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COLORADO
Department of Education

Key Findings from Colorado's Mathematics and Science Partnerships Evaluation from 2011 to 2013

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Title II, Part B of the Elementary and Secondary Education Act (ESEA)[1], also known as Mathematics and Science Partnerships (MSP), provides the opportunity for school districts to partner with faculty from Institutes of Higher Education (IHEs) to offer Professional Learning (PL) to math and science teachers. Local Educational Agencies (LEAs) apply for this competitive grant to improve students' math and/or science performance through the increased content knowledge and improved teaching skills of classroom teachers. The Colorado Department of Education (CDE) has been awarding MSP grants to high-need LEAs since 2003-2004.

Evaluation Method

Each year CDE conducts a comprehensive evaluation of the MSP program in Colorado. The purpose of this paper is to highlight significant findings from the state's most recent evaluation, particularly the comparison between the math performance of students taught by MSP-participating math teachers and those taught by non-MSP math teachers from the same schools. Additional findings are available upon request.

The math performance of students taught by MSP math teachers was compared to that of students in the same schools taught by non-MSP math teachers using Median Growth Percentiles (MGPs). The MGP indicates how the middle student of each group performed on the math portion of Colorado's statewide assessment (TCAP) compared to academic peers. Another metric to evaluate the MSP impact is the percentages of MSP and non-MSP students whose math TCAP proficiency level increased from the year prior. However, because the difference between the two groups in the percentage of students that increased in proficiency level was not statistically different, this report will focus on the differences in MGPs.

Findings

Partnerships with a Focus on Math

Of the seven partnerships during the 2011-2012 and 2012-2013 school years, two provided math PL to educators and three provided both math and science PL. Of the five that focused on math or had math PL as part of the MSP program, three partnerships' students taught by MSP-teachers demonstrated increased math MGPs compared to students within the same schools taught by non-MSP teachers.

2011-2012 Results

[1] See Appendix A for a complete list of acronyms

Reach of Colorado's MSP From 2011 to 2013

- Funding
  - Awards ranged from $91,219 to $352,246 per year, per grantee
  - In sum, $1,196,425 awarded across both years
- Beneficiaries
  - 7 Partnerships
  - 6 Institutes of Higher Education (IHEs)
  - 7 Local Education Agencies (LEAs)
  - 317 Educators
  - 26,383 Students
- Funded Activities
  - Math and/or Science Professional Learning
  - 6 partnerships had a summer institute
  - 6 partnerships incorporated classroom observations as part of its evaluation

Math Focused Grantees

- Eagle County Schools
- Weld 6 - Greeley

Science Focused Grantees

- Denver Public Schools
- Westminster 50

Math *and* Science Focused Grantees

- Adams 14
- Aurora Public Schools
- Colorado Springs 11

Five partnerships provided PL in math during the 2011-2012 school year. Students taught by MSP participants from Eagle County Schools (ECS) had a statistically significantly higher math MGP in 2012 compared to their non-MSP counterparts (*U*=816,113.5, *p*=.001). MSP-taught students from Aurora Public Schools (APS) also had a statistically significantly higher math MGP (*U*=658,995.0, *p*=.001) (see Table 1).

Table 1: 2012 MGPs of Students Taught By 2011-2012 MSP Participants and Comparison Group[2]

	MSP Group			Comparison Group		Mann-Whitney test p-value (2-tailed)
	Number of Teachers with 2012 Math MGP	Number of Students (*N* Schools)	MSP Student 2012 Math MGP	Number of Students (*N* Schools)	Comparison Group's 2012 Math MGP	
ECS	32	1,758 (15)	45.0	1,035 (15)	38.0	.001*
Adams 14	15	947 (1)	28.0	8 (1)	…	…
APS	8	697 (4)	61.0	2,182 (4)	52.0	.001*
Weld 6 - Greeley	61	4,820 (10)	37.0	467 (9)	40.0	.185
Colorado Springs	7	171 (6)	54.0	556 (6)	54.0	.736
Statewide				*395,583*	*50.0*	
**Difference is significant at the 0.01 level*						

2012-2013 Results

Four partnerships provided math PL in 2012-2013. Although students taught by MSP teachers had higher MGPs than comparison groups for all partnerships, only Weld 6's difference was statistically significant (*U*=1,123,370.0, *p*=.004) (see Table 2).

Table 2: 2013 MGPs of Students Taught By 2012-2013 MSP Participants and Comparison Group[3]

	MSP Group			Comparison Group		Mann-Whitney test p-value (2-tailed)
	Number of Teachers with 2013 Math MGP	Number of Students (*N* Schools)	MSP Student 2013 Math MGP	Number of Students (*N* Schools)	Comparison Group's 2013 Math MGP	
Adams 14	14	876 (1)	35.5	80 (1)	33.0	.134
APS	37	2,591 (7)	50.0	2,287 (7)	49.0	.147
Weld 6 - Greeley	68	5,087 (10)	44.0	480 (10)	40.0	.004*
Colorado Springs	9	286 (7)	45.0	488 (7)	43.0	.360
Statewide				*403,319*	*50.0*	
**Difference is significant at the 0.01 level*						

Traits of Successful Partnerships

[2] See Appendix B for student demographics
[3] See Appendix C for student demographics

The defining feature among the three successful partnerships was a significantly higher math MGP on the part of MSP students compared to non-MSP students in either year 2011-2012 or 2012-2013. Grant Request for Proposals (RFPs), as well as the Annual Performance Reports (APRs) and Local Evaluation Reports (LERs) submitted at the end of each grant year, were analyzed to determine the traits of successful partnerships. Across the years of MSP evaluations, the more successful grantees have focused on improving pedagogy ***and*** increasing content knowledge. While each of the partnerships highlighted in this report provided PL activities to support ***both*** pedagogy and content knowledge and utilized classroom observations and assessments of teacher content knowledge (TCK) to evaluate the impact of the MSP grant, the details of each vary from partnership to partnership as delineated below. Key factors noted about each program can be used to guide future grants and the work of future grantees. In sum, the three successful partnerships were innovative, forward-thinking, collaborative and intensive in their implementation of the MSP program.

Eagle County Schools (ECS)

ECS had three observation protocols, the most of the seven partnerships from 2011-2013. Observation protocols included the Classroom Observational Guide to assess student learning, which elicited open-ended responses regarding math proficiency, engagement, and questioning. ECS' Professional Practices Rubric was used to score participants, from unsatisfactory to exemplary, on different domains of instruction such as presentation and feedback. The Inside the Classroom Observation and Analytic protocol was developed by Horizon Research and measured instruction on a scale from Ineffective to Exemplary across four domains: Design, Implementation, Content, and Classroom Culture.

ECS utilized Learning Mathematics for Teaching (LMT) surveys to assess changes in TCK, specifically the elementary and middle Number Concepts and Operations (NCOP) Surveys, and the elementary and middle Proportional Reasoning (PROP) Surveys. During 2011-2012, ECS MSP participants demonstrated significant gains, $t(18) = -3.305$, $p < .01$, on the Elementary NCOP.

ECS provided 120 contact hours of PL, targeted K-12 math teachers and was in its third and final year of the partnership in 2011-2012. Teacher participation was voluntary. ECS partnered with the University of Colorado at Colorado Springs during the first year of the grant and with the University of Denver for the second and third years. Teachers participated in trainings led by IHE faculty that focused on best practices in math instruction, common errors and misconceptions, and active learning and collaboration. Lesson studies focused on using knowledge gained from trainings to design, teach and refine grade-appropriate lessons. Participants were provided ongoing support in the form of instructional coaching, mentoring, and professional learning communities. The professional learning communities utilized a MSP specific website to foster dialog among participants. Reported strengths of the partnership as indicated in the 2011-2012 LER and APR included participant enthusiasm, improvements in teacher confidence, strong collaboration, and thorough data collection and evaluation. Another noteworthy strength is the early engagement of the program evaluator by the program developers and coordinators, which allowed for the intensive dosage and measurements conducted.

Aurora Public Schools (APS)

The observation tool of APS consisted of Lab Classroom Notes, which focused on descriptive observations, not judgments, to make evidence-based inferences. Observations and inferences were based on guiding questions such as, "What was the teacher or students saying or doing?" and "What was the task?"

While the PL content for APS incorporated math, the focus was on science and APS did not assess changes in participants' math TCK. The science assessment used was the Force & Motion Conceptual Inventory. Changes in TCK could not be assessed because participants did not complete the assessment from the end of 2011-2012 through the 2012-2013 school year.

APS provided 120 contact hours of PL, targeted high school math and science teachers and was in its first year of partnership with University of Colorado Denver (UCD) during 2011-2012. Teacher participation was voluntary. APS used

their MSP grant funds to support the realignment of their math/science course sequence so that students received algebra-based physics in 9th grade, followed by chemistry and biology. Teachers spent five days with UCD professors to improve content knowledge in physics, connect math concepts with physics concepts, and model guided inquiry. Math and science teachers met to align content across grades and create common expectations. The main focus of the grant during its first year was on individual classroom coaching to support connections between grade levels and help implement best instructional practices. Reported strengths during the first year of the partnership as indicated in the 2011-2012 LER and APR included a strong connection between district and IHE and collaboration among participants.

Weld 6 - Greeley

The observation tool utilized by Weld 6 consisted of a list of student and teacher behaviors that included: asking or answering high order questions, using a variety of tools, teaching with multiple representations, and providing wait time.

Like ECS, Weld 6 also utilized LMT measurements to assess changes in TCK. Specifically they used the Middle School Patterns, Functions, and Algebra (PFA) and 4-8 Rational Numbers (RN) surveys in 2011-2012 and 2012-2013, and the 4-8 Geometry and 4-8 PROP Surveys in 2012-2013. Weld 6 MSP participants demonstrated statistically significant gains both years on the PFA (2011-2012: $t(30) = -3.109$, $p < .01$, 2012-2013: $t(24) = -4.287$, $p < .001$) and RN (2011-2012: $t(20) = -2.955$, $p < .01$, 2012-2013: $t(10) = -3.200$, $p < .01$) Surveys, and in 2012-2013 on the PROP Survey, $t(19) = -4.980$, $p < .001$.

While ECS and APS were first-time MSP participants, this was Weld 6's third MSP. Weld 6 provided 76 contact hours of PL, targeted middle and high school math teachers in partnership with University of Northern Colorado and was in its second year of implementation in 2012-2013. Teacher participation was required for all math teachers in grades 6-12. In the history of MSP in Colorado, this is the only partnership that did not incorporate any type of summer workshop or institute. This was intentional so that PL would be embedded within the teachers' work, during the school year. PL mostly was divided by grade level/content and consisted of collaboration between IHE professors, district coaches, and teachers to improve math content knowledge and pedagogy, link assessment to instruction, and align curriculum to the Common Core State Standards.

Similar to ECS, Weld 6 incorporated lesson studies in which professors and coaches helped teachers plan class lessons, teachers taught those lessons with instructors and coaches observing, and lessons were re-assessed based on observations. IHE professors and district coaches regularly met to plan PL activities using current research and practices. Principals met four times over the year to train in monitoring for the purpose of increasing accountability and providing technical support to teachers. Reported strengths of the partnership as indicated in the 2012-2013 LER and APR included expanded use of pedagogical techniques and a strong connection between district and IHE which led to improvements in math education courses taught to pre- and in-service teachers.

Next Steps for the MSP Evaluation

On-site visits allow CDE to observe PL activities and provide a deeper understanding of each partnership's functioning. Until now, CDE evaluators' on-site visits have been limited. For the 2014-2015 MSP statewide evaluation, CDE evaluators will conduct at least one annual on-site visit to each partnership to observe PL activities. This will allow for an observation and data collection on program implementation including details that may not be conveyed through RFPs, APRs, and LERs, such as participants' level of engagement and the rigor of the PL activities.

Additionally, Unified Improvement Plans (UIPs), Consolidated Applications, Diagnostic Reviews, and TELL Colorado survey results will be reviewed for an exploration of how the partnership aligns with other district and school efforts.

The combination of these focused efforts will help answer the ultimate question of what makes MSP partnerships effective.

Appendices

Appendix A: Acronyms

List of Acronyms			
APR	Annual Performance Report	**MSP**	Mathematics and Science Partnerships
APS	Aurora Public Schools	***N***	Number
CDE	Colorado Department of Education	**NCOP**	Number Concepts and Operations
ECS	Eagle County Schools	**NEP**	Non-English Proficient
ESEA	Elementary and Secondary Education Act	**PFA**	Patterns, Functions, and Algebra
FEP	Fluent English Proficiency	**PL**	Professional Learning
FRL	Free/Reduced Lunch	**PROP**	Proportional Reasoning
IEP	Individualized Education Program	**RFP**	Request for Proposal
IHE	Institute of Higher Education	**RN**	Rational Numbers
LEA	Local Educational Agency	**TCAP**	Transitional Colorado Assessment Program
LEP	Limited English Proficient	**TCK**	Teacher Content Knowledge
LER	Local Evaluation Report	**TELL**	Teaching, Empowering, Leading and Learning
LMT	Learning Mathematics for Teaching	**UCD**	University of Colorado Denver
MGP	Median Growth Percentile	**UIP**	Unified Improvement Plan

Appendix B: 2011-2012 Demographics from Table 1

2011-2012 Demographics From Table 1		ECS		APS		Students Statewide (*N*=395,583)
		MSP Group (*N*=1,758)	Comparison Group (*N*=1,035)	MSP Group (*N*=697)	Comparison Group (*N*=2,182)	
IEP Status	No	91%	89%	91%	89%	91%
	Yes	9%	11%	9%	11%	9%
FRL Eligibility	Free Lunch Eligible	31%	36%	69%	78%	34%
	Reduced Cost Lunch Eligible	8%	11%	8%	6%	7%
	Not Eligible	61%	53%	22%	16%	59%
Language Proficiency	N/A	62%	50%	36%	31%	82%
	NEP	2%	4%	2%	5%	1%
	LEP	21%	28%	30%	31%	9%
	FEP	15%	18%	32%	33%	8%
Ethnicity	American Indian/Alaskan Native	1%	1%	0%	1%	1%
	Asian	1%	1%	2%	5%	3%
	Black	1%	0%	14%	13%	5%
	Hispanic	46%	57%	68%	69%	32%
	White	50%	41%	13%	9%	57%
	Hawaiian Native/Pacific Islander	0%	0%	1%	1%	0%
	More Than One	1%	1%	2%	2%	3%

Appendix C: 2012-2013 Demographics from Table 2

		Weld 6 - Greeley		Students Statewide (*N*=403,319)
		MSP Group (*N*=5,087)	Comparison Group (*N*=480)	
IEP Status	No	92%	81%	91%
	Yes	8%	19%	9%
FRL Eligibility	Free Lunch Eligible	62%	53%	34%
	Reduced Cost Lunch Eligible	9%	9%	7%
	Not Eligible	29%	39%	59%
Language Proficiency	N/A	58%	68%	82%
	NEP	3%	4%	1%
	LEP	15%	15%	9%
	FEP	24%	14%	8%
Ethnicity	American Indian/Alaskan Native	0%	1%	1%
	Asian	2%	0%	3%
	Black	2%	2%	5%
	Hispanic	67%	59%	32%
	White	28%	37%	57%
	Hawaiian Native/Pacific Islander	0%	0%	0%
	More Than One	1%	1%	3%