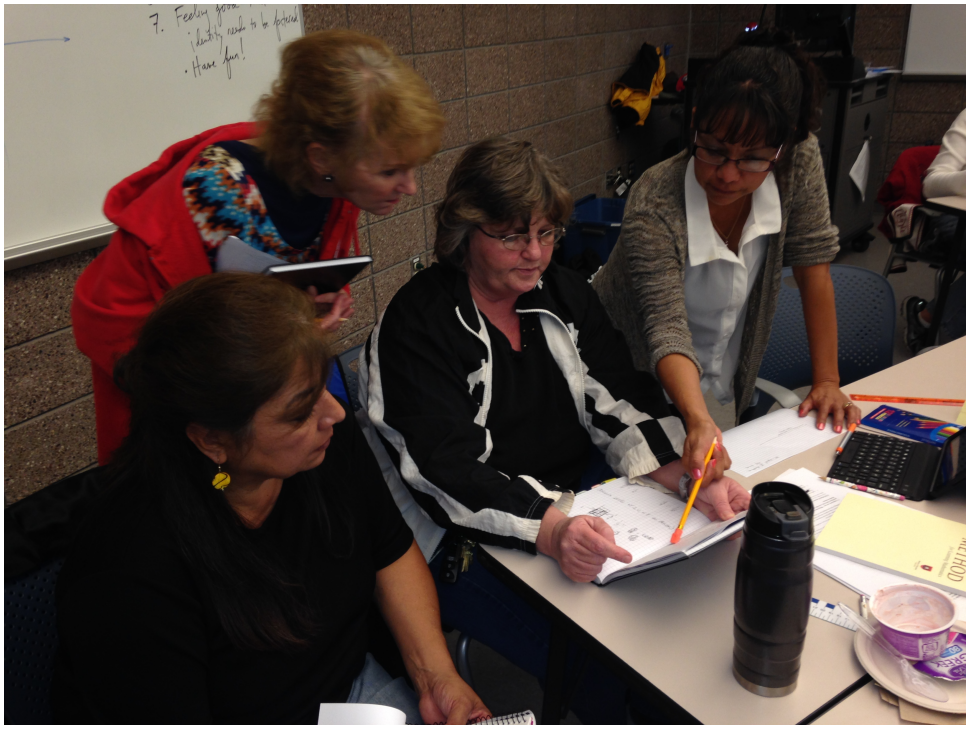
2013-2014 Evaluation Report



MSA is a program of the Los Alamos National Laboratory Education & Postdoc Office and the Los Alamos National Laboratory Foundation

> Effective professional development is intensive enough to allow people to develop new knowledge and skills. And it has a component in the workplace as well as in the training environment. Somehow there's a support system that follows teachers into the workplace and either provides continuing training or some kind of structure enabling teachers to continue solving problems in the workplace.
>
> Beverly Showers, 2002

EXEXUTIVE SUMMARY

The Northern New Mexico Math and Science Academy (MSA) is an intensive and comprehensive professional development program designed to support continuous and sustainable improvement of the teaching and learning of mathematics and science. The MSA team, comprised of four master teachers, supports K-12 teachers and school leaders in job-embedded professional learning with a focus on systems change. MSA offers a comprehensive and integrated menu of activities and supports to help teachers improve their instructional practices and ultimately to raise student achievement.

This evaluation is intended to summarize the impact of the Math and Science Academy program on its participant teachers, schools, and ultimately, on student achievement. The following is a summary of the key findings for the 2013-2014 project year.

- Three years is critical for impacting change in teachers' beliefs about the teaching and learning of mathematics and for impacting instructional practices.

- Professional Learning Communities (PLCs) and peer coaching have the greatest impact on holding teachers accountable for implementing new instructional ideas because teachers become responsible to each other and all of the students.

- The most significant change in teachers' instructional practices include encouraging multiple ways to solve problems, having students explain their thinking, having students use models and write about their thinking, and focusing on concepts over procedures.

- The biggest challenge teachers find for fully implementing their MSA learning is time – time to plan instruction, time to meet with peers, time away from family responsibilities to attend MSA trainings.

- The GANAS framework, developed by MSA, has been a very effective tool for guiding teachers as they do their instructional planning, for providing a common language to all MSA conversations, and as a tool that helps to link the various activities of MSA together through that common language. It is used by teachers and principals, alike.

- Measures of gains in student achievement and learning of mathematics and science will require more reliable data collected at the classroom formative level. NMSBA and NWEA data is not a reliable way to do contribution analysis on the impact of MSA participation on student learning.

PROGRAM DESCRIPTION AND OBJECTIVES

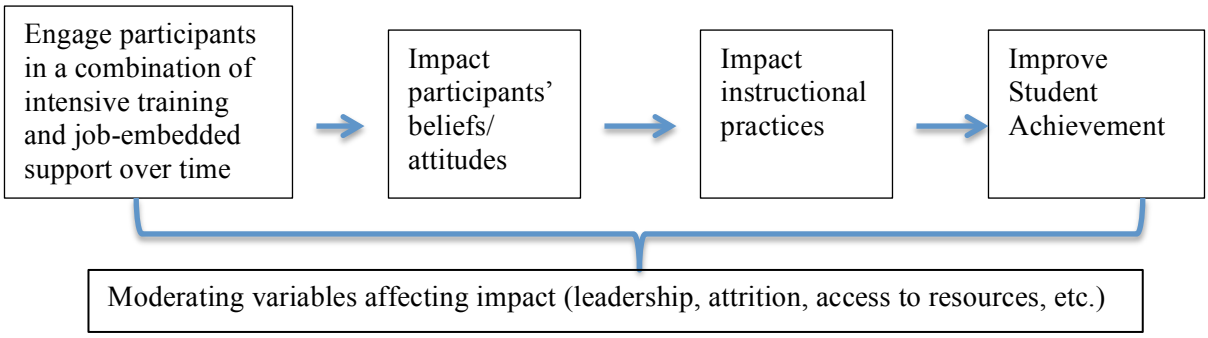
The Northern New Mexico Math and Science Academy (MSA) is an intensive and comprehensive professional development program designed to support continuous and sustainable improvement of the teaching and learning of mathematics and science. The MSA team, comprised of four master teachers, supports K-12 teachers and school leaders in job-embedded professional learning with a focus on systems change.

The overarching goal of MSA is to provide comprehensive math and science professional development for teachers and school leaders to ensure mathematics and science learning of the highest quality for all students. Ultimately, the hope is that teachers will implement effective research-based instructional practices, materials, and assessments that will increase STEM literacy for all students, and expand the number of students who eventually pursue advanced degrees and careers in STEM fields.

The 2013-2014 MSA program description outlines four program goals:

- Increase teacher content knowledge for teaching mathematics and science that bridges content knowledge and knowledge about the practice of teaching.
- Increase teachers' use of research-supported practices to conduct effective math and science lessons in their classrooms.
- Develop school and district leadership capacity that supports continuous improvement in teaching and learning.
- Ultimately improve student learning and achievement in math and science in northern New Mexico.

To meet these goals, MSA provides a three-year comprehensive professional learning program that includes an intensive three-week intensive Summer Institute followed by continuing job-embedded support to participants throughout the year. Year-round supports include content workshops, instructional support from MSA coaches, and support to develop and enhance professional learning communities. The MSA program aligns with best practice research in professional development using the following conceptual framework:



The MSA logic model describes the program design in more depth, including an emphasis on systemic reforms to support teachers as they implement new learning. It illustrates how the activities lead to the program goals they hope to achieve. The MSA logic model can be found as Appendix 1.

During the 2013-2014 school year, MSA adjusted their activities and strategies to continually improve their professional development model. They have included a greater emphasis on helping schools to develop professional learning communities and peer coaching, they have put resources into developing a Massive Online Learning Community (MOOC) for all participants in the MSA program, and they have worked closely with the BIE's Education Line Officer (ELO) who oversees all of the 19 Northern and Southern Pueblo schools in New Mexico to involve three more pueblo schools in the MSA professional development.

The MSA professional development is now entirely focused on seven Native New Mexico pueblo schools in north-central New Mexico. The Summer Institute of 2014 included three cohorts of Pueblo educators:

- Cohort 1: Jemez Pueblo Day School and San Felipe Elementary School began the MSA program in 2012, and are now in their third year.
- Cohort 2: T'siya Pueblo Day School and Ohkay Owingeh Community School began the program in 2013 and have had two Summer Institutes and a year of coaching support.
- Cohort 3: Santa Clara Pueblo Day School, San Ildefonso Pueblo Day School, and Taos Pueblo Day School began with the 2014 Summer Institute.

Because Cohort 3 began at the end of the 2013-2014 evaluation period, there is very little data to include. This report evaluates the MSA program impact for Cohorts 1 & 2.

EVALUATION PURPOSE

Evaluation of a professional development program has two important goals: to improve the quality of the program (formative), and to determine its overall effectiveness (summative). Formative evaluation was done at intervals during the 2013-2014 MSA program. Survey analysis, observations and participant feedback was provided to the MSA team throughout the year, and enabled them to make mid-course adjustments and to fine-tune the program.

The purpose of this evaluation report is summative - to determine the impact of the Math and Science Academy program on its participant teachers, schools, and ultimately, on student achievement. Specifically the objectives of the annual summative evaluation are to:

a. Determine if the MSA program is fulfilling its four program objectives as intended;
b. Guide program staff and managers in making changes and adjustments to the program to maximize the program's effectiveness;
c. Highlight the specific program activities that ultimately contribute to improved teaching quality and gains in student achievement in math and science.

The first level of summative evaluation is to assess the changes in the educators as a result of participating in the professional development program. Participants are asked to describe changes in how they think, what they believe, and what they do in the classroom (Guskey &

Sparks, 2002). They describe their own professional growth and evaluate the program in meeting their personal and professional goals. Such changes in participants can be determined through questionnaires, observations, interviews, self-assessment instruments, and analysis of records.

The second level of summative evaluation is to assess the ways in which the school organization has changed. This assessment is critical because research shows that organizational climate and culture strongly influence both initial and continued use of innovation. Professional development efforts will have a greater impact on student outcomes if the organizational culture provides ongoing support for such efforts. Showers (quoted in Asayesh, 1993) describes the component of organizational change that accompanies effective professional development:

RESEARCH QUESTIONS

Based on the program objectives and the MSA Logic Model, the evaluation sought to describe the teacher/principal participants and to answer six research questions aligned with MSA objectives.

1. **Program Participants**: Who were the participants in 2012–2013 MSA professional development activities?

The next four research questions consider the impact of the MSA program related to the four program goals:

2. **Teacher Pedagogy and Content Knowledge**: There are two parts to this question:
    a. To what extent did MSA PD influence participants' beliefs and attitudes for teaching mathematics and science?
    b. To what extent did MSA influence teacher content knowledge in mathematics and science?

3. **Teachers' instructional practices**. To what extent did MSA PD increase teachers' use of research-supported practices to conduct effective math and science lessons in their classrooms?

4. **Schools' capacity to support continuous improvement**: To what extent has the MSA program had an impact on systemic reform and capacity building for the continuous improvement of mathematics/science teaching and learning?

5. **Student Learning and Achievement:** To what extent did MSA impact student learning/achievement in participant classrooms and schools?

An additional research question considers all of the program data to determine implications for future planning of MSA professional development.

6. **Continuous Improvement:** How can the MSA program be refined to better support and enhance teacher professional development, administrative leadership, and student learning and achievement?

METHODOLOGY

Both quantitative and qualitative measures were used to collect data related to the research questions. The comprehensive data collection plan was created in collaboration with the MSA Team, and is outlined on page ____ of this report.

Quantitative data collection methods included:

- Ir-Rational Number Institute pre/post assessment data on mathematics content knowledge for teaching
- Pre/post Learning Mathematics for Teaching assessment of mathematics content knowledge for teaching for all cohorts. The same assessment, developed by the University of Michigan, is used each summer to provide pre-, post-, and post-post data for each cohort. Thus data can be compared across cohorts, as well as within cohorts.
- Student standards-based assessment (NMSBA) scores 2012-2014, and NWEA mean RIT scores, 2012-2014
- Surveys of teacher beliefs and practices

Qualitative data collection methods included:

- Focus group interview of MSA Core participants
- Individual teacher interviews
- Principal interviews
- Teacher reflections.
- Observations of MSA professional development activities, including training and job-embedded supports.

Data used in this evaluation to understand the MSA program impact on teaching and learning comes from Cohorts 1 & 2, as Cohort 3 just started in the summer of 2014. Some of the pre-assessment data for Cohort 3 is reported below as a baseline for future evaluation, and as a comparison to Cohorts 1 & 2.

Detailed findings on the MSA program impact are reported below, according to the six evaluation questions. For questions 2 through 5, some of the broad educational research on professional development is used as context. Each finding related to the evaluation question is bulleted.

Key findings for Question #1: Who are the 2013–2014 MSA participants?

- Participation in MSA has grown from 29 participants representing 4 New Mexico Pueblo schools in the summer of 2013 to 62 representing 7 NM Pueblo schools in the summer of 2014. MSA continues to build a strong partnership with the BIE's Northern and Southern Pueblos. Table 1 shows demographics for each of the 7 participating schools, and includes the year each school began MSA and the number of staff participating. Table ___ provides school demographics and number of staff participating in MSA.

Table 1: The 7 Pueblo Schools Involved in MSA

School Name	Grades	No. of Students	No. of Teachers	FRL	Began MSA	Staff in MSA
Jemez Day School	K-6	134	9	97.8%	2012	8/8
San Felipe Day School	K-8	424	26	99.3%	2012	17/26
T'siya Day School	K-8	77	6	96.1%	2013	6/6
Ohkay Owingeh Community School	K-6	100	7	96%	2013	6/6
Santa Clara Day School	K-6	120	9	97.8%	2014	10/10
San Ildefonso Day School	K-6	23	3	93.5%	2014	3/3
Taos Day School	K-8	161	11	98.1%	2014	11/11

*100% of students served by these schools are Native American.

- It is significant to note that for all but one school, MSA is a school-wide effort. Principals from each school also participate. The involvement of entire teaching staffs and administrators is not by accident. Based on PD research and their own experience, MSA has realized the importance of involving all teachers in a collaborative professional growth model. MSA has collaborated closely with the BIE Education Line Officer to ensure that expectations for full involvement were supported.

Table 2: Participation, by school, in MSA activities.

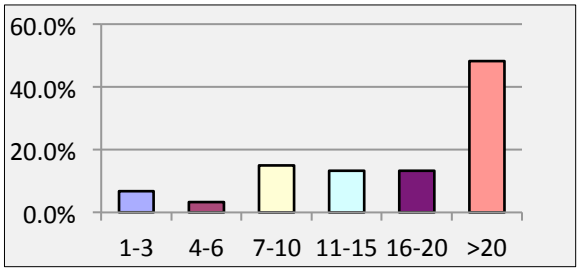
School Name	# in MSA	Summer Institute 2013	Summer Institute 2014	Ir # fall 2013	Ir # spring 2014	Summer Science Week	Math Writing	Master's Program*
Jemez Day School	8	8	8	6	6	9	7	2
San Felipe Day School	17	17	17	17	17	0	17	4*
T'siya Day School	6	6	5	5	5	0	3	
Ohkay Owingeh Comm. School	6	5	6	0	0	0	6	
Santa Clara Day School	10	0	11	0	0	0	0	
San Ildefonso Day School	3	0	3	0	0	0	0	
Taos Day School	11	0	9	0	0	0	0	

*17 teachers began in the Master's Program, 11 dropped, 4 graduated, and 2 remain.

- From the top administrative level, the BIE Education Line Officer, there is the expectation that teachers and principals will participate in MSA, and the expectation is backed with stipends for teacher time outside of the school day. Teachers are paid to attend the Summer Institute and the Ir-Rational Number Institutes. Table 2 indicates participation, by school, in each of the MSA activities for 2013 – 2014.

Chart 1: Years teaching

- Most of the MSA participants are veteran teachers, with 73% having taught more than 10 years. Almost 50% report more than 20 years of experience. Nationally, only 30% of teachers have over 20 years experience (Institute of Educational Science). Chart 1 highlights the years of experience.



- 68% of participants have a master's degree, compared to 39% in all of New Mexico. This is true across all three cohorts of MSA participants. Yet the majority (59%) rate their own mathematics algebra 1 proficiency as a 1 or 2 on a 5 point scale.

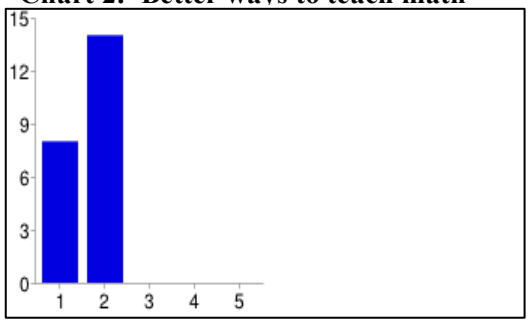
- Over 60% of participants are Native American. This is significant for two reasons. First, very few schools service Native children have such a large number of native teachers. Second, the participants are able to contextualize the MSA professional development to their schools.

- The addition of new schools each year has presented challenges for the MSA program and the participants. One challenge is the distance that participants must travel to attend the Summer Institute and the Ir-Rational Number Institute. The 2014 Summer Institute was held in Albuquerque, a 130-mile drive from the northern-most pueblo of Taos. There has been push-back from some participants who are expected to participate, yet must spend some weekends and three weeks in the summer away from their families. This may have impacted their ideas about the impact of MSA on their beliefs and their teaching. The second challenge is that the needs of first year participants are different that those of 2nd or 3rd year participants.

Key findings for Question #2a: To what extent did MSA PD influence participants' beliefs and attitudes for teaching mathematics and science?

Background: The National Council of Teachers of Math (NCTM, 2000) found that 40% of elementary and middle school teachers of mathematics report that they do not feel qualified to teach the content. Gaining confidence in their teaching skills and developing their teaching ability in general are not just the concern of teachers who are new to the profession, but also of experienced teachers when they meet new challenges which seem to threaten their long-standing values and beliefs about learning and teaching, especially if these may imply changes to their teaching practices. Teachers' self-confidence as mathematics teachers has been significantly correlated with students' perceptions of their own competence as mathematics learners (Stipek, et al, 2001).

Chart 2: Better ways to teach math



- Interview data and survey data indicate that teachers feel significantly more confident in their mathematical competence as a result of their involvement in MSA. On a Spring 2014 survey of 22 MSA participants involved in the spring Ir-Rational Number Institute, 100% indicated that they agree or strongly agree that they are continually finding better ways to teach mathematics.

- Teachers report that not only do they feel greater confidence in teaching mathematics, but they feel greater confidence in teaching in general as a result of learning new instructional strategies.

> In the past, I was fearful (about math) and didn't think that I could learn it. The conceptual approach to math is a whole new paradigm shift for me and I actually am beginning to really look forward to more classes at the Ir-Rational Number Institute."

MSA has given me an opportunity to learn math, where as in the past, I was fearful and didn't think that I could learn it. The conceptual approach to math is a whole new paradigm shift for me and I'm actually beginning to really look forward to my classes at the Ir-Rational Number Institute.

I have learned lot from the MSA program and it has helped me to become more confident in my abilities as a teacher.

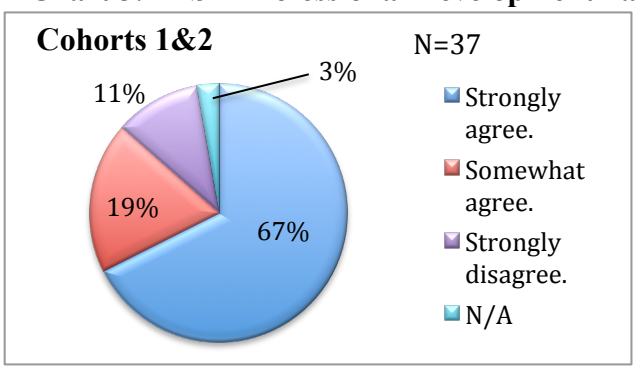
The reason I joined Ir-Rational Number is because math is the area that I am the weakest. I needed more help. That has been so beneficial for me in being able to deliver better/plan better, deliver the content in math. It's having the experience and the knowledge.

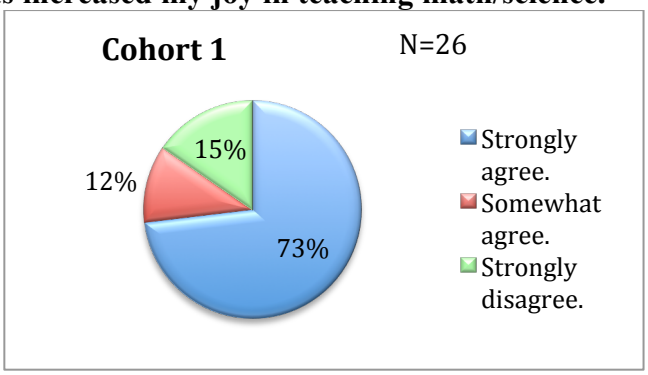
This PD hasn't been one that you take the binder and put it on the shelf and no one comes to follow up. You really use what you learn.

- Participation in MSA has increased teachers' joy for teaching mathematics and science. In a survey of all participants in Cohorts 1 & 2, 67% report strong agreement with the statement, "MSA professional development has increased my joy in teaching math/science." Interview data confirms that teachers are more positive about their mathematics and science instruction. "MSA has renewed my energy and my love for teaching."

  Chart 3 breaks down responses from Cohort 1 & 2 participants on a survey about their joy for mathematics/science teaching. Further research will be needed to determine why four participants strongly disagreed. For teachers in Cohort 1, who have been involved with MSA for over 2 years, there was even more positive response.

Chart 3: **MSA Professional Development has increased my joy in teaching math/science.**





- MSA professional development in mathematics content and pedagogy has led to many participants feeling more confident in their own mathematics ability, and in teaching mathematics.

- Participants felt that the most effective professional development activities for improving their practices were working in groups of their peers on actual mathematics/science problems and looking together at student work with other teachers. Table 3 indicates that the job-embedded support of peer coaching, looking together at student work, and watching a coach or other teachers model lessons are highly valued. Of those who responded to "other", 45%

indicated that all of the activities were helpful, while the rest heavily favored peer coaching, observation of lessons and looking together at student work.

Table 3: Most Effective Professional Development practices.

Which of the following professional development activities are most effective for improving your teaching practice? (Check all that apply.)		
Answer Options	**Response Percent**	**Response Count**
Working in groups of my peers on actual mathematics or science problems.	41.0%	15
Hearing from an expert on ideas for teaching mathematics or science.	19.0%	7
Training in the use of curriculum materials.	21.6%	8
Professional development where teaching strategies are modeled with students.	38.0%	14
Having a coach model in my classroom.	27.0%	10
Having a coach or peer teacher observe my lesson and then debrief.	32.4%	12
Observing another teacher teach a lesson.	27.0%	10
Watching a video lesson and then critiquing it with peers.	27.0%	10
Looking at student work with other teachers.	43.0%	16
Other (please specify).	32.4%	12
answered question		**37**

- While teachers feel that collaboration with peers and looking together at student work are most effective in improving their instructional practices, the following Table 4 from the survey indicates that peer collaboration and looking together at student work are not regular practices at their schools. It is also important to note that while collaboration around science was a part of the survey, it was not a major focus for MSA this year.

Table 4: School level instructional growth activities

How often do you do the following in your school, related to mathematics or science?					
Answer Options	**Never**	**Once a year**	**3-4 times a year**	**monthly**	**weekly**
Discuss the mathematics curriculum and the implementation.	2	3	13	12	5
Discuss the science curriculum/kits and implementation.	20	3	8	4	1
Exchange teaching materials with colleagues.	6	6	15	5	4
Look together at student work.	4	4	13	9	7
Engage in discussion about the learning of specific students.	4	2	8	7	12
Observe other teachers' classes and provide feedback.	8	4	**18**	3	3
Meet in teams to collaborate about the teaching and learning of mathematics	6	2	14	9	5
Meet in teams to collaborate about the teaching & learning of science.	**17**	7	9	3	1
Discuss and coordinate homework expectations and practices.	13	6	9	4	3
Ensure common standards in assessing student learning/ progress.	6	5	11	9	5
Collaboratively discuss and develop formative assessments.	9	6	10	7	4
			answered question		**36**

Key findings for Question #2b: To what extent did MSA influence teacher content knowledge in mathematics and science?

Background: Researchers have found a striking parallel between U.S. teachers' knowledge of mathematics content and the performance of the students they teach. (Carnegie Corporation, 2010).

The National Council of Teachers of Math (NCTM) reports, "forty percent of elementary and middle school teachers of mathematics report that they do not feel qualified to teach the content that they teach." (NCTM, 2000). A teacher who lacks confidence and strength in the material can negatively impact the educational experience for students. Content knowledge is associated with confidence levels and new teachers will continue to be a focus of this type of research. Research shows that in recent years a lot of emphasis has been placed… on the role that subject knowledge plays in the classroom practice of primary teachers. "This knowledge has come to be seen as a major component of teacher expertise . . . one that underpins the ways in which teachers help children to develop understanding" (from Traianou, 2006, p.1-3).

The domain of *mathematical content knowledge for teaching* (MCKT) can be distinguished by both subject matter (e.g., number and operations, algebra) and the types of knowledge deployed by teachers. It is not only knowledge of content but also knowledge of how to teach content that influences teachers' effectiveness (Hill, 2008).

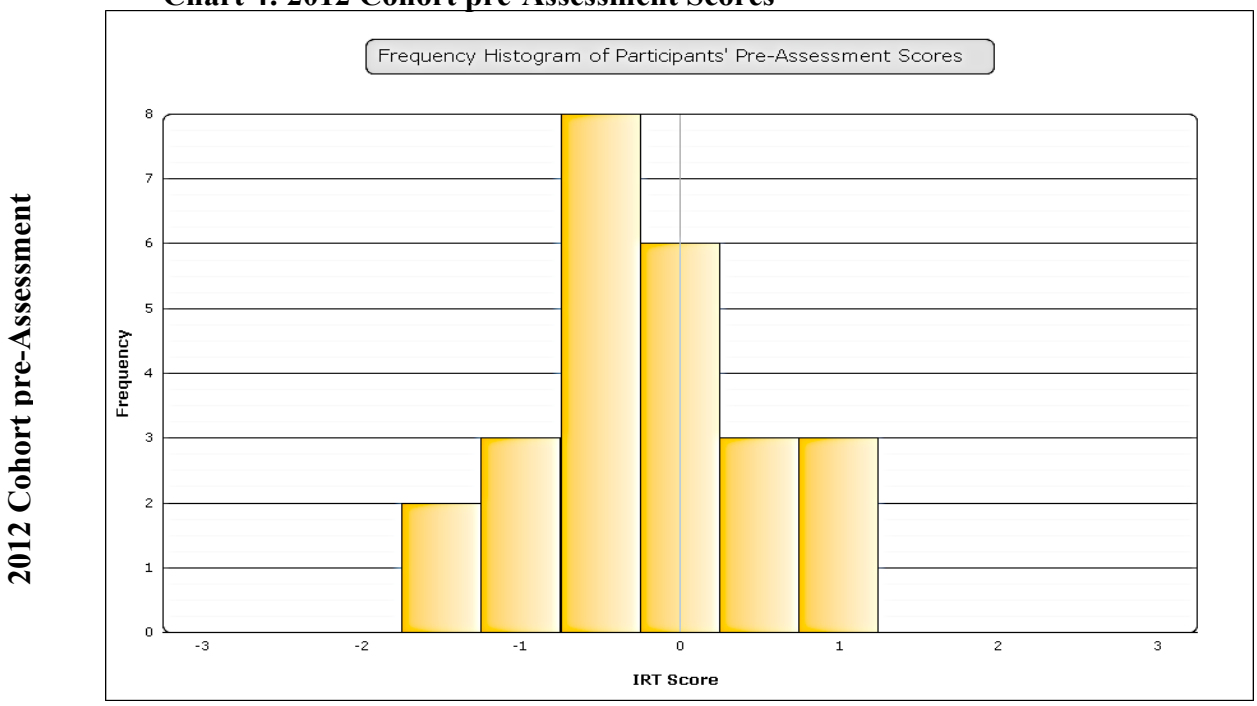
Teacher MCKT is assessed at the beginning of each MSA Summer Institute using the Learning Mathematics for Teaching (LMT) assessment, developed at the University of Michigan School of Education. It is designed to assess the mathematical knowledge needed for teaching, and how such knowledge develops as a result of experience and professional learning. The LMT is an instrument focused on "measuring the mathematical knowledge used in teaching: not only the content that teachers teach to students directly, but also the professional knowledge that helps support the teaching of that content." (LMT website, 2014).

Cohort 1 participants were given the LMT pre-assessment in the summer of 2012, a post-assessment in the summer of 2013, and a post-post assessment in the summer of 2014. Cohort 2 took the LMT pre-assessment in the summer of 2013, and the first post-assessment in the summer of 2014. Cohort 3 has only taken the pre-assessment.

- According to the LMT assessment, MSA participants continue to show gains in their mathematical content knowledge for teaching, as measured by the LMT assessment:
    - Cohort 1 started in 2012 and completed their third Summer Institute June 2014. Item Response Theory (IRT) is used to map their scores.[1] Their growth on the LMT shows a *change score* that is significant (Cohen's d = .4557, where anything above .3 is considered significant). As a group, they moved from a mean of -0.2513 (below large test sample group) to a mean of +0.2962 in the second year. There was a slight regression in 2014, although the group performed above the test sample mean, with +0.1801. Charts 4 and 5 indicate graphically how the mean has shifted to the right on the normal curve as teachers have been involved in the Summer Institute, the Ir-Rational Number Institute, and various coaching activities. The gain of roughly 2-3 items more correct responses on the post assessment is statistically significant, and is a promising finding.

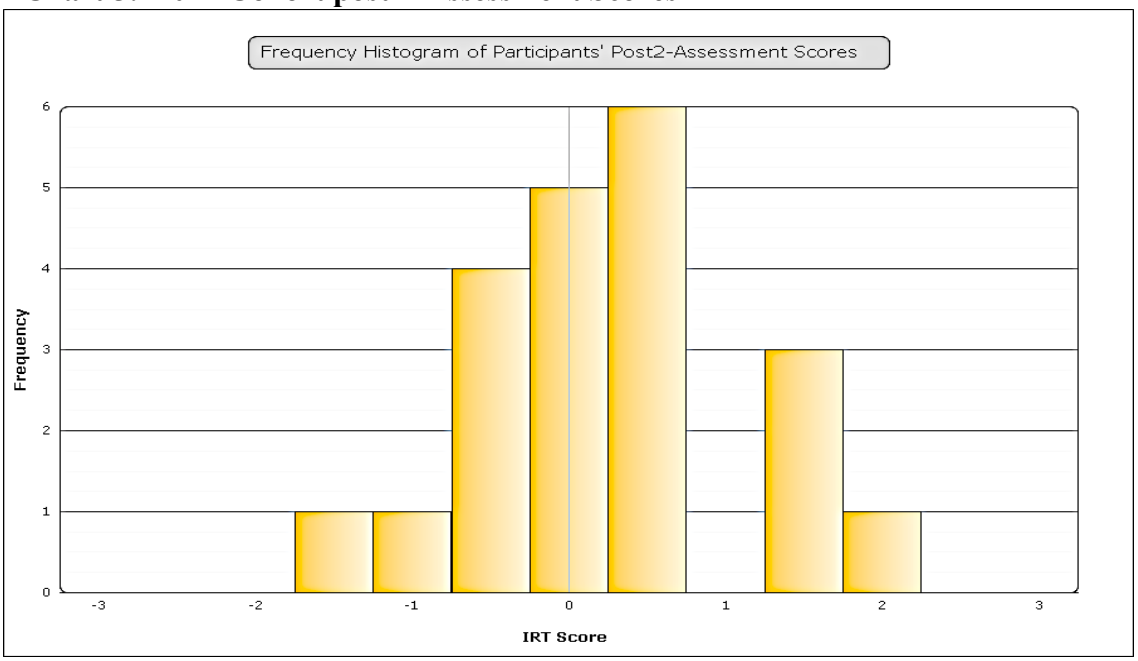
[1] The IRT score, calculated from normative data from the LMT pilot on over 2000 teachers, is used to indicate the degree of change in teachers' content knowledge for teaching. The first useful measure is the group mean, compared to the pilot mean.

Chart 4: 2012 Cohort pre-Assessment Scores



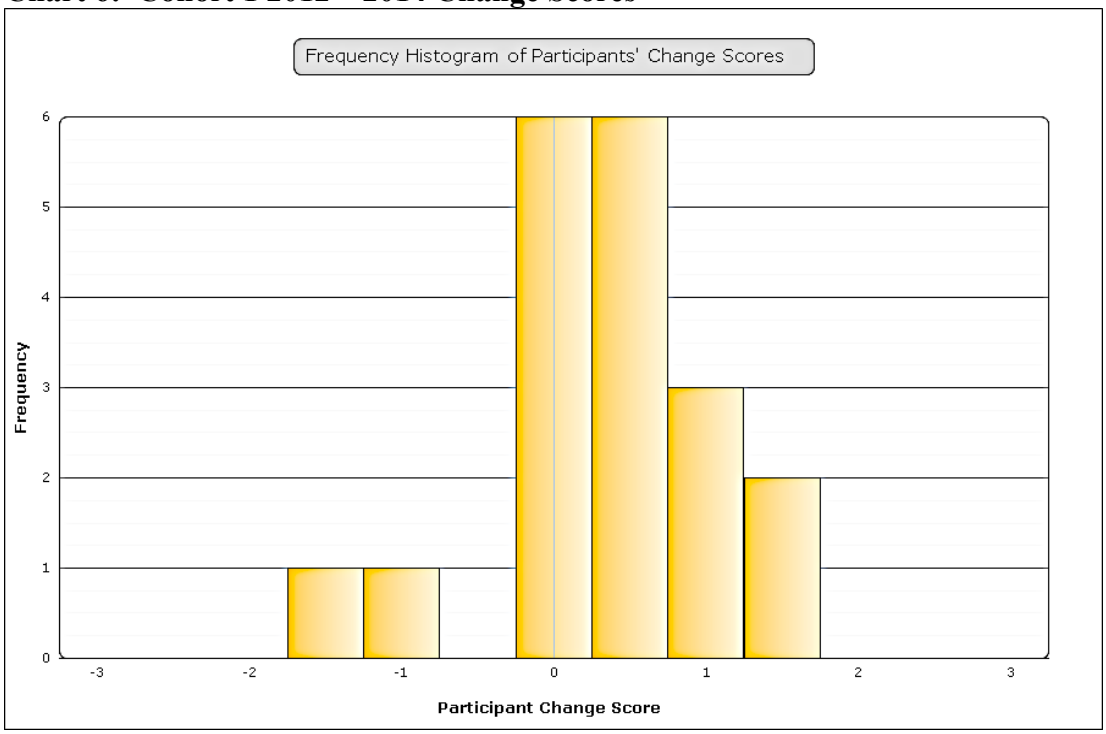
N	Minimum	Maximum	Mean	Standard Deviation
25	-1.4727	1.1542	-0.2513	0.7473

Chart 5: 2012 Cohort post2- Assessment Scores



N	Minimum	Maximum	Mean	Standard Deviation
21	-1.507	1.9417	0.1801	0.8218

Chart 6: Cohort 1 2012 – 2014 Change Scores



Descriptive Results for 2012 – 2014 Group Participants' Change Scores

N	Minimum	Maximum	Mean	Stand. Dev.
19			0.345	0.7052
Cohen's d (calculated with paired data) = 0.4557				

- Cohort 2 also shows growth in their content knowledge for teaching mathematics, although the change score is only Cohen's d = 0.1349, which is not at the significant level. They will be assessed again in 2015.

- For each of the cohorts, there is quite a range of scores, as shown in Table 5. Cohort 3 has the biggest range on the pre-assessment. The large range makes it a real challenge to reach all levels in a group training. The MSA team observed that some teachers were really struggling with the mathematics in the Ir-Rational Number Institute Fall 2013, so in the spring Institute, they broke the participants into two groups – one for K-3 teachers and one for 4-8 teachers.

Table 5: Comparison of Cohorts 1, 2, 3

Cohort #	Mean on Pre-	Mean on post1	Effect Size Cohen's d	Mean on post2	Effect Size Cohen's d	Range on pre	Range on post1	Range on post2
1	-0.25	0.30	.68 (large)	0.18	.46(med)	-1.4 to 1.15	-1.3 to 2.2	-1.51 to 1.94
2	-0.16	0.08	.135(small)			-1.3 to 1.0	-1.03 to 1.32	
3	-0.20					-1.7 to 1.44		

- Each of the cohorts started MSA with a mean below the sample mean. Cohort 1 had the lowest pre-assessment mean.

- The range of scores for Cohort 1 actually *increased* from 2012 to 2013. While there may be

a number of moderating variables responsible for this, it is worth considering that more attention is needed to address those participants with the weakest CKT skills. In the spring of 2014, MSA recognized that some of the variation was between primary and middle grade teachers, so they split the group into K-3 teachers and 4-8 teachers.

- Problems that presented the greatest challenge to participants were fraction problems that asked participants to choose a problem to represent computation with fractions. The following is an example of a problem that most participants answered incorrectly:

> Which of the following story problems could be used to illustrate 1 ¼ divided by ½ ? Select yes, no or I'm not sure for each example.
>
> - You want to split 1 ¼ pies evenly between two families. How much should each family get? (17 of 25 participants answered incorrectly. This is the one that confused most participants.)
> - You have $1.25 and may soon double your money. How much money would you end up with? (19 correct, 6 incorrect.)
> - You are making some homemade taffy and the recipe calls for 1¼ cups of butter. How many sticks of butter (1 stick = ½ cup) will you need? (18 correct, 7 incorrect.)

- Cohort 1 participants improved their understanding of fractions over the three years based on pre- and post1- post 2 responses to a question like the following.
    - Show on number line 7/16 x ½. (In the 2014 assessment, 11 responded correctly and only 4 responded incorrectly).
    - All saw that the number line representation could be used to show ¼.
    - All but one correctly compared 5/9 to 3/7. (Answered that 5/9 is greater because 5/9 is more than ½ and 3/7 is less than ½.
- In solving complex mathematics problems, participants heavily prefer procedures and algorithms over drawing models and using written language. In the Ir-Rational Number Institutes for fall 2013 and spring 2014, presenters Dr. Rick Kitchen and the MSA team worked with teachers to think conceptually about the mathematics using modeling strategies in order to to help teachers develop a deeper conceptual understanding of the mathematics they teach. On an assessment given in the spring of 2014 to Ir-Rational Number participants (see questions in Appendix ____), participants were asked to use images, language and procedures in their answers. For the six assessment problems, images were used about in only 27% of the solutions. Language was used an average of only 7% of the time, while procedures were used 65% of the time.
- In interviews and reflections, teachers reported increased understanding of mathematics concepts in ways that improved their instructional work with students.

> I've improved my own content knowledge. Now I feel that I can make adjustments to my teaching on the spot."
>
> I tell my students that 2 years ago I couldn't draw a model to save my life. But I understood that a lot of students understand through models. Connecting numbers to models really has deepened my understanding. And I see how to do it with kids.

> MSA is doing a fine job of hammering the point that my own content knowledge as a teacher will directly impact how I teach and the content knowledge that my students come away with from my teaching. After some time thinking about it, I am determined to do better and to learn more content.

- Participants felt that the MSA summer institute and the Ir-Rational Number Institutes helped them to better understand the new Common Core State Standards for Mathematics (CCSSM). In 2012, the National Common Core State Standards for Mathematics (CCSSM) were introduced. MSA devoted part of the 2013 and 2014 summer institutes to the CCSSM. For cohort 1 and 2, the MSA support made a very significant difference, with 65% reporting a great deal of improved understanding. For Cohort 1, who has had two full years of MSA, there was even greater impact, as reflected the comparison between Charts 7 and 8.

Chart 7: Cohorts 1 & 2

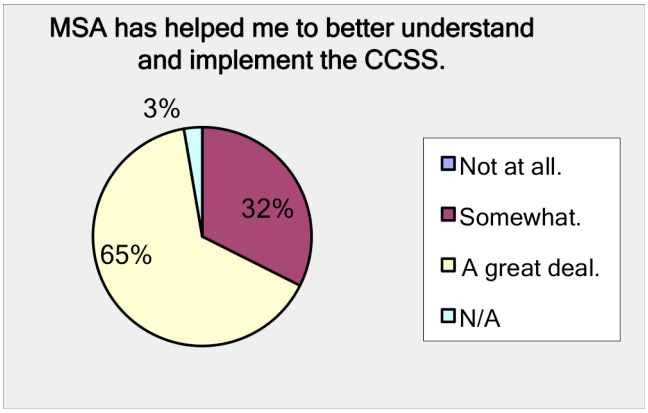
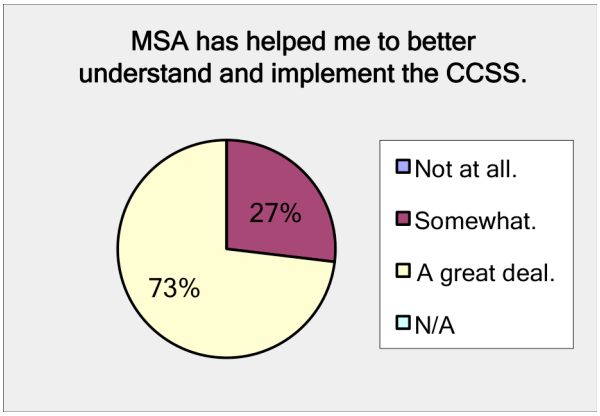


Chart 8: Cohort 1



> I'm glad we worked on common core standards and prioritize the standards to the grade level we teach.
>
> We appreciate the support and want more so we are able to keep up with the curriculum requirements especially with common core state standards.

- Teachers want more professional development that connects the common core with the curriculum. Individual teacher interviews revealed that teachers appreciated the attention to the standards, but want to continue to learn more through MSA.

> We want time to go through the books. Time to work with the lessons and the common core.
>
> I want MSA to work with me on Investigations fractions. Last summer we really worked hard on common core, but they need to make sure that we revisit that.

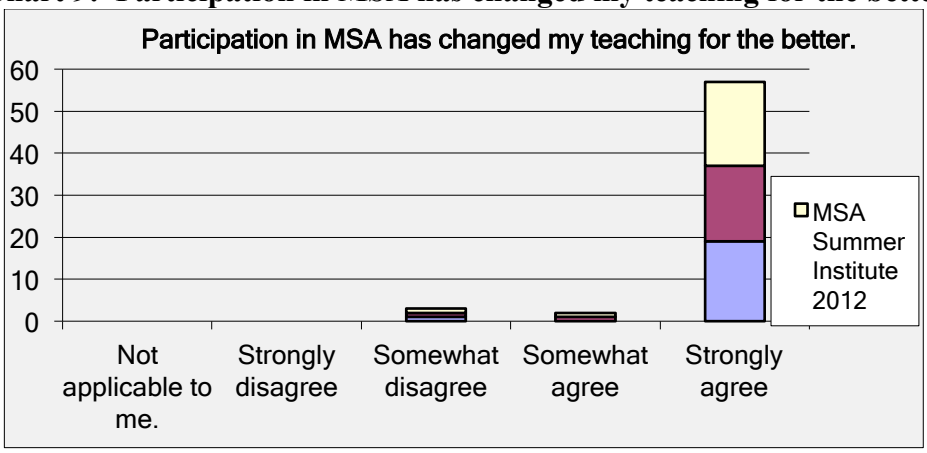
Key findings for Question #3: To what extent did MSA PD increase teachers' use of research-supported practices to conduct effective math and science lessons in their classrooms?

- Participants in Cohorts 1&2 report having changed their teaching practices as a result of MSA. Cohort 3 has not been involved long enough to respond. They also rate that those changes are for the better. Table 6 and Chart 9 give survey results for Cohorts 1 & 2.

Table 6 How would you rate your MSA experience?

Answer Options	Response Percent	Response Count
I have significantly changed my instruction of math/science.	31.1%	19
I have learned a lot, and I am beginning to apply my new learning to my classroom instruction.	21.3%	13
I have learned some new ideas, but I have not really changed much about my instruction.	3.3%	2
I participated but MSA has not really impacted my ideas or my teaching.	4.9%	3
answered question		37

Chart 9: Participation in MSA has changed my teaching for the better



We have seen our classrooms evolve. We have gone from rote memorization/ algorithms to more conceptual instruction. We work to explore how to get to the algorithm. When I first started with MSA, I was teaching the algorithm because that's the way I was taught. MSA has given us a way to teach more conceptually.
When I first started teaching middle school, they were so apathetic. When I got in Ir-Rational, I would give them a problem we had worked on in the Institute, and it would get them to thinking. I can now understand ways to bring in problems and have the kids try to find ways to solve them.

I can now understand ways to bring in problems and have the kids try to find ways to solve them.

Making them accountable for their learning is big. I have them report out, I make sure the learning goal is clear. That's a big part of my teaching.

You can also see if they can explain their thinking using the exit ticket. I stand by the door and ask them to read me their explanation before they go out.

I have students come up and show their work now. I draw a name stick and call up random students. If they are shy and can't talk through their explanation, I let them ask a friend to help. This means students know they can't opt out.

> We are keeping them engaged, asking each other questions and training them to listen. Setting up procedures and routines is important.

- Teachers learned a great deal about their instructional practices by having a lesson video-taped and then reflecting on the lesson with groups of their peers, using the GANAS form as a guide. They used the same video to talk about their teaching at the December MSA day and the May MSA Day. Most significantly, teachers commented that they saw how far they had come in their teaching. The following quotes are from the second video reflection:

> I was looking at things so totally different from October to May. So now I think about my teaching so differently!
>
> At first I was defensive when people were critiquing my teaching in my video, but as I watched the video again, I saw exactly what they were pointing out.
>
> In my head, I had already done it (given information), but I saw in the video that I didn't ask kids for a wrap-up.
>
> How efficient am I? What are the other students doing when I am working with a group. The video allows me to see that. And I want to know, did they learn what I taught them?
>
> I have changed so much as a teacher and when I look back at this video from October, I thought they got it, but now I see they really didn't.
>
> When I showed this video in December, I didn't see so much. I wasn't asking the questions that I am now.

- Four activities stood out in surveys and in interviews as having the greatest impact on improving teacher practice: 1) looking together at student work; 2) having a coach or a peer teacher observe in their classroom and then debrief the lesson; 3) observing another teacher teach a lesson, and 4) working in groups of their peers on actual mathematics or science problems. Table 7 reflects participants' ideas about what makes the most effective professional development for them. Interview data corroborates participants' interest in these four areas in particular.

Table 7: Most effective professional development activities

Which of the following professional development activities are most effective for improving your teaching practice? (Check all that apply.)		
Answer Options	**Response Percent**	**Response Count**
Working in groups of my peers on actual mathematics or science problems.	**23.0%**	14
Hearing from an expert on ideas for teaching mathematics or science.	13.0%	8
Training in the use of curriculum materials.	15.0%	9
Professional development where teaching strategies are modeled with students.	15.0%	9
Having a coach model in my classroom.	16.0%	10
Having a coach or peer teacher observe my lesson and then debrief.	**23.0%**	14
Observing another teacher teach a lesson.	**21.0%**	13
Watching a video lesson and then critiquing it with peers.	16.0%	10
Looking at student work with other teachers.	**25.0%**	15

- Three of the four "most effective professional development activities" were addressed at Cohort 1 schools through peer coaching and PLC's. As one principal stated,

  > The one piece that is so key is that when teachers observe really good teaching, they get ideas, and they know what it looks like. They do whatever it takes to move their teaching to a new level because they know that in two weeks everyone is coming in. The more the cycle continues, the better they feel about what is going on. IT is a positive competition. Teachers see what they are accountable for. They have a common language.

- The GANAS lesson framework has helped teachers to plan more inquiry lessons, as well as to bring common language to teacher collaboration and peer coaching.

  > I am making sure that I get those goals up. They are up. I am trying to follow the GANAS framework, including a summary.
  >
  > The GANAS lesson framework helps me remember I need to make time for the summary. I notice I put too much time in the launch and don't leave enough time for the students to explore and then summarize. I'm working on it.
  >
  > We use the GANAS form for planning our lessons and for our peer observations. It helps us all be on the same page and use the same language. The biggest benefit of GANAS is common vocabulary – launch, explore, summarize, etc.

- PD on using the "Model Method" for fractions changed teachers' instruction.

  > I got the model method Rick taught in Ir-Rational Numbers right away. It just made sense to me, so I have been using it with my students. I now have students who can solve a problem like: *4 students share ½ lb. of chocolate. How much does each student get?*
  > Now I have my students draw a model. One girl drew a rectangle and divided it up, explaining, "First I divide the candybar in half. Then that half is in 4 parts. Even though they don't have the other half, we split it into 4 parts too, so we had eighths."

- There are several instructional ideas addressed in the MSA trainings that teachers want more support with: the lesson summary, the ICFLP (images, language, procedures), writing in mathematics, and helping students to explain their thinking.

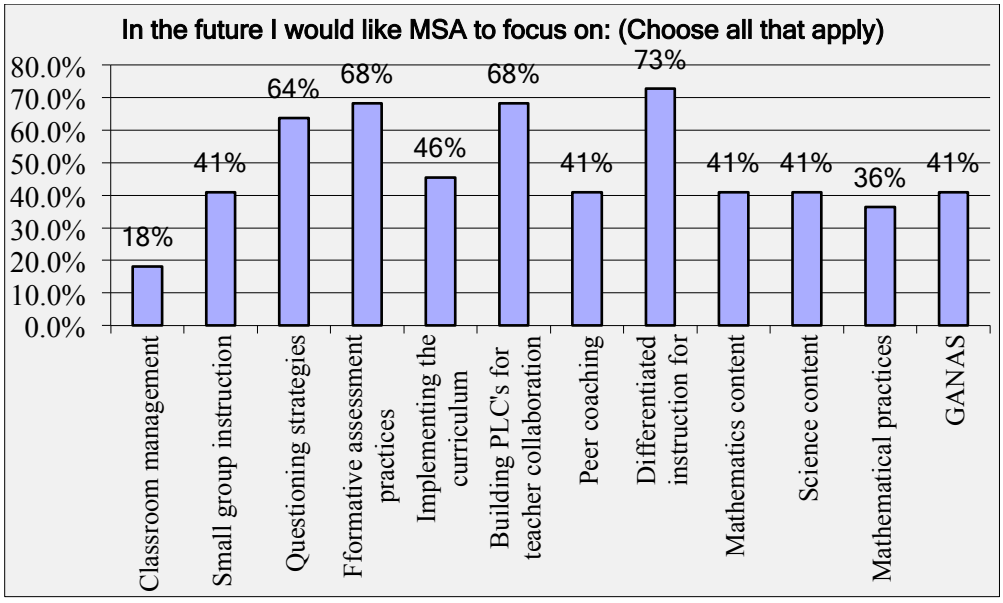
  > A big change is not just me just standing there teaching and giving them all the information. That's a big change for all of us where we have to give the kids control and make sure that they talk to one another and they're helping one another solve these problems and talk it out and discuss it and argue it out. Sometimes there are little arguments and they're all, "No, that's not how you do it . . . So that was a change. You always wanted them to do that, but I don't think I ever taught how to do it or expected them to do it all along. I would always want to rescue them and give them the answer. That's a big change in my teaching.

The summary is so difficult. I don't know why**. I could use having it modeled for me**. She (my coach) modeled it. I really think about it. Reading instruction is just like the GANAS, but I don't know how to do it for math. I forget to do the summary. I need to really take the time. IT is time. Not much time, but it is time.

The writing is really HARD. The math writing is really hard. It is the highest level of thinking. It is hard for kids to understand what to do. It is something we are working on. *It is really scratching the other side of the brain.*

- On a survey of all participants, teachers identified four major areas where they would like MSA to focus in the next year. 73% of teachers identified "differentiated instruction for struggling students" as the most critical area, followed closely by "building PLCs for teacher collaboration (68%), formative assessment practices (68%), and questioning strategies (64%).

Chart 10: Where teachers want to focus with MSA PD.



- Participants acknowledged that changing their teaching practices to align with what they are learning in MSA is a process that takes time, practice and support.

I really hope to put all the pieces of MSA together. In the first two years, I've implemented what feels like bits and pieces. This year I want to implement as many elements of MSA teaching as possible from GANAS to assessment on a regular basis.

- Jemez was the only school to receive targeted professional development in science. For 2012 – 2013, their first year, they requested to focus particularly on science. In the 2013-2014 school year, they asked MSA to focus on professional learning teams and peer coaching, looking at the teaching and learning of mathematics. Jemez teachers also participated in a Summer Science training during the summer of 2014, with a focus on science writing. There was no pre-post assessment given. A pre-post survey was used to learn about changes in the way participants thought about science instruction. 11 teachers completed both the pre- and post- assessments. There are some interesting findings related to the week-long training, as indicated in Table 8 below:

- Teachers gained confidence in the teaching of science and look forward to teaching it more after a week of training.

- Teachers gained a greater understanding of science concepts and of strategies for engaging students in thinking about science.

- Teachers rated their use of science kits lower after the week, perhaps because they realized what full use of the materials really entailed.

Table 8: Jemez Teachers Beliefs About Teaching Science.

What are your current beliefs/attitude about teaching science? (Check 1 for low thru 5 for high.)	μ Pre assessment rating	μ Post assessment rating
I am confident in my understanding and teaching of science concepts	3.18	3.72
I look forward to teaching science each week.	3.63	4.1
I understand science concepts well enough to be effective in teaching them.	3.0	3.63
Students learn science best through teacher explanations.	2.45	2.5
I know strategies for engaging students in thinking about science.	3.18	3.72
I fully use the science kits.	4.1	3.8

Key findings for Question #4: To what extent has the MSA program had an impact on systemic reform and capacity building of mathematics/science teaching and learning in the local school district and school unit?

Over the years, the MSA team has realized the importance of building school-based leadership that supports professional growth and continuous improvement. Research has shown the importance of school leadership to design systems that support teachers and to hold them accountable for reforms such as those emphasized by the MSA professional development. School based leadership is needed to sustain the reforms that are begun with MSA involvement. In 2013-2014, MSA worked with school leaders and the BIE Education Line Officer to build systems to support the MSA efforts: full participation by all teachers and the principal; alignment of classroom observations with the GANAS form used by MSA; and the establishment of weekly professional learning communities (PLCs) and peer coaching for teachers.

- The expectation that all teachers and principals will participate in MSA professional development is seen as an important school improvement factor.

  I am understanding that they (MSA) want us . . . and it only makes sense that we become the leaders and we take care of each other. Very soon our principal will be leaving, we have improved, and now it is up to us to maintain and not let the ball drop. Because our leader is changing, we have to sustain the growth.

Before (MSA), I was happy just being in the classroom and looking from a classroom perspective. Now in the leadership cohort I have to look at the bigger picture – how everything fits together. This has been an eye opener. I really see how the whole school is impacted. We are more accountable because we see the bigger picture (participant in MSA master's leadership cohort).

I feel that we've taken on a lot this semester, peer coaching, Ir-Rational #'s – all of it. Then we talked about how we can do this on our own when MSA is gone. They (MSA) are creating a lot of leaders. We are learning how to coach each other and work together. We're becoming the leaders.

- Principals with whole-school participation believe that MSA has changed the teaching and learning at their schools.

With their (MSA) modeling – we have improved on rigor and predictability. We do math at the same time every day. We have routines that we follow. Our kids know consistency with the help of MSA, consistency with using GANAS. That consistency – the way the brain operates, it's very important for student growth, this predictability. The foundation is solid (principal participant in focus interview May, 2014).

- School-wide use of the GANAS form to guide classroom lesson planning, principal observations, peer observations, and video reflections has enhanced the learning and implementation of new instructional strategies as well as accountability to continuously improve.

This is our first year. Initially I thought it (the goal) was to implement the GANAS within our classroom. After today (May MSA Day) I am understanding that they want us . . . and it only makes sense that we become the leaders and we take care of each other. Very soon our principal will be leaving, we have improved, and now it is up to us to maintain and not let the ball drop. Because our leader is changing, we have to sustain the growth.

The GANAS framework, I think about those aspects when I go through my lesson and my lesson planning. You have to get to a summary – close it out in a way that can wrap up the concepts, or can carry on or a way that is meaningful.

- In 2013-2014, MSA began to focus on facilitating professional learning communities and peer coaching in Cohort 1 and 2 schools. They supported full implementation in one Cohort 1 school – Jemez Valley Elementary. The other Cohort 1 & 2 schools are expected to fully implement them in the fall of 2014.

- The combination of facilitated PLC's and peer coaching have had a profound impact in creating a culture of professionalism, support and accountability. The combination of discussing lesson objectives, observing one another, and offering constructive criticism has enhanced teachers' understanding and implementation of strategies and concepts presented in MSA.

People in MSA are more excited and talk math more than the ones who aren't in MSA.

Having everyone involved will raise expectations and help with routines throughout the school.

- The success of the PLC/peer coaching work has hinged on good facilitation and structure. Participants spoke of the important role of the MSA coach as facilitator. "We need someone to drive it – to focus it. It didn't work at my other school with teachers running it." Teachers appreciate that their peer coaching discussions and the PLC's have a specific format. But there was also a recognition that there is a need to build capacity in the school for facilitation and structure. "We are not going to have our MSA coach forever, so we have to build capacity. As a coach, my principal wants me to be in the PLC alongside the MSA coach, since I will eventually be the facilitator."

- One school, Jemez Valley Day School, provides a case study (Appendix __) for how supportive systems and structures in the school community provided a fertile environment for enhancing the potential for MSA to impact teacher practice and student learning over time. During the 2013-2014 school year, an MSA coach facilitated highly structured professional learning communities that met twice a month. In addition, the coach facilitated peer-coaching, which included a pre-conference where the teacher in focus that week presented the mathematics lesson objectives to a team of teachers. Then the team went to watch the lesson. In the post-lesson review, the team followed the GANAS framework to debrief the lesson.

Key findings for Question #5: To what extent did MSA support and influence student learning/achievement in teacher participant classrooms, schools and districts?

Linking professional development programs to student outcomes is difficult, as there are so many moderating variables to consider. A large meta-study (*Reviewing the Evidence on How Teacher Professional Development Affects Student Achievement)* reviewed more than 1,300 studies identified as potentially addressing the effect of teacher professional development on student achievement in reading, mathematics, and science (Yoon, et al. 2007). Only *nine* met the What Works Clearinghouse evidence standards, attesting to the scarcity of rigorous studies that directly examine this link. At best, most studies can show the direct affect on teaching practices and an indirect affect on student learning.

In an attempt to determine the effectiveness of current instructional practices on student learning in MSA schools, and to inform future efforts of MSA, four types of student achievement/learning data were analyzed for this evaluation report: 1) grade-level proficiency rates on the NM Standards-based Assessment (NMSBA); 2) yearly growth, by grade level, on the NWEA short-cycle assessment, given three times a year; 3) evaluator observations of student work in MSA classrooms; and teacher/principal interview data and reflections on changes in student learning.

Proficiency on the NMSBA and the NWEA Assessments

- Each of the participant school collects student achievement data using two standardized assessments: the NM Standards Based Assessment (NMSBA) and the NWEA short cycle assessments. For this evaluation, access to the data for these assessments was a challenge. The evaluator was given access codes for the school data, but the data was not analyzed or

summarized. Only one school – Jemez Day School – had data presentations for the past three years. This is an important finding because it indicates that schools are not analyzing and synthesizing data for use with teachers for continuous improvement. Teachers see their NWEA data, but not data trends. "The school leadership team goes through the data review, but not all the teachers." (IT coordinator, Jemez Day School, Sept 2014.)

- NMSBA proficiency scores for each school by grade are available for looking at growth over time. However, using the growth data to assess the impact of MSA professional development on student achievement is deemed unreliable at this point. There are three reasons the NMSBA data is not reliable for evaluating impact:

  1. In 2013-14, the NMSBA was changed to follow the Common Core State Standards, while New Mexico teachers continued to address the older New Mexico State Standards. Therefore the assessment changed but the teaching goals did not. And again in 2014-15, there will be a new state test, the PARCC Assessment, which means growth scores will be difficult to align to the NMSBA.

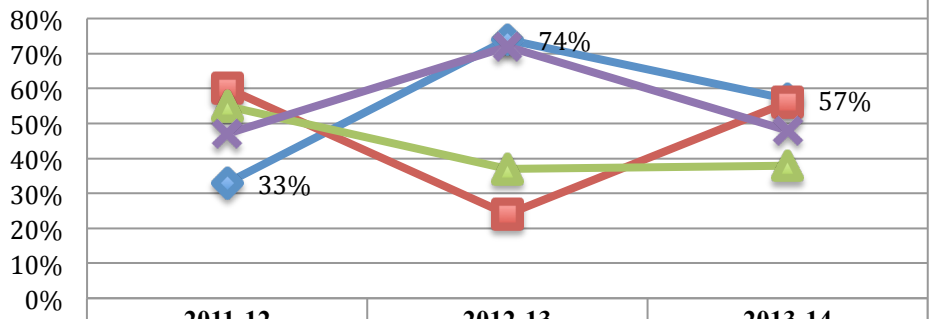
  2. For several of the participating schools, the number of students in each grade is too small to provide reliable trend data. As with the NWEA, if two students on either end of the range do not matriculate to the next grade, the data could be significantly skewed.

  3. Several teachers in the participating schools have changed grade levels during the past 3 years, so their MSA involvement cannot be correlated to 3-year growth data.

  3-Year NMSBA data from the two cohort 1 schools and the NM state average is reflected in the three charts below. While not useful for evaluating how MSA participation contributes to high stakes achievement outcomes, it is interesting to note the significant change in each grade over the three years. At Jemez, for example, 4th grade dropped over 35 percentage points from 2011-12 to 2012-13, and then the next group of 4th graders with the same teacher jumped back up over 30 points.

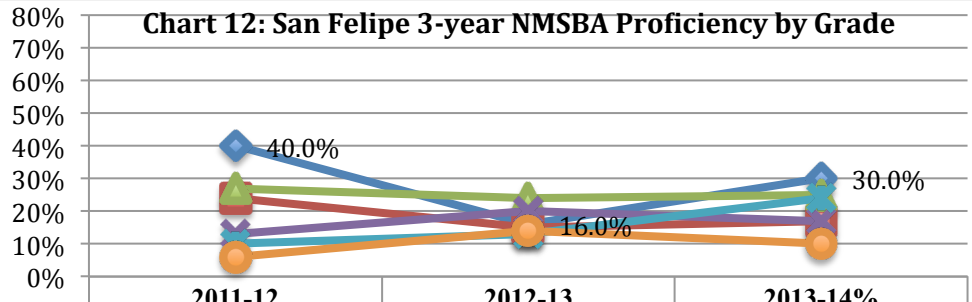
- The two schools in Cohort 1 show markedly different levels of student proficiency. Jemez Valley students performed above the New Mexico state average, while San Felipe consistently performs below. The three charts below reflect fluctuation over 3 years.

Chart 11: Jemez 3-year NMSBA Proficiency Data by Grade



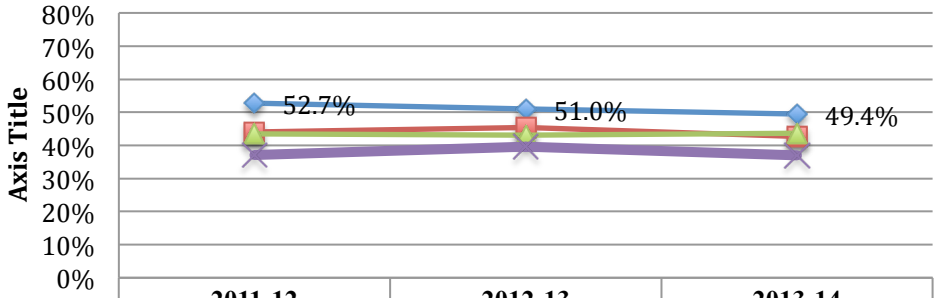
	2011-12	2012-13	2013-14
Grade 3	33%	74%	57%
Grade 4	60%	24%	56%
Grade 5	55%	37%	38%
Grade 6	47%	72%	48%

Chart 12: San Felipe 3-year NMSBA Proficiency by Grade



	2011-12	2012-13	2013-14%
3rd	40.0%	16.0%	30.0%
4th	24.0%	15.0%	17.0%
5th	27.0%	24.0%	25.0%
6th	13.0%	20.0%	17.0%
7th	10.0%	13.0%	24.0%
8th	6.0%	14.0%	10.0%

Chart 13: NM state 3-year proficiency data by grade



	2011-12	2012-13	2013-14
3	52.7%	51.0%	49.4%
4	44.0%	45.4%	42.7%
5	43.5%	43.1%	43.7%
6	37.1%	39.6%	37.0%

- If there are fewer than 11 students with valid test data, the NWEA Academic Growth over Time (AGT) model does not report a result for this group of students. This is due to several reasons, including privacy concerns for identifying individual students, and very large confidence intervals because of lack of data available to evaluate the growth of small student groups. (Battelle for Kids, 2014).

- The three charts below present NWEA end-of-year RIT[2] means for three schools. Jemez and San Felipe are Cohort 1 schools, and T'siya is a Cohort 2 school. In examining the data, it became clear that it is not reliable for discerning the impact of MSA professional development on student achievement because the small numbers in each grade. As an example of why it is hard to evaluate growth data for a grade level, consider the 3rd grade at T'siya, highlighted in Table 9, below. The number tested in the 3rd grade changed from 11 in 2012 to 5 in 2013, to 9 in 2014. For 2013 – 2014, the 3rd grade class had an End of Year score percentile range from 1% to 78%. So imagine if the next year, when only 5 students were tested, the child who scored in the 78th percentile moved away.

Table 9: T'siya Day School 3-Year NWEA Data, 2011-2014

Grade	N 11-12	EOY Median 11-12	N 12-13	EOY Median 12-13	N 13-14	EOY Median 13-14	NWEA EOY mean
Grade K	8	158	14	155	11	155	159.1
Grade 1	9	169	7	178	12	173	179.0
Grade 2	4	173	8	182	8	185	191.3
Grade 3	11	192	5	187	9	190	203.1
Grade 4	8	198	8	209	6	191	212.5
Grade 5	8	203	5	204	8	211	221.0
Grade 6	7	208	7	224	6	205	225.6
Grade 7	6	211	7	211	8	223	230.5
Grade 8	7	219	6	222	8	221	234.5

Table 10: San Felipe Day School 3-Year NWEA Data, 2011-2014

Grade	N 11-12	EOY Median 11-12	N 12-13	EOY Median 12-13	N 13-14	EOY Median 13-14	NWEA EOY mean
Grade K	49	159	34	160	52	159.5	159.1
Grade 1	45	175	46	176	35	180	179.0
Grade 2	54	183	41	184	40	181	191.3
Grade 3	49	194.5	58	193.5	43	194	203.1
Grade 4	47	202	55	202	47	203	212.5
Grade 5	48	210	51	213	59	210	221.0
Grade 6	62	214	50	214	53	214	225.6
Grade 7	29	217	38	211	34	215	230.5
Grade 8	17	220.5	30	216	31	214	234.5

[2] The RIT Scale is a curriculum scale that uses individual item difficulty values to estimate student achievement. An advantage of the RIT scale is that it can relate the numbers on the scale directly to the difficulty of items on the tests. In addition, the RIT scale is an equal interval scale. Equal interval means that the difference between scores is the same regardless of whether a student is at the top, bottom, or middle of the RIT scale, and it has the same meaning regardless of grade level.

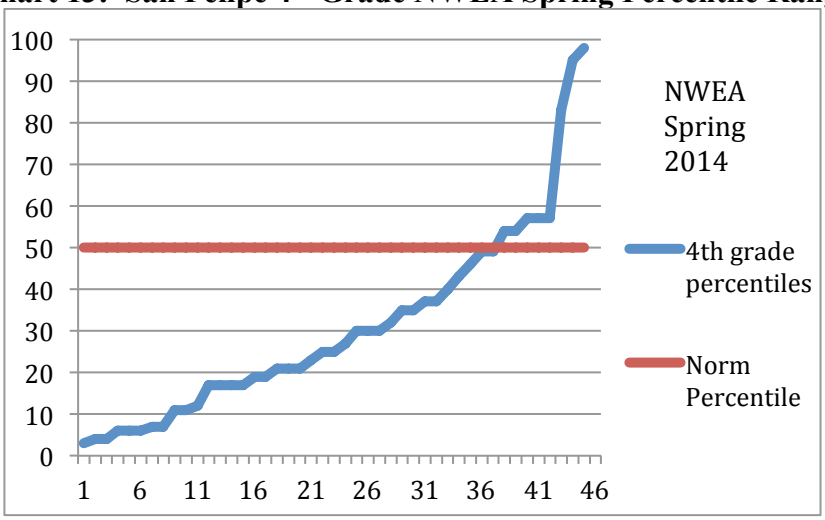
Table 11: Jemez Day School 3-Year NWEA Data, 2011-2014							
Grade	N 11-12	EOY Median 11-12	N 12-13	EOY Median 12-13	N 13-14	EOY Median 13-14	NWEA EOY mean
Grade K	11	154		156	18	164	159.1
Grade 1	12	177		171	24	175	179.0
Grade 2	8	189	22	183	24	190	191.3
Grade 3	9	197	19	204	23	199	203.1
Grade 4	21	216	21	201	18	213	212.5
Grade 5	20	223	22	218	20	214	221.0
Grade 6	17	226	19	229	21	219	225.6

The only way the data might be useful for indicating the impact of MSA is if it were disaggregated by student to see individual student growth, and then triangulated with formative assessment classroom data like end of unit assessments and samples of student work.

An additional concern with evaluating the impact of MSA professional development on student achievement using the NWEA is that the NWEA assessments were re-aligned to the Common Core State Standards in 2012-13, while New Mexico teachers were still teaching to the New Mexico State Standards. New Mexico switched to the Common Core in 2013-2014. Because of changes in the relationship of the assessments to what was being taught, it further raises concerns about reliability of the data.

A more useful look at the NWEA data for each school would be to look at individual student growth, which is beyond the scope of this evaluation. But in disaggregating the data, some interesting themes emerged. First, teachers have students who perform across a wide range of abilities – from the 2nd[s] percentile to the 98th[th] percentile in a 3[rd] grade class of 46 students, as shown in Chart 13, below. Second,

Chart 13: San Felipe 4[th] Grade NWEA Spring Percentile Range



- It is more reliable to use the NWEA data to look at individual student RIT gains over the year, from fall to spring. Teacher interviews and observation data indicate that some teachers have looked at NWEA data for their students and can report significant student growth. They attribute this growth to their MSA experience.

  I have not seen growth in my students like I did this year of MSA. My 6th grade student growth on the NWEA was 15 – 20 points! And they are only supposed to make an average of 3-4 point gain! One student came in really low – at 201 points (12th percentile for fall). He just tested at a 225 (48th percentile for spring). That's one short of proficient for 6th grade. That's amazing.

- Students in MSA classrooms are using math journals to write about their problem-solving, and then referring to their journals to explain their reasoning to the class. This was observed by the evaluator in the classrooms of four MSA teachers, two in each of the Cohort 1 schools. Teachers report that their students are now more likely to use drawings and models to help them problem-solve.

  I saw a big improvement in students' ability to communicate verbally and in writing. Having to explain thinking was so important.

  Explaining their thinking and working through problems together has really been a big change. In terms of their understanding, I think they're able now to make a lot more connections and retain the information a lot more. Sometimes you have to still prompt them, but compared to previous years when I taught math . . . their retention, and even generalizing the material and the skills has improved.

  They've been able to attempt the problem with some of the models that they learned. They know that 'well maybe if I try it this way maybe I could' – and they are able to at least attempt it.

- Teachers were able to articulate important changes in student learning and the development of student conceptual understanding in mathematics. They attributed this change to changes in their instructional practices using MSA strategies and ideas.

  My students have grown so much this year. They didn't know part/whole, and that's 4th grade! But now they divide and multiply with fractions!

  I will call students up to the front to verbally explain what they have done. You don't have to pull teeth anymore. Any one would getup and make an effort to explain their thinking. How they came to a certain answer.

  One of my big successes, related to the GANAS framework, was after the summer science notebooking training. I had the kids do a lot of conclusion writing. That spilled over into reading and math. That was a big focus – how valuable it can be – I saw a big improvement in their ability to communicate verbally and in writing. Having to explain thinking was so important.

Key findings for Question #6: How can the MSA program be refined to continuously improve and enhance teacher professional development, administrative leadership, and student learning

and achievement in Northern New Mexico schools?
MSA provides a comprehensive approach with a combination of intensive training sessions like the Summer Institute and the Ir-Rational Number Institute, as well as job-embedded year-round support to implement new learning in the school/classroom. In a review of findings from recent research on effective professional development for teachers, Desimone (2008) listed the characteristics of high-quality professional development. MSA professional development meets each of these criteria:

- offered for a longer duration and greater frequency (3 years);
- involves teachers directly for more hours in active, engaged learning activities and environments (ongoing professional support during the school year);
- focused on a particular content area, (mathematics and science);
- teachers gain knowledge on how to teach the content to their students (modeling, videos, peer coaching);
- coherent to teachers' needs and circumstances (aligned with CCSS and curriculum);
- involves teachers learning from their peers through collective participation (PLCs and peer collaboration).

Desimone also described how effective management and implementation of professional development programs and activities insure that high-quality professional development will work with sufficient supports in a sustained manner with the maximum of effect on teachers. Putting what research has defined as the characteristics of high-quality professional development together with research findings on effective education reform models, Desimone offered six suggestions for improving evaluations of professional development. Again, MSA professional development has these characteristics:

- Include a focus on subject-matter content (Ir-Rational # Institute, Science content weeks, Math content weeks).
- Use a conceptual framework (see Appendix ___).
- Account for state and district policy (working with BIE Education Line Officer and school principals.
- Use self-report surveys that are focused on specific teacher behaviors, activities, and practices (annual survey, topical surveys, self-reflection).

- The use of the GANAS framework across all MSA activities, as well as the facilitation of PLCs in the schools has helped to make the discrete elements of the program more fluid and connected.

- Three full years of MSA, with the intensive training institutes and the job-embedded coaching and PLC facilitation, is critical for changing teaching practices.

> This PD hasn't been one that you take the binder and put it on the shelf and no one comes to follow up. You really use what you learn.

Wait for the next summer. Once we got to the second summer, it all begin to click in. One thing that I've learned is to think of it as a process.

- Continuing to expand the understanding and implementation of the PLC and peer coaching processes using best practice frameworks is critical to building a school culture that continually focus on improving student learning. It is through the PLC and peer coaching process that the MSA experience will be sustained.

- Over the past several years, MSA has increasingly modeled the strategies they hope teachers will use with students. For example, a best-practice strategy for students to more deeply understand mathematics concepts and to problem-solve is to use images or "models" and language. Many teachers expressed that this is a new way to approach mathematics problems, as they were trained using procedures/algorithms in their own experience. Therefore, it is important for MSA trainers to have teachers use models and language in their own learning of mathematics.

- Designing student interventions is a challenge reported by participants substantiated by the NWEA data that shows a huge range of proficiency within classrooms. Teachers need strategies to help address students who are performing more than two standard deviations below or above the norm.

- Although MSA has emphasized the importance of having students problem-solve using images or "models" and language as they solve problems, teachers themselves do not regularly do more than the procedure/algorithm in their own problem-solving. In their work with teachers, MSA needs to hold participants accountable for using all three in their problem-solving: models, language and procedures.

- Interviews, observations and teacher reflections often referred to the importance of all teachers using common language, both in the classroom for instruction, and in professional learning communities. "We need to do a better job of having our students use the vocabulary. They won't remember something like "simplify" on a test if we don't make them use it." And "Teachers using shared common language elevates our practice."

- Some of the non-school-based MSA activities are reaching almost all participants, including the three-week Summer Institute, Math Week, the Ir-Rational Number Institute. Which schools/participants are involved in other activities appears to be dependent upon the coach working with that school and school requests. For example, not all participants had coaching in math writing, science was only a focus at one school, PLC's and peer coaching were heavily emphasized at only one school.

- Based on teacher reports and the MSA Survey data, impact on teachers' beliefs/attitudes, their content knowledge for teaching, and their instructional practices is greatest when the training and job embedded supports are combined with highly structured weekly PLCs and regular opportunities for peer coaching.

- Focus on a smaller number of "big ideas". With the MSA focus on developing content knowledge and pedagogy, there is a lot of new learning for teachers. For participants, more is not necessarily better. They need reinforcement of strategies and concepts practiced in

training, such as using the GANAS form for lesson planning, implementing formative assessment practices. All activities and materials should reinforce and support the practices teachers are learning to implement. Participants assimilate the new learning from MSA trainings best the training focuses on a smaller number of big ideas, like collaborative work and the GANAS form. The MSA training, including the summer institute, Ir-Rational Number Institute, and Math Week, has emphasized formative assessment in the classroom.

- The MSA efforts to incorporate the GANAS form into all of their professional development activities has helped participants to grasp more deeply the fundamentals of inquiry teaching and learning. IT has created a central framework for all MSA PD activities, and for the school-based PLC work. Additionally, it has provided a common language for participants as they discuss instructional practices.

- The development of a Massive Open Online Community for MSA is already showing signs of being a useful resource. Teachers have begun to post their reflections related to MSA activities, and in 2014-15 they will be able to access courses that reinforce the ideas/concepts from Ir-Rational # Institutes, and access documents introduced in the trainings, such as PLC frameworks, the GANAS framework, etc.

- It is important that teachers begin to have access to the data the evaluation process is collecting.

- Measures of student learning and achievement that are classroom and curriculum-based would provide more reliable data about student growth than the NMSBA or the NWEA. Teacher-developed unit assessments including common formative assessments using rubrics, as well as student notebooks/portfolios, can be used to triangulate student achievement data in evaluating the impact of professional development on student achievement. Systematic assessments and analysis of the student performance data using a standardized rubric will require support and an accountability structure.

- Time is a continual challenge for the MSA participants. Time challenges include time to plan lessons according to the GANAS framework and the CCSS; time to fully implement an inquiry lesson; time to attend Ir-Rational Number Institutes and the Summer Institute. A third-grade teacher explained, “I hate to leave the classroom for professional development, and I don’t want to take up more time from my family on weekends. It is hard because there is a lot we can learn.”

CONCLUSIONS

MSA provides professional development that is consistent with research on effective professional development. They provided opportunities for teachers to focus on what students are to learn consistent with the CCSS, and how to deal with the problems students may have in learning the subject matter. They focused on research-based knowledge about student learning of content. They included opportunities for teachers to examine student work collaboratively - and in relation to standards for what the students in question should know and be able to do. They led teachers to actively reflect on their practice and compare it with high standards for professional practice. They engaged them in identifying what they needed to learn, and in planning the learning experiences that would help them meet those needs.

The MSA activities are increasingly planned so that they included activities that strengthen interaction and collaboration in the school – the level of professional community activities like peer coaching and looking together at common formative assessments and resulting student work. They included activities that led teachers to de-privatize their practice and gain feedback about their teaching from colleagues. They provided time for teachers to test new teaching methods and to receive follow-up support and coaching in their classrooms as they faced problems of implementing changes.

The impact of professional development on actual instructional practices and student learning outcomes is difficult to show in a two-year time frame. However, we are more confident about the measures of impact on practice. The quantitative and qualitative data available from surveys, interviews and observations show that MSA has had a significant impact on teacher practices. Recent studies indicate that it is reasonable to place confidence on surveys and interviews that rely on teachers' reports about their practice. Teachers are not reluctant to speak their minds frankly when it comes to assessing the value of professional development programs. There is little reason to think that their responses might be biased one way or another (Ingvarson, Meiers and Beavis, 2005).

The evaluation for 2014-2015 will include data in each of the categories of the MSA Logic Model, adding data on the use and importance of the MOOC, the iPads, and the Cohort 3 participants. MSA is continually using data to formatively assess and modify their professional development to best meet the needs of participants and schools. It will be exciting to see the continued growth.

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APPENDICES

Appendix 1: Ir-Rational Number Survey Assessment Questions Spring 2014

Directions: Solve the following problems using **Images, Language, and Procedures** to demonstrate your solutions.

1. Dunearn Primary school has 280 pupils. Sunshine Primary school has 89 pupils more than Dunearn Primary. Excellent Primary has 62 pupils more than Dunearn Primary. How many pupils are there altogether?

2. At a sale, Mrs. Tan spent $530 on a table, a chair and an iron. The chair cost $60 more than the iron. The table cost $80 more than the chair. How much did the chair cost?

3. A cow weighs x kg more than a dog. A goat weighs 1 ½ times a dog. A dog weighs 80kg. The animals weigh 600kg altogether. How much does a cow weigh?

4. A tank of water with 171 litres of water is divided into three containers, A, B and C. Container B has three times as much water as container A. Container C has 1/4 as much water as container

5. A school bought some mathematics books and four times as many science books. The cost of a mathematics book was $12 while a science book cost $8. Altogether the school spent $528. How many science books did the school buy?

6. Federal standards require the angle ramp for wheel chairs to be less than five degrees (5^0). If the length of a ramp is 20 feet and the vertical rise is 15 inches, does it meet federal standards?

N = 20	Q #1	Q #2	Q #3	Q #4	Q #5	Q #6
Correct Responses	13	10	10	8	10	0
Procedures Used	19	13	13	10	13	6
Images drawn	6	5	2	9	10	0
Language used	4	3	1	1	0	0

Appendix 2: Case Study of Jemez Day School, Jemez Pueblo NM.

Jemez Valley Day School is an example of a school where many important systemic reforms were put in place to support the MSA learning. There were several moderating factors that helped to make Jemez Valley Day School well-positioned for the reforms. First, the school leadership has been stable, with the same principal for 13 years. They had a math coach (whose position was cut for the 2014-2015 school year) who could help organize structural supports for job-embedded learning to take place. And the principal found funds to hire a cadre of Instructional Assistants to take over the classroom when teachers were involved in professional learning communities and peer coaching.

With such systemic structures to support professional learning, MSA coaching focused on the facilitation of professional learning communities and peer coaching, teaching the staff how to support one another in the use of the GANAS framework to plan, implement, and reflect on a mathematics lesson. The school began the program in 2012, with all teachers, the coach, and the principal participating. Teachers were expected to attend all MSA activities, but were also compensated at their hourly rate for any time in professional development outside their duty day. The two charts, below, reflect data from a survey given to Cohorts 1 & 2. A comparison indicates that Jemez teachers feel that the school systems give a great deal of attention to their professional growth, providing a culture where they are supported to practice what they are learning in MSA (reflected in the comments below the charts).

Chart _____: Jemez Day School

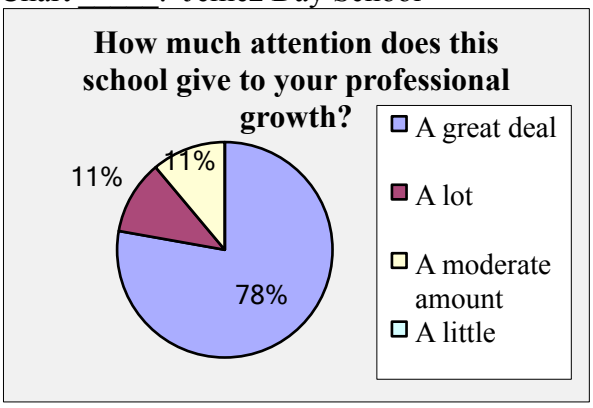
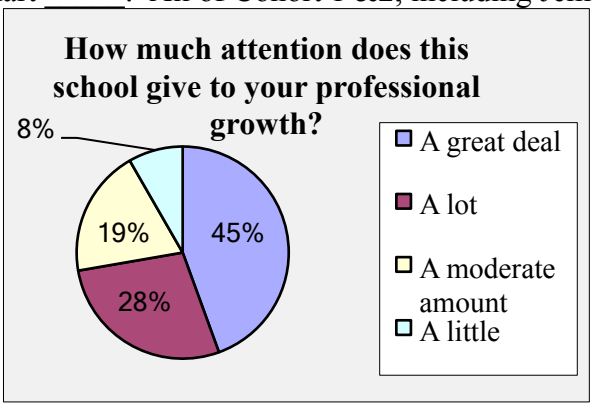


Chart _____: All of Cohort 1 &2, including Jemez



MSA has provided focus and direction for Jemez Day School. They (MSA) are a catalyst for continued improvement.

We hold each other accountable. The opportunity to have teachers work together creates a level of professionalism I have not experienced thus far."

Peer coaching and PLC's have really opened up everyone's door, everyone's mind.

We look at everything vertically now. 1st grade knows what 2nd grade is doing, 3rd grade knows what 4th grade is teaching, and on up.

In peer observations, we are walking away with tons of strategies, as well as giving constructive criticism.

I have felt tired after nearly 4 weeks of professional development, but I certainly felt energized this afternoon when we met as a school. It was a great feeling to see the focus

> and determination in each of our colleagues. We laugh a lot, so it seems like we're slacking but over time we have aligned our collective focus for our school. This allows us to get right down to business. We understand what our mission and vision is and what it entails in its simplicity. That's likely why I feel so capable of accomplishing much this year. It's because I know I have the support of my team and they know I've got their back also.

During the 2014 Summer Institute, one of the Cohort 3 teachers, new to MSA, reflected on a session where she sat with teachers from Jemez. This participant's comment indicated that the Jemez teachers have become peer coaches and take a leadership role.

> I was glad the Jemez teachers were present for this session. They were able to articulate their thoughts and clarify the pre-conference and teaching components. Poquin expressed that peer coaching did make a significant difference in her school setting - allowing her to expand and refine her teaching instruction and models.