Leverage Instruction for Student Success" engages K-8 teachers across three school districts—

School District of Cudahy, School District of South Milwaukee, and Milwaukee Public Schools—in deepening their mathematical content knowledge and strengthening their use of high-leverage, mathematics teaching practices. The first institute, held in summer 2014 and focused on the study of operations and algebraic thinking, was a resounding success in setting the stage for three-years of work together by this group of 39 teachers and leaders, as illustrated in the following quotes from three participants.

What I took away from our two weeks would be difficult to put into just a few paragraphs, but if I had to pick two, I would say it is the understanding of using the math practices as we teach the standards and the use of the mathematical representations as a means for the depth we need to ensure true understanding.... The visual, symbolic, verbal, contextual, physical representations relate to one another and when we ensure students have an opportunity to engage in all of these we will do a better job of making sure we go deeper for greater understanding. As I think about engaging in the work of digging deep into the standards, I see this as one way to make sure we really get at how they think about mathematics.

Who knew that spending two days on equality would be so much fun! It is amazing to examine the misconceptions students have surrounding this idea. It seems like such an easy concept, but, after our work in class, I see that it is likely the problem behind many of my students struggles with equations.

One idea that stood out to me, above all the others from this summer's session, was the idea of coherence. Ever since I started teaching I have wondered what they were supposed to learn at each grade level. Coherence is the idea that students learn skills in earlier grades and then build on them as they move up. We are trying to get them to see that these ideas are all related, rather than separate little skills that are disconnected from each other.

Goals and Objectives

The work of the *Core Math Partnership* is framed by three project goals:

- Deepen teachers' mathematical knowledge and understanding of content progressions aligned to the *Common Core State Standards for Mathematics*.
- Strengthen teachers' instruction through the use of high-leverage teaching practices to increase student success in mathematics.
- Increase teacher collaboration within and across schools in moving to common practice with the *Common Core*.

Program Plan: The *Core Math Partnership* engages teachers in professional learning through three project components: (1) summer institutes, (2) school-year project sessions; and (3) classroom-based support from district math specialists.

The two-week (80 hour) summer institutes are held in July each year. A key feature of the institutes are its emphasis on use of the *Common Core* progression documents. The daily sessions explore and deepen participants mathematical knowledge and model the use of the Standards for Mathematical Practice and high-leverage teaching practices. Each summer institute targets a specific focus area: Year 1 Operations, Algebraic Reasoning, and Number and Operations in Base Ten; Year 2 Fractions, Ratios, Proportional Relationships; and Year 3 Geometry and Measurement. The following participant comments provide a glimpse into the summer institute:

In thinking about the past two weeks, it has been a tremendous learning experience. Coming in, I thought that I knew, somewhat, an effective way to teach mathematics. However, I now see that I had much to learn and understand. One major idea that I continue to think about is the idea of the distributive property.... Another specific idea that really struck me is the discussions around different representations. When teaching math, I would always have students come up and share their different strategies. But I NEVER thought that the students should be talking to each other, comparing their strategies, and talking about why those strategies work for them. This was huge for me to think about.

I need to give my students time to talk through the ideas we are learning.... Doing the intersecting lines activity really helped this to hit home.... It was amazing to see two teachers talk about the strategy they used to find the answer. One teacher was very open about how she wasn't confident but in the end she got it right. The process they used alone could lead to so many discussions about what slope is and how to write the equation of a line. This came from discussion and people struggling through a problem. ... This year, I need to develop an atmosphere that leads to this type of discourse. My students need to be comfortable sharing with each other, be willing to make mistakes, and most importantly be willing to struggle. Like someone said in class, and what will most definitely become a poster in my classroom, "If you're not struggling, you're not learning!"

During the school year, the participants meet monthly on Tuesday evenings (9 sessions, 3 hours per session). They continue study of mathematics content and learning progressions and work toward implementation of high-leverage mathematics teaching practices. The core set of teaching practices are based on the recently released "Principles to Actions: Ensuring Mathematical Success for All" by the National Council of Teachers of Mathematics (April 2014). During the 2014-2015 school year, the participants continued their study of operations and algebraic thinking and delved into classroom implementation of three high-leverage teaching practices that included: (1) Facilitate meaningful mathematical discourse; (2) Use and connect mathematical representations; and (3) Support productive struggle in learning mathematics (NCTM, 2014). Additional teaching practices that provide high-leverage for student learning of mathematics will

be studied in subsequent years. Classroom support also occurs during the school year by the district mathematics specialists who also attend project sessions.

Evaluation and Reflection: The evaluation of the *Core Math Partnership* utilizes a quasi-experimental, matched-comparison group design. Specifically, the outcomes of the participating teachers are being compared to those of comparison group of non-participating teachers after controlling for baseline performance. The specific outcome measures include: (1) mathematical knowledge for teaching, (2) knowledge of the *Common Core State Standards for Mathematics*, (3) mathematics teaching practices, (4) teacher collaboration, (5) student perceptions of mathematics teaching and learning, and (6) student achievement in mathematics. The participant (n=39) and comparison group (n=31) teachers were recruited during the 2013-2014 school year and baseline data was collected. The project then held its first summer institute in July 2014. Participating teachers completed pre- and post-institute surveys during summer 2014. The results demonstrated significant improvement in teachers' knowledge of the *Common Core State Standards for Mathematics* after participating in the summer institute (n=35; Pre-Survey mean=3.21, SD=0.13; Post-Survey mean=4.71, SD=0.12; t=9.624, df=34, p=0.000). The teachers also completed a post-institute self-reflection at the completion of the summer institute. An emergent theme amongst the teachers was a realization of viewing themselves as learners of mathematics as a result of the difficulties they experienced while taking the pre-assessment on their mathematics content knowledge and completing the pre-surveys. The teachers realized they had gaps in their own understanding of mathematics and of the Common Core. The summer institute supported shifts in their beliefs about teaching mathematics and a stronger understanding of the importance of coherence in the CCSSM that impacts the progression of student learning from grade to grade. Another common theme was the emergence of the importance of mathematical discourse as a high-leverage teaching practice and developing the mathematical practice of constructing viable arguments and critique the reasoning of others (MP3) in order to surface multiple strategies to approaching mathematics tasks in their classroom and ensuring full engagement of their students.

Evaluation activities will continue throughout the project by gathering formative and summative data. Each spring teachers in both the treatment and comparison groups will complete a Mathematics Teaching Practices Inventory and their students will complete a Student Perceptions of Mathematics Instruction survey. The teachers will also complete measures of Mathematical Knowledge for Teaching (LMT) each year. Student mathematics achievement data will be used to measure the value-added of the overall project by examining the results for the participating teachers and comparison. The basic framework is use of the matched-control, interrupted-time series model. The idea is to follow the achievement outcomes of students in matched classrooms over time as some of their teachers begin to participate in the project. The change in student achievement will be tested for statistical significance to determine if the change can be attributed to the Core Math Partnership project.

Project Title: Southwest Wisconsin Science and Engineering Practices

Principal Investigator: Melissa Wiegel (Weston School District) and Andrew Pawl (University of Wisconsin-Platteville)

High Need Partner LEAs: Weston School District

Higher Education Institute: University of Wisconsin-Platteville

Project Leaders: Melissa Wiegel, Andrew Pawl, Lisa Riedle

Total Funding: $231,446

Teacher served: 25

Abstract: The Southwest Wisconsin Science and Engineering Practices Project forms a partnership among UW Platteville and several high needs school districts in science as identified by the DPI. With an emphasis on the eight Science and Engineering Practices featured in the Next Generation Science Standards, which reflect the most recent work in the science disciplines and are similar to the Common Core State Standards in mathematics, our vision is that this three-year project will ultimately lead to increased student achievement in science across the grades as teachers will be better able to guide students in adopting the practices of scientists and engineers in ways that support learning of science content.

Introduction: Classroom instruction is most effective and simultaneously most practical when different disciplines are integrated in a synergistic manner. Science instruction at the elementary school level provides an opportunity to realize multiple productive synergies. Potential synergies between science and math instruction have long been understood. There are also equally-important but less-recognized opportunities to bring the skills of critical thinking and reading into the science classroom. A "Claims, Evidence, Reasoning" (CER) approach to science practice can be directly extended to teach students about the structure of argument in reading passages related to any subject or discipline. This synergy is also a practical necessity due to the current culture of high-stakes assessment focused on reading and mathematics. One way to frame elementary school science instruction is as a context to teach students about the use of experimentation and quantitative reasoning as evidence to inform argument. This framing blends practice in key elements of mathematics and reading comprehension with instruction in traditional science content. In this project we seek to demonstrate through active engagement of the participants how the process of learning science content can simultaneously serve to expose students to the process of quantitative reasoning and argumentation, and to illustrate how the structure of the Next Generation Science Standards (NGSS) emphasizes this core mission.

Goals and Objectives:

1. increase teachers' content knowledge in physics
2. elevate teacher efficacy to support students' learning of science content and practices, and
3. build social capital through relationships among participants.

Program Plan: The program is designed for 30 participants who are active science teachers at the K-8 level and that target was reached. Each year of the project involves a two-week summer institute, which focuses on increasing content knowledge in physics, improving understanding of the Science and Engineering Practices, broadening pedagogical content knowledge to be used to design classroom instruction to support student science learning, and providing support for teachers to translate learning to their individual classrooms. Quarterly support seminars provide continued learning experiences and opportunity for participants to network and support one another as they improve their instructional practices by implementing learning from summer institutes. Participants are able to continue to network with eachother and with other science teachers nationwide using online memberships in the National Science Teachers Association online Learning Center website.

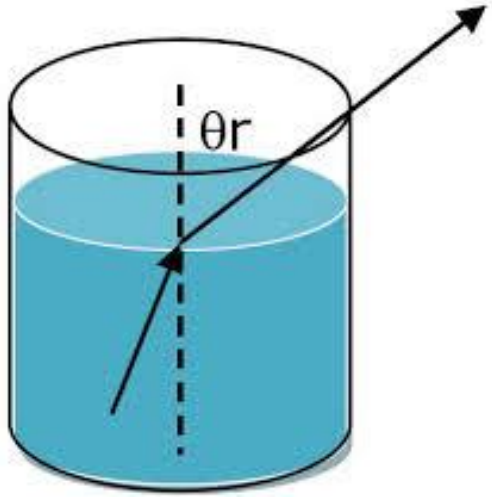
Evaluation and Reflection: The 30 participants and a comparison group of 20 teachers were each given four assessments before and after the completion of the year 1 summer institute. The instruments included two content assessments, one assessment regarding comfort with and utilization of science practices, and one assessment of self-efficacy related to science instruction. In all cases, the participant group and comparison group exhibited similar knowledge or levels of positive response on the pre-institute assessment. In all cases except the efficacy instrument, the participant group exhibited a significant positive shift from the pre-assessment to the post-assessment, while the control exhibited no shift or a negative shift. On the efficacy instrument the participant group was essentially unchanged in their responses.

These assessment results are overall quite encouraging. Even the fact that the efficacy results are unchanged is perhaps not surprising. At the conclusion of the two-week summer institute the teachers had not been given the opportunity to bring the techniques discussed into their own classrooms. There is reason to hope that the efficacy responses will be more positive in year 2, since the participants have now had a year to employ new knowledge and techniques.

Speaking with the teachers during the school year has made it clear that the "Claims, Evidence, Reasoning" (CER) framework for understanding science pedagogy is the message that resonates most across the wide range of grade level focus that is represented in our participant group. By the time we met during the fall semester following the year 1 summer institute, several teachers in the upper grades (5-8) had already made an effort to explicitly implement some or all of the CER. This simple mnemonic has proven incredibly versatile. The analogy to critical reading skills is obvious. Just as importantly, the CER framework gives context when discussing the rationale behind the detailed science practices described in the NGSS. In the year 2 summer institute, the CER framework will continue to take center stage as the discussion revolves around incorporating mathematics standards and the concept of quantitative claims, evidence and reasoning

Mathematics & Science Partnerships

2014-2017 Projects



UW-Eau Claire/Clayton
(mathematics)

UW-Eau Claire/Cornell
(mathematics)

UW-Oshkosh/Mondovi
(mathematics)

UW-Parkside/Kenosha
(mathematics)

Project Title: A^3 – Assess, Analyze and Address

Principle Investigator: Chris Hlas

High Need LEA: Mondovi School District, Cornell School District

Higher Education Institute: University of Wisconsin-Eau Claire (UWEC)

Project Leaders: Chris Hlas (UWEC), Ryan Harrison (UWEC), Lori Vetterkind (Mondovi), Ashley Rosentrater (Cornell)

Total Funding: $428,043

Teacher served: 42

Abstract: Through this grant teachers will develop and use a process to first diagnose and then address specific gaps in their students' conceptual and procedural knowledge, with a focus on those gaps that indicate a lack of readiness for high school mathematics. Participants will be selected from targeted districts and range from upper-elementary through lower high school levels. All work will be based on the Common Core State Standards for Mathematics (CCSS-M) documents: the CCSS-M standards, CCSS-M learning progressions and trajectories. The proposed process is designed to address the following three goals.

Goal #1. To increase teachers' mathematics knowledge for teaching in three content areas: 1) statistics and probability, 2) measurement and geometry, and 3) the number system and algebra. To accomplish this, teachers will begin with a guided in-depth analysis of CCSS-M documents and exploration of research on mathematics content and pedagogy related to high school readiness. A key feature of this activity will be training on how formative assessment probes can be designed to align to CCSS-M content standards and used to differentiate instruction, assess students' depth of knowledge around a given topic, analyze trends in student thinking and assess effectiveness of instructional strategies.

Goal #2. To uncover student thinking in order to identify misconceptions, specific gaps, or weaknesses in conceptual understanding and procedural knowledge directly related to high school readiness. To accomplish this, teachers will interview students using proven probes and others that they have developed. They will compare and relate their students' responses to points along the mathematics progressions as described in CCSS-M documents. Key features of this activity include: collecting and evaluating data on student thinking, using appropriate interview protocols and statistical analysis to identify trends and commonly held misconceptions.

Goal #3. To improve teaching practices by employing and analyzing strategies that purposefully address previously identified student needs. Teachers, in a professional learning community made up of peers and university mathematics faculty, will use data analysis to identify student needs and define appropriate teaching strategies for addressing these needs. Key features of this activity include: Structured observations of the implementation of specified strategies with reflections on the use of those identified strategies and the collection of longitudinal data regarding student response to the teaching strategies used.

Participation in interactive workshops during the school year and attendance at summer institutes over a three year time period will facilitate attainment of all goals. Teachers will share specific probes developed and appropriate teaching strategies based on the student thinking data both during the scheduled interactions and eventually through a website model available to the public. All activities will take place under the guidance of university mathematics faculty and experts in the field of formative assessment.

Goals and Objectives:

Goal 1: To increase teacher's mathematics knowledge for teaching and develop research-based beliefs about learning mathematics.

Objective 1-1. In year one, teachers will increase their mathematics knowledge for teaching in the content area of statistics and probability, as measured by the Learning Mathematics for Teaching (LMT) assessment using a pretest posttest design.

Objective 1-2. In year two teachers will increase their mathematics knowledge for teaching in the content area of measurement and geometry, as measured by the LMT using a pretest posttest design.

Objective 1-3. In year three, teachers will increase mathematics knowledge for teaching specifically focused on development and understanding the number system and algebra (operations and algebraic thinking, expressions and equations, and functions), as measured by the LMT using a pretest posttest design.

Re: Objectives 1-1, 1-2 and 1-3: In the content areas identified, teachers in the project will show significant gains over teachers in the comparison group as measured by the LMT at the end of the third grant year.

Objective 1-4. In years 1-3, teachers will develop beliefs that are more aligned with a constructivist theory of learning.

Goal 2. To uncover student thinking in order to identify misconceptions, specific gaps, or weaknesses in conceptual understanding and procedural knowledge directly related to high school readiness.

Teachers will understand how formative assessment probes are used to make student thinking transparent, differentiate instruction, assess students' depth of knowledge around a given topic, analyze trends in student thinking and assess effectiveness of instructional strategies as follows.

Objective 2-1. Teachers will design and then administer formative assessment probes to their students. They will then use the data generated from these probes to classify students along learning trajectories as defined by CCSS documents.

Objective 2-2. Teachers will analyze student probe data to identify trends in student thinking as well as misconceptions and gaps that are commonly held across grade levels and content areas.

Goal 3. To improve teaching practices by employing and analyzing strategies that purposefully address previously identified student needs. (identified in goal # 2)

Based on the analysis of student probe data, specific teaching practices will be developed to aid students in overcoming the identified misconceptions and differentiate instruction.

Objective 3-1. Teaching strategies will improve so that students will address their misconceptions and gaps in learning of mathematics. This will be measured by student performance on formative assessment probes administered at the start of the project and at the end of each year.

Objective 3-2. Teaching strategies will improve so that student achievement on formative assessment probes will be higher for teachers in this project versus teachers in comparison classrooms.

Objective 3-3. Teaching strategies will improve student achievement. Using the 2014 WKCE* scores as baseline, by 2017 the percentage of grade 10 students scoring at the advanced and proficient levels in mathematics will increase.

Program Plan:

Year 1: September 1, 2014 through August 31, 2015

- Pre-October (2 hours). Identify teachers for participation and comparison groups. Administer pre-assessments on content and beliefs assessment for all teachers.
- October (12 hours). Participant teachers attend a training session focused on CCSSM documents.
- November (12 hours). Participant teachers will attend a training session on formative assessment probes and the formative assessment cycle.
- January–March (online contact). Participant teachers will use existing formative assessment probes to collect student-thinking data of 4th-9th grade students.
- April (8 hours). Professional learning groups.
- Summer (2 weeks for 80 hours). Summer institute focusing on statistics and probability. Initial stages of the online tool will be planned and implemented.

Year 2: September 1, 2015 through August 31, 2016

- September–October (online contact). Participant teachers will use self-made formative assessment probes to collect student-thinking data of 4th-9th grade students.
- Early November (8 hours). Professional learning groups.
- December–January. Teacher observations.
- February–March (online contact). Participant teachers will use self-made formative assessment probes to collect student-thinking data of 4th-9th grade students based on the mathematical focus for the grant year. Further, teachers will continue collecting data for the probe from Year 1 to make longitudinal comparisons.
- Early April (8 hours). Professional learning groups.
- April–May. Teacher observations.
- Summer (2 weeks for 80 hours). Summer institute focusing on measurement and geometry. Participant teachers will provide input for the design and use of the online tool.

Year 3: September 1, 2016 through August 31, 2017. We will use a similar structure to Year 2 with the following enhancements:

- September–October (online contact). Participant teachers will use the online tool of formative assessment probes to collect student-thinking data of middle school students.
- Early November (8 hours). Professional learning groups. Additionally, teachers will provide feedback for improvement of the online tool in terms of accessibility and desired features.
- December–January. Teacher observations.
- February–March (online contact). Participant teachers will use the revised online tool of formative assessment probes to collect student-thinking data of middle school students.
- Early April (8 hours). Professional learning groups. Additionally, teachers will continue to provide feedback for improvement of the revised online tool.
- April–May. Teacher observations.
- Summer (2 weeks for 80 hours). Summer institute focusing on the number system and algebra. An additional focus will be to finalize the online formative assessment. Finally, all teachers will take post-assessments on content and beliefs.

Evaluation and Reflection:

At this time we have started collecting baseline data. The table below highlights the planned evaluation measures.

Evaluation Measures/Procedures	**Intervention Teachers**	**Comparison Teachers**
Learning Mathematics for Teaching Assessment	Yes	Yes
Mathematics Beliefs Scales	Yes	Yes
Concerns Based Adoption Model	Yes	No
Observations (Danielson's Framework for Teaching)	Yes	No
	Intervention Students	**Comparison Students**
Wisconsin Knowledge & Concepts Examinations	Yes	Yes
Formative Assessment Probes	Yes	No

Project Title: Teachers Engaged in Authentic Mathematics (TEAM)
Principle Investigator: Jennifer Harrison
High Need LEA: School District of Clayton
Higher Education Institute: University of Wisconsin – Eau Claire
Project Leaders: Jennifer Harrison & Manjula Joseph
Total Funding: $383,885
Teacher served: 38

Abstract: The Teachers Engaged in Authentic Mathematics (TEAM) project has brought together a partnership between the University of Wisconsin - Eau Claire, the School District of Clayton, and 14 other northwestern Wisconsin rural school districts - Amery, Boyceville, Clear Lake, Elmwood, Grantsburg, Osceola, Plum City, St. Croix Falls, Shell Lake, Siren, Spooner, Turtle Lake, Unity, and Webster.

This project will provide the structure and commitment for regular and special education teachers to collaborate as they meet the needs of ALL students, grades 4-8 based on the local professional development (PLC) structures and coordination with the IHE. Districts participating in this project chose to support a grade 4-8 configuration. TEAM will develop a professional learning community locally and across our region to develop the leadership needed for all students to become successful in mathematics.

Introduction: To support teachers in implementing the CCSSM and the complex learning needs of students, professional development activities must incorporate both content standards as well as engage teachers in the Standards for Mathematical Practice (SMP) (Sztajn, Marrongelle, Smith, 2011). To ensure teachers grow their knowledge of the CCSSM content domains and the SMP, teachers need opportunities to make sense of the mathematics through active engagement in the learning process. Implementing such professional development involves "modeling the sought after practices and constructing opportunities for teachers to practice and reflect on the new strategies" (Shaughnessy, 2011). Furthermore, in review of nine studies, Yoon et al. (2007) found that student achievement gains were directly related to sustained and intensive professional development.

Many teachers feel overwhelmed by the challenges of CCSSM and the learning needs of their students. To make appropriate grade-level mathematics more accessible to ALL students, especially those with learning difficulties, regular and special education teachers need opportunities to plan collaboratively and proactively (Brodesky, Gross, McTigure, & Tierney, 2004).

Through the *TEAM* Project, regular educators and their special education partners will collaborate in learning together and planning strategies, bringing their combined expertise to

strengthen each other's teaching experiences, resulting in improved learning for ALL students. This collaboration will offer participants a sustained professional development opportunity whereby regular educators will expand their repertoires of content, practices, and differentiated strategies, and special educators will deepen their mathematics content knowledge and pedagogical content knowledge.

Goals and Objectives:

The ***TEAM*** project intends to bring together 60 teachers of mathematics in grades 4-8 and engage them in a sustained three-year professional development program centered on the mathematical learning of ALL students. Teachers will be recruited as school teams, each team consisting of 3-5 teachers of regular education and at least one special education teacher.

Goal 1: Strengthen the mathematics content knowledge of regular and special education teachers, grades 4-8

Measurable Objective: 1:1 Gain a deeper understanding of content knowledge for teaching mathematics as evidenced by growth on the Diagnostic Teacher Assessment of Mathematics and Science (DTAMS).

Goal 2: Enhance mathematics pedagogical content and assessment practice to provide support for ALL students.

Measurable Objective: 2:1 Develop and use problem-based collaborative approaches that focus on the Math Progressions across the CCSSM targets as evidenced by Tier I lesson plan analysis, classroom observations, defined SBAC classroom activities, and performance tasks with writing rubrics/scoring guides.

Goal 3: Establish a relationship between and among participants and partners to sustain teachers' on-going professional collaboration, leading to instructional change and teachers' growth.

Measurable Objective: 3:1 Increase collaboration on mathematics instruction through a professional learning community design (PLC) between regular and special education teachers.

Measureable Objective: 3:2 Increase collaborative planning time as evidenced by PLC local documentation and MIST tool.

Goal 4: Improve student achievement in mathematics, grades 4-8.

Measurable Objective: 4:1 Improve students' ability to use their thinking and reasoning skills to solve performance-based tasks as evidenced by performance on pre-post assessments based on lesson plans developed by participants.

Measureable Objective: 4:2 Decrease gaps for students of economic disparity and special education in participants' classes as evidenced by improvement on pre-post performance tasks and SBAC.

Measureable Objective: 4:3 Increase math understanding in targeted content areas as measured by assessment procedures aligned with math "interactive" note-booking and reflective practices.

Program Plan: This project will provide systemic and long-term professional development for teachers. Our intention is to connect subject matter with pedagogy enhancing and expanding the repertoire of research-based instructional methods that support students in mastering new content

and skills. Learning will be imbedded with opportunities for collaborative planning (PLC), professional development in effective content unit planning and reflective math "interactive" note-booking practices, and developing a support network which connects teacher to university math personnel and other professionals within and beyond their school. Professional development will include directed practices in solving math content as an individual, as well as with a "team work" approach.

The program activities follow the recommendations of the National Research Council and the Learning Forward Council, www.learningforward.org, with professional development driven by data concerning what students need to know and are able to do. Professional development will be constructed around collegial conversations about student work and strategies to improve classroom practices and student learning with the CCSSM Targets and Practices, and the PI-34 WI Teacher Standards (WTS). Each of the ten WTS is addressed. Our model will consist of four components and will be evaluated for structure, content, perceptions, and participant learning, and impact that learning on their respective students. These components include –

TEAM* Visions Conference:** This conference will bring participants together in the Spring of each year of the project to actively engage in a PLC model that will support their ability and skill set to create and maintain supportive leadership and structural condition with their local PLC teams as students' interests and needs are addressed. Year one will introduce the objectives, structures and evaluations of the ***TEAM project and the PLC program elements and constructive modeling. A diagnostic content pre-assessment using DTAMS will be embedded into this structure so to give feedback to the IHE faculty as to following summer academy instructional needs and formative assessments. Each following year, participants will have explicit instruction on PLC as it relates to math content and instruction along with the diagnostic content assessment pre-test for the summer academy content focus. Participants will actively engage with the PLC Consultant in developing the PLC protocols and local student assessment needs. This conference will be targeted for math and special education teachers. The PLC design chosen will model the initiatives, strategies and practices of DuFour & Eaker (2006). All activities of the Visions Conference will be designed and facilitated by the IHE Faculty and PLC Consultant based on needs and data collected from the local PLC work and collaborations.

TEAM* Content Summer Academy:** This structure will provide participants with a two-week academy designed, facilitated, and taught by the UWEC Faculty targeted for grades 4-8 math and special education teachers. Each summer academy will provide participants with a reflective and collaborative experience grounded in content and math progressions knowledge, pedagogical content knowledge, assessment techniques, and content literacy, including Interactive Note booking - related to CCSSM. Each summer will develop as assessments of teachers' and students' needs are uncovered through yearly project evaluation and participant feedback. ***TEAM will be introduced to the formative assessment of Math Interactive Notebook design. This tool supports students as they identify the content they are learning along with a reflective component of "making sense" of the math in order to apply this knowledge. Culminating these summer

academies, each teacher will be provided with a first-hand experience of ways to learn mathematics that research suggests is effective for all students. The PLC structures, developed within the academy, will support teachers at their school sites as they work with peers to analyze artifacts from their own classrooms, evaluate instructional "next steps" and modify their own lessons based on their students' incorrect or partial understandings of the math, thus building their knowledge of teaching. As the ***TEAM*** participants develop the leadership skills for PLC collaboration and data collection procedures, the home grade-level or vertical teams will be impacted by the guiding PLC structures. Each district will also develop a District SMART Goal(s) in support of their intentional work.

Year-Long Follow-Up Assistance and Training Modules: ***TEAM*** participants will receive the following ongoing training, support, and technical assistance: **1) Winter PLC Assessment Workshop** – during the school year a workshop opportunity will be provided for content follow-up training and support on the material covered in the Summer Academy. Teachers will share progression and success with developed content progressions, instructional practices, and receive more training on PLC protocols using "authentic" student data, formative/summative assessment analysis and design, intervention/extension models and strategies, and collegial networking. **2) Classroom Observation** UWEC faculty will visit (once per year) the participants' PLC group to observe collegial conversations, student protocols and assessments, troubleshooting and provide feedback in support of the content developed in the Summer Academy, specifically the use of the Math Interactive Notebooks, Math Progressions, and Formative Assessment Practices. **3) Collegial Networking/Study Groups** – each district will host a bi-monthly study group for local PLC teams as a model for collaboration and district leadership. Facilitation will be shared by participants and video of these meetings may be developed. Participants will develop reflective journals to accompany these meetings. PLC videos will be shared on D2L for constructive support of cohort successes and needs. Other district personnel will be encouraged to attend along with the PLC Consultant and/or local principal. **4) Collaborative Exchange among PLC Participants** – School-based teacher teams participating on the PLC team will visit each other's classrooms in support of best practice, create formative assessment routines and needs, observe videos of PLC practices, develop literacy practices for math content, and high light strengths/needs in support of low achieving students. **5) Ongoing Electronic Community** – Throughout the length of this project, networking and support among project participants and the IHE partners will include sharing via online collaborative tools – D2L (used to host assessments, coursework, best practices, content, interactive notebook strategies, and project feedback components).

Evaluation and Reflection:

Evaluation: To assess teacher learning and practice with both formative and summative evaluation tools in order to identify measureable outcomes. These tools include:

- Diagnostic Teacher Assessment of Mathematics (DTAMS) assessment of Elementary/Middle Level Math Teachers

- Middle School Mathematics and the Institutional Setting of Teaching, MIST Instrument
- PLC process and reflection journaling and video in support of district team development
- Pre-post assessment of student target development
- Pre-post attitudinal surveys and exit slips.
-

To determine the impact of this project on student performance, each TEAM participant's respective students will complete pre-post assessments that will measure changes in their math knowledge and skills.

Expected Benefits: This project is designed to develop the content and pedagogical content knowledge of mathematics for both regular and special education teachers. The focus of the content development within the summer academy will develop and carry over those needed conceptual understandings as the teams develop the formative work of their PLC.

The PLC concept will create and strengthen the "learning conversations" needed for teaching teams to collaborate, coordinate and reflect on their own personal development as well as the academic development of their students. These professional learning communities promote efficiency for teachers, equity for students, strategies for determining whether the guaranteed curriculum and grade level targets and progressions are being taught, information and feedback for teacher practice, and most importantly provide a powerful tool bringing regular and special education teachers together with purpose.

Project Title: Making Mathematical Connections: Mathematics Knowledge for Teaching the Common Core

Principle Investigator: Eric Kuennen

High Need LEA: Medford Area School District

Higher Education Institute: University of Wisconsin Oshkosh

Project Leaders: Laura Lundy (Medford), Eric Kuennen (UW Oshkosh)

Total Funding: $297,941

Teacher served: 29

Abstract: We envision an environment where teachers prepare our students to think mathematically and be able to solve non-routine mathematical problems. In striving to realize this vision, teachers' reliance on prescriptive textbooks must decrease, and our reliance on teachers' own mathematical knowledge must increase. In order to develop strong district curricula and classroom instruction aligned to the Common Core, teachers need deep and flexible math knowledge and practices, and constant vertical collaboration between grade levels.

Our rural location limits our professional development opportunities. This proposal will bring these opportunities to our teachers' doorstep. Experienced and highly qualified mathematics faculty will provide two-week intensive summer workshops that infuse the Common Core practice standards while focusing on our weakest mathematical content areas: Algebra and Functions, Fractions, Probability and Statistics, and Mathematical Processes.

Introduction: A key feature of these workshops is Problem-Based Inquiry: teachers will be daily engaged in authentic mathematics problem solving on rich problems designed by the math faculty to elicit a deep exploration and discussion of the math content in the Common Core in grades 4-9, mathmatical thinking and the Common Core Math Processes, and connections among math concepts. By becoming active participants in the mathematics practices as outlined in the Common Core, teachers will better understand what is meant by these practices and how to implement them in their classrooms. A second key feature to the workshops will be a Focus on Children's Thinking: faculty-led workshop sessions that focus on children's misconceptions, thinking and learning of these math concepts and processes, and teachers will analyze videos of children doing mathematics and teachers implementing classroom activitiies from the mathematics education literature. The third key feature to the workshops will be Connections to the Common Core, where the math content and practices learned by the teachers are directly connected to the Common Core standards, and teachers design lessons and activities for implementation in their own classrooms.

During the academic year, participants will collaborate in teams on lesson implementation and evaluation. The key feature of the academic year follow-up will be that mathematics faculty will visit classrooms to coach each participants' teaching for depth and press for student

understanding, and alignment with both the Common Core content and process standards. This one-on-one contact in the teacher's classroom will allow for great immediacy of feedback, relevancy of discussion, and help to build a strong relationship for on-going collaboration between teachers and mathematics faculty.

Goals and Objectives: The project's **goals** are to deepen teachers' mathematics knowledge for teaching and to increase student achievement in mathematics. The **objectives** are for our teachers to (1) gain a deep understanding of the Common Core Mathematical Content and Practice Standards in order to effectively facilitate student learning of math concepts and processes; (2) effectively implement the use of rich and engaging mathematical problems in the classroom; (3) understand how students learn math content in order to diagnose and respond to students' mathematical misconceptions in the classroom; and (4) collaborate vertically between grade levels in order to develop a continuum of developing knowledge and skills.

Program Plan: Thirty-six (36) teachers in grades 3-10 will be recruited, with preference given to grades 4-9 teachers from the targeted schools in the needs assessment, and to creating vertical teams within schools. Participants will receive either graduate credit or a stipend. Credits offered will be eleven graduate credits over three years (3 the first year, and 4 each in years 2 and 3), are based on a total 280 hours, and 26 hours per credit. The stipend offered will be $1540 per year, based on the Medford teacher's contract stipulated rate of $19.25 per hour for the 80 hour summer workshop.

Every year of the program, each participant will attend two weeks of full-day intensive summer workshops on mathematics content. The workshops sessions will be taught using a student-centered collaborative learning model with participants working in small groups, and collaborating vertically between grade levels in order to develop a continuum of knowledge and skills that build from one grade level to the next. Teachers will be supported by five mathematics faculty members in order to maximize participant/ faculty interaction. Following small group work, the faculty will lead larger group discussions of the key content and math practice ideas generated by the problem-solving activities. Each day of the summer workshop will focus on a specific mathematics topic within the Common Core, via three types of sessions:

1. Problem-Based Inquiry (PBI). Participants will deepen their understanding of a specific content topic through problem solving in small groups on rich problems designed to spark and sustain conversation about, and exploration of, a specific piece of the Common Core. These sessions will engage the teachers in analyzing solutions and methods, exploring representations, communicating, and making mathematical arguments. These sessions will represent about half of each day's workshop.

2. Focus on Children's Thinking. In the afternoons, we will study children's thinking and misconceptions about the specific content topic that was the focus of the morning's problem solving. Participants will appraise children's methods and discuss whether they are correct and generalizable. We will view video clips of children thinking aloud as they solve problems in order to better understand the ways children reason mathematically. We will also discuss how to respond to common student questions (as established in the research literature) related to the content, and address how to assess student written work (constructed response) in mathematics.

3. Connections to the Common Core. Finally, each day participants will study how the specific content topic is treated in the Common Core and in classroom lessons. We will analyze lessons and activities, such as from the NCTM Navigations Series and Common-core aligned textbooks and discuss the underlying concepts and the purpose and motivation for their approach. Participants will collaborate in grade bands in vertical teams and present their ideas for how they teach the content in the classroom.

Coursework Details. While making connections to children's thinking, mathematics practices and to teaching strategies, the professional development workshops will be driven by mathematics content in the Common Core. Each year of the program there will be a different content theme. In year one (1) the theme will be "Numbers and Algebraic Thinking", with a focus on the Common Core content strands of Operations and Algebraic Thinking, Number and Operations in Base Ten, Number and Operations - Fractions, Number Systems, and Expressions and Equations. In year two (2), the theme will be "Geometry and Measurement" with a focus on the Common Core strands of Geometry, Measurement and Data, and Ratios and Proportional Relationships. In year three (3) the theme will be Probability and Statistics, with a focus the content strands of Probability and Statistics, Measurement and Data, and Ratios and Proportional Relationships. While each year will have an identified content theme, the Common Core mathematical practice standards will be specifically addressed and identified in the workshop activities throughout the three-year program. Furthermore, key concepts involving number and algebraic thinking from year one will reinforced throughout the program.

Daily reflections. At the end of each workshop day, teachers will be given time to write and submit online a reflection on what they learned that day. Questions to guide their reflections will include "What is the most important or useful thing you learned today?" and "What questions or confusions are you left with today?" These reflections will not only be a learning tool for the teachers, but also formative evaluation tool for the mathematics faculty, as the faculty will read and respond to these reflections by email nightly.

Academic Year Follow Up. During the academic year, teachers will be expected to collaborate in vertical teams to discuss mathematics lessons share data collected on their students. Specific objectives for this collaboration will be provided by the mathematics faculty in the form of "Classroom Projects". In one classroom project, teachers will be asked to select an upcoming unit from their curriculum and identify the key content and practice standards underlying the unit, and develop strategies and lessons to implement in the classroom that will have a high level of cognitive demand for student understanding. The participants will be charged with implementing these lessons in their classrooms and reflecting on the results. In another classroom project, teachers will be asked to pay particular attention to students reasoning and misconceptions and to collect and analyze examples of student misconceptions and common errors. Teachers will be expected to make use of an online learning community through UWO to facilitate this collaboration and to interact with mathematics faculty during the academic year. These collaborative classroom projects will take place primarily in the Fall in years 2 and 3, and represent 8 contact hours each of those years.

Content-Focused Coaching. Each participant will be observed in their classroom once in year 2 and once in year 3 by one of the mathematics faculty, who will coach for mathematical depth and accuracy of the lesson, and level of cognitive demand and press for student understanding, and connection the Common Core content and practice standards. Each coaching session will include a group pre-lesson conference, a classroom observation of the lesson, and a group post-lesson conference to discuss suggestions. The participant will write both a pre-observation plan, outlining the goals and strategies of the lesson and identifying specific focal points of attention for the teacher and coach, and a post-observation reflection on the lesson. The Coaching component will represent 6 contact hours in year 2 and year 3 of the program. The goal of this coaching component of the program is to enrich and refine the teacher's mathematics knowledge for teaching.

Evaluation and Reflection: A group of 30 non-participating teachers and classrooms will serve as a comparison group for the various treatments. Although they will be compensated for the time required for data collection, these individuals will not be exposed to the concepts and methodologies contained in the project's workshops. Comparison group teachers and classes will be matched, as closely as possible, to the demographic characteristics of project participants and their classes. Teachers will be asked to provide professional biographical information, such as years of teaching and the number of mathematics courses taken in college.

Participating teachers' content knowledge will be assessed using the scales from the Learning Mathematics for Teaching (LMT) project, including Number Concepts and Operations, Patterns Functions and Algebra, and Rational Numbers, Geometry, and Probability and Statistics. A subset of items from the LMT will also be used to assess teacher's knowledge of common student misconceptions. A pretest-posttest design will be used with measures obtained from both the control and participant groups. Teachers' understanding of the Common Core content and practices standards will be assessed based on the external evaluator's observation and content analysis of the professional development sessions, pre and post surveys and interviews with participating teachers, and classroom observations of teaching by math faculty. A significant increase in student achievement on CCSS-aligned Smarter Balanced categories will also be an indication of an effective implementation of the Common Core.

Teachers' implementation of rich and engaging mathematical problems for fostering student engagement will also be evaluated using a pretest-posttest design. Items from the Surveys of Enacted Curriculum (SEC) or similar measures developed by the external evaluator will be obtained from all participating and control group teachers. Specifically, our target is to annually increase teachers' expectations of students in the areas of demonstrating understanding, conjecturing/generalizing, solving non-routine problems and making connections, increase the percentage of class time that students spend explaining their reasoning, solving mathematical problems that require novel or non-formulaic thinking, and justifying their mathematical thinking.

Improvement in student performance will be measured using two different techniques. Long-term classroom impact will be measured using the new Smarter Balanced Assessment in mathematics and the individual standards performance data in mathematics. Furthermore, each district will conduct its own local assessments, such as through MAPs.

Project Title: Enhancing Teaching of Middle School Mathematics (ETM2)

Principle Investigator: Shannon McGuire

High Need LEA: Kenosha Unified School District

Higher Education Institute: UW-Parkside

Project Leaders: Shannon McGuire (UW-P), Jennifer Lawler (KUSD), Rosalie Daca (RUSD), Connie Zinnen (BASD)

Total Funding: $411,645

Teacher served: 42

Abstract: The Enhancing Teaching of Middle School Mathematics (ETM2) project establishes a partnership between the University of Wisconsin-Parkside, Kenosha Unified School District, Racine Unified School District, and Burlington Area School District, in order to deliver targeted professional development for middle school mathematics teachers. Our overarching goal is to equip teachers to fully understand and implement the Common Core State Standards for Mathematics (CCSSM), leading to improved student attitudes and outcomes in mathematics.

The project will serve a cohort of 40 in-service teachers for three years, with the following objectives: 1) Increase student achievement in mathematics; 2) Increase teachers' depth of mathematical content knowledge and pedagogical content knowledge; 3) Increase teacher leadership capacity related to Common Core State Standards for Mathematics implementation.

To achieve these objectives, ETM2 will offer nearly 350 hours (more than 100 hours per year) of professional development activities. Each year's activities will concentrate on a key set of middle school level mathematical concepts as outlined in the Progressions for the Common Core State Standards for Mathematics: Proportional Reasoning (Year 1); Expressions, Equations and Functions (Year 2); and Statistics (Year 3). Teachers will participate in content seminars during the academic year, led by mathematics faculty members and designed to deepen teachers' mathematical content knowledge by engaging them as math learners, and a two-week summer institute of content training and lesson studies. Throughout the program, teachers will participate in group and individual coaching sessions and observations, and online networking and reflection activities.

Programming will be complemented with leadership development activities designed to build teachers' leadership capacity in math instruction and development of Common Core implementation techniques within their schools and across school districts.

Introduction: Enhancing Teaching of Middle School Mathematics (ETM2) will develop and deliver targeted professional development for middle school mathematics teachers to implement the Common Core State Standards for Mathematics (CCSSM), with the ultimate goal of increasing student achievement in mathematics. The Kenosha Unified, Racine Unified, and Burlington Area School Districts (KUSD, RUSD, and BASD, respectively) will collaborate with the University of Wisconsin-Parkside to deliver a multi-phased educator development program to prepare middle school mathematics educators to enhance their instruction to align with the new standards. The need for professional development is particularly acute among middle school mathematics teachers because the CCSSM are substantially different from the previous expected outcomes in mathematics.

Goals and Objectives: ETM2's overarching goal is to prepare middle school mathematics teachers to understand and implement the Common Core State Standards for Mathematics. We anticipate that this experience will strengthen their teaching and, in turn, improve student mathematics achievement in high need areas.

Objective 1: Increase student achievement in mathematics.

- Indicator 1.1: Improved scores on student Measures of Academic Progress (MAP) Mathematics assessment, as measured by a) individual student performance and b) student performance compared to a control group of peers.
- Indicator 1.2: Improved understanding of and attitudes toward mathematics, as measured by pre- and post-surveys.

Objective 2: Increase teachers' depth of mathematical content knowledge and pedagogical content knowledge.

- Indicator 2.1: Increased mathematical knowledge for teaching, as measured by University of Michigan Learning Mathematics for Teaching pre- and post-assessments for teachers.
- Indicator 2.2: Increased confidence in mathematical knowledge and pedagogical skills, as measured by pre- and post-delivery of the Mathematics Teaching Efficacy Belief Instrument (MTEBI).
- Indicator 2.3: Enhanced classroom teaching performance, as observed and reviewed by coaches throughout the three year project.

Objective 3: Increase teacher leadership capacity related to Common Core State Standards for Mathematics implementation.

- Indicator 3.1: Increased demonstration of leadership, as measured by a) pre- and post- self-evaluation by teachers using PRIME Leadership Assessment rubrics and reflective tools and b) coach and peer feedback.

Program Plan: To achieve these objectives, IHE University of Wisconsin-Parkside and LEA Kenosha Unified School District will partner with Racine Unified School District and Burlington

Area School District to carry out professional development programming serving 40 middle school (grade 6-8) mathematics teachers. Through our recruitment efforts, we will aim to include 15 teachers from KUSD, 15 from RUSD, and 10 from BASD; if additional spaces remain they will be offered to other school districts in southeastern Wisconsin. Over the course of the three year project, teachers will receive nearly 350 hours of high-quality, content-specific professional learning opportunities.

Each year's activities will concentrate on a key set of middle school level mathematical concepts as outlined in the Progressions for the Common Core State Standards for Mathematics: Proportional Reasoning (Year 1); Expressions, Equations and Functions (Year 2); and Statistics (Year 3). Activities will include:

1. **Academic Year Content Seminars (24 hours per academic year):** Teachers will participate in three eight-hour content seminars during the academic year, led by mathematics faculty members from UW- Parkside, coaches, and adjunct instructors. Coaches and adjunct instructors will be licensed K-12 teachers, with a minimum of five years classroom teaching experience. Coaches will also have experience in some form of peer instructional teaching or coaching techniques. Focusing on one of three themes each year, content seminars will deepen teachers' mathematical content knowledge through modeling activities, development of mathematical content related to Common Core, and "Math Circles," a form of educational enrichment that brings mathematicians together to work on interesting mathematical problems.

In year three, an additional Coaching and Leadership component will be provided for any project participant interested in developing skills to encourage more school or district implementation of math strategies beyond the grant. These seminars will focus on three primary areas including "Coaching: What it is and what it isn't," "Core Competencies of a Coach," and "Coaching Strategies." Participants will meet three times for eight hours each (24 hours total) on one topic per session.

2. **Individual Coaching Sessions (4-6 hours per participant per academic year):** Between content

seminars, coaches will guide participants on instructional strategies related to their mathematical content. Each coach will be assigned up to 15 participants with the expectation that coaches will observe participants at least twice (minimum of one hour per observation) between Content Seminars. Observations may include videotaping for teacher and coach review and discussion. Feedback will be provided to the participant either face-to-face or via web based technology regarding positive teaching strategies and areas for potential growth. Coaches may recommend online resources, journals, or peer conversations to enhance participants' knowledge and pedagogy.

3. **Summer Institute: Content Training and Lesson Studies (80 hours per summer):** Each year of the project, participants will take part in two weeks of intensive summer institute programming (summer 2015, 2016, and 2017). Like the yearly seminars, these are built on

Common Core strategies and enhance the content and pedagogy learned during the seminars, coaching experiences, and online networks. Year one will concentrate on Proportional Reasoning, year two on Expressions, Equations and Functions, and year three on Statistics. Each summer institute will include content expert guest speakers, instruction from mathematics faculty, networking and lesson sharing/development at specific grade levels and across grades, and visits to regional partners to connect mathematics with relevancy and daily use.

4. **Online Networking and Reflection:** Between face-to-face activities during the academic year, teachers will participate in self-paced online networking and reflection. These monthly reflection prompts and webinars will provide added content resources while allowing participants to ask questions, share successes, and pose challenges to their mathematical content and teaching strategies. Participants, program faculty members, adjunct instructors, and coaches will contribute in an open format. The project will use LiveText as the platform for participants to upload reflection prompts, as well as videos and other resources to support professional growth.

Evaluation and Reflection: Ongoing review of MAP mathematics testing scores of students in mathematics classes taught by teachers participating in this project.

Individual student data will be reviewed to assess progress, and student scores will be compared to a Annual pre- and post-participation survey of students in mathematics classes taught by teachers participating in this project. The survey will measure changes in students' perceptions of their understanding of and attitudes toward mathematics, in hopes of correlating improved attitudes and improved achievement. Annual pre- and post-participation assessments will measure the development of teachers' mathematical knowledge throughout the project. LMT assessments will be tailored to address the mathematical content addressed in each year of the project. Annual delivery of the MTEBI to participating teachers. Each year's results will be compared to the first delivery, which will serve as baseline data. Coaches will conduct observations of participants' classroom teaching as an additional measure of their use of new mathematical knowledge and/or increased pedagogical skills. These observations will be shared with participants so that they can direct their focus to areas for improvement or enhancement as needed. Year 3 participant self-evaluations will measure the extent to which participants believe they have grown as collaborators and leaders in mathematics instruction. Participants completing the additional Leadership and Coaching track in year three will be assessed using a combination of self-reflection, feedback from project coaches and instructors, and interviews and assessments from peers within the project

MSP Resources

U.S. Department of Education/MSP Program:

The website of the U.S. Department of Education offers background and legislative information on the MSP Program: http://www.ed-msp.net.

Teacher Education Materials Project (TE-MAT):

The TE-MAT site offers a database of resources to support mathematics and science professional development providers as they design and implement programs for in-service teachers: http://www.te-mat.org.

Horizon Research, Incorporated (HRI):

The website of HRI offers a wealth of information related to research and evaluation of mathematics and science initiatives. Some of its tools may be helpful in conducting a professional learning needs assessment: http://www.horizon-research.com

Learning Mathematics for Teaching (LMT) Project:

The LMT Project website offers information on the assessment instruments required by all funded mathematics MSP projects: http://sitemaker.umich.edu/lmt/home.

Project MOSART: Project MOSART's website offers thorough information, including a tutorial, on the required assessment instruments: http://www.cfa.harvard.edu/smgphp/mosart/.

Common Core State Standards for Mathematics:

The Common Core State Standards for Mathematics were adopted by Wisconsin on June 6, 2009, officially becoming the Wisconsin Common Core Standards for Mathematics. As teacher preparation programs and K-12 school districts work to implement the new standards, it is important that MSP projects and activities are aligned to and reflect the intent of both the Common Core Standards for Mathematical Content and the Standards for Mathematical Practice.

- http://dpi.wi.gov/standards/math-tchingandlrng.html
- https://sites.google.com/a/dpi.wi.gov/disciplinary-literacy-in-mathematics/

National Council of Teachers of Mathematics (NCTM):

The NCTM is a public voice of mathematics education supporting teachers to ensure equitable mathematics learning of the highest quality for all students through vision, leadership, professional development and research: http://www.NCTM.org.

Wisconsin Mathematics Council (WMC):

The WMC was formed to lead in the development of, advocate for, and promote quality mathematics education for all students: http://www.wismath.org.

Wisconsin Society of Science Teachers (WSST):

The Wisconsin Society of Science Teachers was founded in 1958. Today it is the largest Wisconsin organization of individuals interested in the advancement of science education. WSST's purpose is to promote, support and improve science education in the state of Wisconsin by providing leadership, advocacy, and programs to enhance the teaching and learning of science: http://www.wsst.org.

MSP Resources

Next Generation Science Standards:

- http://www.nextgenscience.org/
- http://www.nap.edu/catalog.php?record_id=13165

Differentiated Instruction for Math and Science:

Differentiated instruction is used to adapt instruction to meet the individual needs of the learner. A differentiated classroom offers multiple ways for students to access content, to process and make sense of the concepts and skills, and to develop products that demonstrate their learning (Tomlinson, 2001). It is a process through which teachers enhance learning by matching student characteristics to instruction and assessment. Differentiated instruction allows all students to access the same classroom curriculum by providing entry points, learning tasks, and outcomes that are tailored to students' needs (Hall, Strangman & Meyer, 2003).

Differentiation in science and math instruction provides students with varied experiences to engage in the content. The following resources focus on differentiating science and math instruction.

- Differentiated Instruction for Math

http://www.k8accesscenter.org/training_resources/mathdifferentiation.asp

- Differentiated Instruction for Science

http://www.k8accesscenter.org/training_resources/sciencedifferentation.asp

The National Science Teachers Association:

The NSTA website offers science teaching resources developed by Page Keeley and colleagues. To order Page Kelley's publications refer to the NSTA at: http://www.nsta.org

Vertical Teams

What is a Vertical Team?

Most commonly a vertical team consists of middle school and high school educators who teach in the same academic area. It may also include elementary teachers, school counselors, administrators, department chairs, or curriculum specialists. Through communication and cooperation, teams design curricular change and create support structures necessary to make high achievement by all students a reality.

Purpose of a Vertical Team

In vertical teams, teachers from different grade levels work together to develop a continuum of knowledge and skills that build from one grade level to the next. Team communication leads to a greater understanding of what is taught each year, which helps teachers organize strategies, plan introduction of concepts, and reduce repetition of content. As a result, student achievement and success is enhanced.

Goals of a Vertical Team

- To increase achievement of all students to close the achievement gap
- To bring about coordination and communication between grade levels
- To foster greater inclusion and to build enrollment in advanced coursework
- To introduce skills, concepts, and assessment methods to prepare students for success in advanced coursework
- To encourage innovation
- To stimulate enthusiasm for advanced coursework in the school, family and community

Benefits for Students

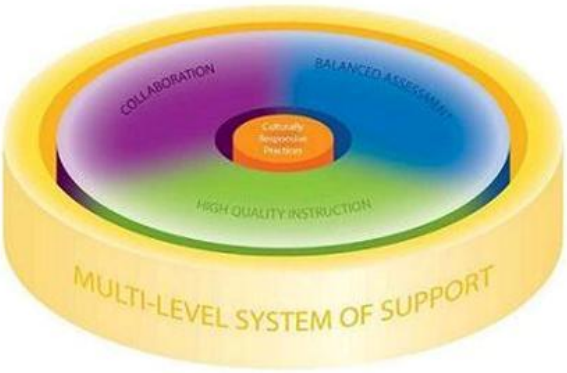
A successful vertical team will:

- Prepare students for the next level of challenge by developing skills and strategies necessary for success in advanced coursework
- Promote greater inclusion and progress towards closing the achievement gap
- Improve student achievement

Equity and Access

The concept of vertical teams is based on a philosophy of inclusion; on the notion that all students benefit from experiencing a rich and rigorous curriculum. Research shows that students of color and socio-economically disadvantaged students tend to be under-represented in advanced coursework. The goal of vertical teams is to prepare all students for success in rigorous courses at the secondary level, not only certain groups. This results in an organizational pipeline that promotes equity and access for all.

Wisconsin's Response to Intervention



Why RtI? Wisconsin's Response to Intervention (RtI) is a process for achieving higher levels of academic and behavioral success for all students. RtI is not distinct from a school improvement plan or a school-wide program plan; RtI is a school-improvement plan/School-wide program plan. Culturally responsive practices are at the core of the RtI process, to reflect the growing diversity in Wisconsin, and to ensure that Wisconsin educators are positively impacting each and every student through curriculum and instruction, assessment, and collaborative practices.

In thinking about RtI, your first thoughts might turn to interventions and the typical triangle model of interventions, but it is important to note that an RtI process is about more than providing interventions to struggling students. The first element of an RtI system must be effective, high quality instruction in the core program. High quality instruction is engaging, standards-based, data-driven, and research-based. All students, including Special Education students, should receive high-quality, culturally-responsive core academic and behavioral instruction, that is differentiated for student need, and aligned with the Common Core/State Standards. Implementing an RtI system may require professional development in providing differentiated instruction to all students. A guiding principle for high quality instruction is that RtI is something you do, not necessarily something you buy. Interventions, provided in addition to core academic instruction, are intended to increase student performance in the general curriculum for students who are not meeting benchmarks. Additional challenges are intended to meet the needs of students who are exceeding benchmarks. Interventions and additional challenges are the responsibility of both the Regular Ed and Special Ed staff.

We live in a data-rich world, but how effectively do we really use all that data? RtI is about being more mindful and systematic in our practices. Balanced assessment refers to a continuous review of student progress using multiple measures to determine the current skill level of a student or group of students; how students are responding to core curriculum and instruction, and how students are responding to interventions or additional challenges. No single test score should determine a student's experience at any phase of an RtI system. Data collected on students can be formal (quantifiable, norm-referenced tools) or informal (observations and/or teacher-developed formative tools) and can be implemented with individual students or an entire class. To get a complete picture of students, data such as teacher observation, family interviews, and student self-assessments should also be among data collected on students. Some components of an RtI system may also be used as a method for identifying students with specific learning disabilities (SLD). As a student moves further toward a process of a SLD determination, the criteria of progress monitoring tools becomes more stringent to ensure strict consistency, fidelity, and reliability across the state.

Collaborative protocols such as problem-solving processes and professional learning communities (PLC) can be used to systematize discussions of student, class, grade, school, district, and state-level data.

Wisconsin's Response to Intervention

The frequency and intensity of collaborative teaming should increase with student need. Including common time for collaboration, in school schedules can be a challenge, but many different models of incorporating cooperative effort into all types of school schedule structures currently exist. Collaborative time is not enough, however. It should be structured, and protocols should be established, so that the time is used efficiently and effectively.

The RtI process requires us to think differently about our students, our schedules, and our practices. That is no easy undertaking! Using a multi-level system of support, to identify and respond to student needs, can increase the success of all students. Implementation of a multi-level support system includes meaningful family involvement, data-based decision making, and effective leadership. Comprehensive RtI implementation will contribute to increased instructional quality, equitable access to high quality and effective programming, and will assist with the identification and support of learners with varied abilities and needs. Visit the Wisconsin RtI Center website at www.wisconsinrticenter.org for information on resources, tools, and professional learning.

Notes