Final Report

Cycle-4 DHE Improving Teacher Quality Grant
July 31, 2007

Project Title: Science and Mathematics Achievement from Rural Teachers (SMART) – Year 1 (2006-2007)

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Institutional Partners:

Rural Southwest Missouri Partner School Districts:

High Needs:
Bakersfield R-IV, Cassville R-IV, Dora R-III, Hollister R-V, Seymour R-II , Shell Knob 78, and Skyline R-II.

Additional Permissible:
Branson, Clever, Kirbyville, Lebanon, Niangua, Ozark, Reeds Spring, Sparta, and Spokane.

Missouri State University:

College of Natural and Applied Sciences – Departments:
Mathematics; Physics, Astronomy & Material Science; Geography, Geology & Plan

College of Education – Department:
School of Teacher Education

Additional Permissible:
MSU-Mathematics at West Plains (a 2-year Institution)
Southwest Regional Professional Development Center (SWRPDC)

Abstract:

Teams of 4th -8th grade math and science teachers from rural, high-need school districts will participate in a summer institute (2 Saturday and 2 immersion weeks) and a 5 session follow-up sequence for each year of this project (AY 2006-2009). Five objectives will be addressed:

- Increase teacher skills and knowledge base in mathematics (number/operations, geometry, data analysis, algebraic thinking) and science (physical science, earth science, environment) by participating in model lessons and exploring beliefs about the nature of science, math, communication, learning, and assessment.
- Improve inquiry-oriented instruction by participating in model lessons with follow-up discussions during summer, then teaching inquiry lessons and receiving coaching and feedback from project personnel during academic years. Cooperative-learning and differentiated instruction strategies will be considered.
- Increase assessment data-based instructional decision making by participating in dedicated workshop sessions on MAP assessment, and practice those decision during academic years.
- Improve student achievement in math and science by implementing instructional knowledge and skills acquired during project activities.
- Enhance pre-service content and methods courses by incorporating activities and other instruction materials developed for and during the project into those classes.

An integrated problem-based approach will be used to enhance participants' use of inquiry oriented instruction. During the first year of the project, participants will acquire content knowledge and skills within specific Number/Operations and Physical Science GLEs common to both content areas. The content focus of year 2 will be on specific Geometry and Earth Science GLEs, with year 3 extending into geometric and algebraic modeling and analysis for environmental GLEs. Participants will produce and implement at least one curriculum unit each year on the designated math/science GLEs for their grade level. Units will incorporate authentic uses of writing, and will include an assessment plan based on higher-order multiple choice, constructed response, and performance events.

Timeline for Project:

Date(s)	**Director will …**	**Participant teachers will …**
March-May, 2006	convene monthly advisory committee meetings to plan project activities; recruit participants; plan summer activities; coordinate consultants and presenters	
June 17/18, 2006	lead initial Friday/Saturday summer institute session (MSU, 14 hrs)	study content knowledge and skills, beliefs, Standards, GLEs (math & science), MAP assessment, curriculum, writing, instruction cooperative learning
July 10-14, 2006	lead immersion week of the summer institute (MSU, dorms, 11 hrs per day)	study content knowledge and skills, writing, assessment, differentiated instruction, curriculum development & presentations
July 17-21, 2006	lead second week of summer institute (MSU and school sites, 7 hrs per day)	study content knowledge and skills, writing, assessment, refine curriculum
Sept. 2006-April 2007	plan 5 all-day follow-up workshops; lead Saturday follow-up meetings (Sept. 23, November 11, March 10) and on-line discussions; make site visits to partner schools; evaluate participant units to assign graduate course grade	participate in follow-up activities, including 5 professional development sessions (2 at schools, 3 at MSU), site visits, on-going virtual discussions; document student math and science achievement outcomes.

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List of School Districts

By the close of this academic year project, 30 participants from 16 Institutional Partner School Districts remained active, as listed below. The high needs partner districts are indicated by a preceding "*". We did begin the project with 39 participants, but 3 of those were "no shows," and the other 6 completed between 2 and 7 days of the project.

*Bakersfield R-IV (1 participant)
Branson R-IV (1 participant)
*Cassville R-IV (2 participants)
Clever R-V (2 participants)
*Dora R-III (1 participant
*Hollister R-V (3 participants)
Kirbyville R-VI (1 participant)
Lebanon R-III (2 participants)
Niangua R-V (4 participants)
Ozark R-VI (1 participant)
Reeds Spring R-IV (5 participants)
*Seymour R-II (1 participant)
*Shell Knob 78 (2 participants)
*Skyline R-II (1 participant)
Sparta R-III (1 participant)
Spokane R-VII (2 participants)

Project Activities

Project activities included a Friday/Saturday June session as well as a 2-week professional development institute during July 2006 – the first week had 11-hour-day immersions with the content, curriculum, and technology (see Schedule of Activities on Agendas). Other activities included follow-up professional development in-service during the 2006-2007 academic year; on-going collaboration between participants and project personnel in the form of on-site school/classroom visitations and on-line communication during the 2006-2007 academic year; and various forms of data collection (demographic data survey; pre/post-test; teacher beliefs survey; reflective writing; pre/post-end of project evaluations; and observations during professional development activities and on-site school visitations).

The initial summer workshop was held June 9-10; and the continuing 2-weeks summer institute was held on weekdays July 11-22. Formal follow-up Saturday regroups were held on the MSU campus on September 23, 2006, November 11, 2006, and March 10, 2007. This represented a total of 121 contact hours with everyone in the project. During the summer institute, teachers in grade-level and academic-subject groups completed development of a curriculum unit with appropriate assessments; and they implemented those lessons during the academic year. These units along with instructional logs and journals of impact of the project on their classrooms were requirements for those teachers seeking graduate credit. Fifteen of the thirty teacher participants chose to receive 4 hours of graduate credit for their summer and academic year involvement in the project. Additional informal follow-up professional development activities were held at various times throughout the school year and offered for individual schools. Visits to classrooms of participants (usually to observe them presenting their designed curriculum unit to students) began in the fall and continued through spring semester. All initially planned project activities were completed.

There were no major changes made to the project design. The difficulty of recruiting from small rural schools did result in having participants from a larger number of districts than we had originally hoped for, limiting the overall impact on teaching and learning within each district. We also experienced some technology problems from school "firewalls" that limited our use of synchronous classroom visitations with Centra and a webcam (technology we had practiced during summer institute sessions).

Our project was very successful in achieving a significant level of administrator support and participation in the project (at least one full day's participation in the summer institute, a classroom observation of their teacher-participant when presenting an inquiry lesson, and communication with us during the year). The availability of some project funds to provide materials related to project activities, but linked to administrator participation, resulted in participation by administrators from 15 schools from our 16 school districts.

Project design and activities, including dedicated sessions, were explicitly linked to the Missouri Show-Me Standards and the National Council of Teachers of Mathematics Standards. In particular, the project focused on inquiry-based instruction and the communication process standard from these sources. Also, the content oriented sessions and curriculum units developed by participants were explicitly tied to Missouri's Grade Level Expectations. The particular focus was on mathematics number and operation GLEs, and physical science force and motion GLEs.

State and Project Objectives

Objective 1: Increase teacher skills and knowledge base in mathematics and science – number and operation and physical science during year one. Teachers participated in model lessons in the content areas and engaged in discussions about the nature of science and mathematics, the inquiry approach to developing content knowledge, and assessment of content knowledge. Project-developed pre- and post-tests in the areas of math content (and confidence level) and science content demonstrate a significant increase in knowledge base, particularly for the area in which each participant attended the majority of break-out sessions (as demonstrated below). The state evaluation team also reported the participant's perspective of improved content knowledge resulting from participating in this project.

PRE/POST ASSESSMENT GAINS BY 25 PARTICIPANTS TAKING BOTH TESTS			
Participants Attending a Majority of Math Break-Out Sessions			
Participant	Math Content Percent Gain / Loss	Math Confidence Percent Gain / Loss	Science Content Percent Gain / Loss
1	4.8%	6.8%	9.1%
2	9.4%	2.0%	5.3%
3	0.0%	21.6%	13.3%
4	4.3%	10.0%	75.0%
5	30.2%	170.8%	-5.0%
6	31.3%	9.8%	16.7%
7	-1.5%	4.9%	-20.0%
8	17.8%	22.0%	13.3%
9	22.2%	13.6%	25.0%
AVERAGE	13.2%	29.0%	14.7%
MEDIAN	9.4%	10.0%	13.3%
STANDARD	12.6%	53.6%	26.1%

DEVIATION			
Participants Attending a Majority of Science Break-Out Sessions			
	Math Content	**Math Confidence**	**Science Content**
Participant	**Percent**	**Percent**	**Percent**
	Gain / Loss	**Gain / Loss**	**Gain / Loss**
1	23.1%	25.6%	36.8%
2	24.6%	18.5%	47.1%
3	58.8%	10.4%	42.1%
4	117.6%	17.9%	11.8%
5	4.3%	6.2%	-10.5%
6	-1.3%	10.3%	4.2%
7	3.7%	9.3%	27.3%
8	48.9%	-4.7%	71.4%
9	73.3%	-6.1%	13.6%
10	15.9%	13.3%	29.4%
11	14.0%	-6.3%	16.7%
12	62.2%	3.4%	-4.0%
13	29.8%	3.4%	8.7%
14	55.3%	70.8%	93.3%
15	14.8%	11.3%	38.9%
16	45.3%	-5.4%	26.1%
AVERAGE	36.9%	11.1%	28.3%
MEDIAN	27.2%	9.8%	26.7%
STANDARD DEVIATION	31.6%	18.5%	27.0%

Table II.4: Improvement in Content Knowledge Relevant to Teaching Assignment

	End of Summer Institute										End of PD program									
	Frequencies							Descriptive Statistics			Frequencies							Descriptive Statistics		
Subject area	0	1	2	3	4	5	n/a	*n*	*M*	*SD*	0	1	2	3	4	5	n/a	*n*	*M*	*SD*
Mathematics	0	0	1	8	13	8	0	30	3.9	0.8	0	0	0	6	7	1	0	14	3.6	0.6
Science	0	0	0	9	4	12	0	25	4.1	0.9	1	0	4	4	3	2	0	14	3.0	1.4

0=No gain in content knowledge; 1=None of the gain was relevant to my teaching assignment; 2=Very little was relevant; 3=A Moderate amount was relevant; 4=Most of the gain was relevant; 5=All of the gain was relevant; n/a=I have no teaching assignment.

Objective 2: Improve inquiry-based instruction. Participants experienced an integrated inquiry/problem solving approach to instruction in model lessons presented during both the summer and follow-up workshops. During the first summer week participants also focused on differentiated learning and how to engage all learners with an inquiry approach. During the second week of the summer workshop, participants developed their own inquiry-based lessons to use in their classrooms. Observations of classroom activities by project investigators document an enhanced

focus on inquiry-oriented instruction by participants. We also present evidence, provided by the state evaluation team, of the participant's perceived improvement in this area. We interpret this as creating some changes in perception of what to value in math and science, and how students learn.

Table II.8: Perceived Improvement in Teaching Practice

	End of Summer Institute							End of PD program						
	Frequencies				Descriptive Statistics			Frequencies				Descriptive Statistics		
Subject area	0	1	2	3	*n*	*M*	*SD*	0	1	2	3	*n*	*M*	*SD*
Improving content knowledge	0	0	11	19	30	2.6	0.5	0	4	9	2	15	1.9	0.6
Creating lessons aligned with GLE's	0	0	5	26	31	2.8	0.4	1	1	6	7	15	2.3	0.9
Assessing student learning	0	0	14	17	31	2.5	0.5	0	3	7	5	15	2.1	0.7
Increasing student motivation	1	3	9	17	30	2.4	0.8	2	4	5	4	15	1.7	1.0
Analyzing student performance data	2	3	13	13	31	2.2	0.9	1	3	7	4	15	1.9	0.9
Using inquiry-based / problem-centered teaching	1	0	4	26	31	2.8	0.6	0	4	6	5	15	2.1	0.8
Collaborating with other teachers	0	1	9	21	31	2.6	0.6	0	4	3	8	15	2.3	0.9
Using technology effectively to enhance your teaching	1	1	12	17	31	2.5	0.7	1	5	4	5	15	1.9	1.0
Participating in classroom activities as your students would	0	3	6	22	31	2.6	0.7	0	4	6	5	15	2.1	0.8
Implementing activities in your classroom	0	2	13	16	31	2.5	0.6	0	4	8	3	15	1.9	0.7
Developing materials for use with your students	0	0	7	24	31	2.8	0.4	0	4	8	3	15	1.9	0.7
Managing inquiry-based / problem-centered classrooms	1	0	10	20	31	2.6	0.7	2	3	6	4	15	1.8	1.0

0=none; 1=a little; 2= moderate; 3=very much.

Objective 3: Increase instructional decision making from assessment data. The focus of the two-day June session was on assessment, and participants were provided with extensive activities related to MAP assessment and grade-level expectations. The written model lessons presented during the summer and follow-up sessions also included appropriate assessment items. During curriculum development activities the second week of the summer workshop, teachers generated pre- and post-tests for their units and incorporated items to assess higher-order thinking (MAP-like items and essential questions) at much higher rates than typical publisher-designed tests. Instructional design in their developed curriculum units was influenced by identifying general student weaknesses from their MAP scores. The use of questioning and other alternative assessment practices, including notebooks and journals, were clearly evident from both classroom observations and journals of yearly activities provided by the participants. We also present two tables from the state evaluation team that highlight the participant's change in attitudes towards assessment strategies over the year of the project.

Table III.4: How Often Do You Assess Student Progress in Mathematics/Science in Each of the Following Ways?

	Pre (*n*=32)							Post (*n*=20)							Change (*n*=20)	
	Frequencies							Frequencies								
	0	1	2	3	4	*M*	*SD*	0	1	2	3	4	*M*	*SD*	*diff*	*t*
Conduct a pre-assessment to determine what students already know	2	7	15	6	2	1.97	0.97	0	4	9	6	1	2.20	0.83	0.15	0.72
Observe students and ask questions as they work individually	0	2	7	18	5	2.81	0.78	0	0	2	13	5	3.15	0.59	0.15	0.90
Observe students and ask questions as they work in small groups	0	0	10	18	4	2.81	0.64	0	0	3	12	5	3.10	0.64	0.25	1.75
Ask students questions during large group discussions	0	0	4	17	10	3.19	0.65	0	0	6	8	6	3.00	0.79	-0.05	-0.29
Use assessments embedded in class activities to see if students are getting it	0	3	11	12	6	2.66	0.90	0	0	4	13	3	2.95	0.60	0.15	0.57
Use assessments to monitor effectiveness of instruction	0	0	6	22	4	2.94	0.56	0	0	4	13	3	2.95	0.60	-0.05	-0.25
Review student homework	0	0	7	12	13	3.19	0.78	0	0	2	11	7	3.25	0.64	0.10	1.00
Review student notebooks/journals	2	5	9	12	3	2.29	1.07	0	1	4	10	5	2.95	0.83	0.45	2.13*
Have students contribute to individual portfolios	10	10	7	5	0	1.22	1.07	4	4	7	5	0	1.65	1.09	0.50	3.25**
Have students do long-term math/science projects	6	11	12	3	0	1.38	0.91	3	6	9	2	0	1.50	0.89	0.05	0.24
Have students present their work to the class	1	5	14	12	0	2.16	0.81	0	3	8	9	0	2.30	0.73	0.15	0.72

0=Never; 1=Rarely; 2= Sometimes; 3=Often; 4=All/almost all lessons.
*$p < .05$. **$p < .01$.

- Continued -

Table III.4: How Often Do You Assess Student Progress in Mathematics/Science in Each of the Following Ways (Continued)

	Pre (*n*=32)							Post (*n*=20)							Change (*n*=20)	
	Frequencies							Frequencies								
	0	1	2	3	4	*M*	*SD*	0	1	2	3	4	*M*	*SD*	*diff*	*t*
Include group assessments	5	10	14	2	1	1.50	0.95	2	4	11	2	1	1.80	0.95	0.40	3.56**
Give predominantly short-answer tests	0	11	14	5	2	1.94	0.88	2	7	9	2	0	1.55	0.83	-0.25	-1.23
Give tests requiring open-ended responses	0	2	9	19	2	2.66	0.70	0	0	5	12	3	2.90	0.64	0.25	2.52*
Grade student work on open-ended tasks using defined criteria	0	5	5	18	4	2.66	0.90	0	0	5	13	1	2.79	0.54	-0.05	-0.33
Have students assess each other	2	11	13	6	0	1.72	0.85	0	4	13	3	0	1.95	0.60	0.25	1.42
Have students engage in performance tasks for assessment purposes	2	3	18	9	0	2.06	0.80	0	2	10	8	0	2.30	0.66	0.10	0.62
Use assessment of group interactions as part of the grade	2	12	14	2	2	1.69	0.93	0	8	10	2	0	1.70	0.66	0.10	0.44

0=Never; 1=Rarely; 2= Sometimes; 3=Often; 4=All/almost all lessons.
*$p < .05$. **$p < .01$.

Objective 4: Improve student achievement in mathematics and science - Best-practice instruction for high student achievement was and will continue to be supported through on-going modeling, coaching, and collaboration between project personnel, lead teachers, classroom participants, and administrators. Descriptions of student achievement gains, through pre- and post-tests associated with implementing their curriculum units, were shared by participants during follow-up sessions; but actual data was collected from only two participants, reporting 20% and 34% gains from pre- to post-test. However, the most meaningful but least quantifiable assessment of student achievement was reported by participants through anecdotal stories of dramatic changes in the way students approached math (particularly mental arithmetic) and science during conversations and through their written journals.

Objective 5: Enhance pre-service content and methods courses - Those who teach methods and content courses for elementary and middle school pre-service teachers have incorporate activities, case studies, classroom examples, and other instructional materials developed for and during this project into their courses. In classes for pre-service teachers, grant personnel have taken advantage of repeated opportunities to share school classroom examples and teacher strategies/difficulties. Some of these topics have included E-mints classroom expectations and prevalence in rural schools, basic facts strategies, dealing with GLEs not always matching the ability/background of students at that grade level, appropriate use of calculators and data-collecting devices, and lessons on MAP scoring using anchor papers and scoring guides for released items and sample student work. One example of an attempt to adjust pre-service experiences based on the project focus on assessment and MAP scoring is one instructor's use of student responses on MAP-like items to enhance the pre-service teachers' ability to give complete, detailed, and reasoned answers through asking them to assess their own and others' work using scoring guides. Initial results generated a significant improvement in communication and reasoning processes on assessments. Another example was another instructor's generation of and regular use of misconception "probes" for initial assessment and discussion of a topic.

Assessment procedures used to measure achievement of project objectives relied heavily on data generated by the Cycle 4 state evaluation team. We had no additional objectives beyond those addressed by that team. The tables that follow reflect the satisfaction of participants and potential impact of project activities for them. They examine changes reflected over time, comparing satisfaction at the end of the summer and again at the end of the program. It is valuable to see that change increase over time, and activities positively impact the participants.

Participant Satisfaction with the Project

Table II.6: Teacher Satisfaction with Professional Development

	End of Summer Institute							End of PD program							
	Frequencies				Descriptive Statistics			Frequencies					Descriptive Statistics		
Subject area	0	1	2	3	*n*	*M*	*SD*	0	1	2	3	n/a	*n*	*M*	*SD*
Confidence in my ability to teach improved	0	0	15	15	30	2.5	0.5	0	4	4	7	0	15	2.2	0.9
I will use/used materials and activities from this project in my classes	0	0	7	23	30	2.8	0.4	0	3	7	5	0	15	2.1	0.7
The summer institute/PD project was relevant to my teaching assignment (for the coming school year)	0	1	5	24	30	2.8	0.5	0	2	2	11	0	15	2.6	0.7
Overall, I am satisfied with my experiences in this project	0	0	6	25	31	2.8	0.4	0	1	3	11	0	15	2.7	0.6

0=not at all; 1=a little; 2=moderate; 3=very much; n/a=not applicable.

Table II.7: Assessment of Project Instruction

	End of Summer Institute								End of PD program							
	Frequencies					Descriptive Statistics			Frequencies					Descriptive Statistics		
Subject area	0	1	2	3	4	*n*	*M*	*SD*	0	1	2	3	4	*n*	*M*	*SD*
Quality instruction was delivered in this project	0	1	3	15	12	31	3.2	0.8	0	0	3	5	7	15	3.3	0.8
Instructors modeled good practice	0	2	2	12	15	31	3.3	0.9	0	1	1	8	5	15	3.1	0.8

0=never; 1=< ½ the time; 2=½ the time; 3=> ½ the time; 4=always

Table II.11: Extent to Which Professional Development Content Influenced Professional Practice

Aspects of PD project	End of PD Program (n=15) M	SD
Content knowledge (improving knowledge about science and/or math)	6.6	1.7
Pedagogy (improving how I teach and interact with students)	6.8	2.0
Instructional materials (developing or revising lessons and related materials)	7.9	1.6
Assessment (developing and using methods for gauging students' learning)	7.4	1.5
Communication/Collaboration/Professionalism (developing working relationships with other PD teachers, instructors, and/or staff)	7.8	2.7

0=none to 10=very much.

Project Modules / Curriculum Units

All participants were required to develop a curriculum unit both during the summer session (see list below), to cover a minimum of five days of lessons. Both a unit plan and lesson plans were required. Assessment components, including MAP-like items, were required elements of the developed units. Also, participants were encouraged to develop units that integrated mathematics and science at some level. Most participants were able to develop these units in partnership with fellow participants with compatible grade-levels. Some groups planned units with lessons in both mathematics and science when their various teaching duties involved both subjects. Participant groups shared their planned curriculum units with the whole group of participants during the summer session and reported results of presenting those units during the follow-up Saturday sessions. Copies of each unit in completed form were distributed to each participant with the intent that it could be used in other classrooms as well. Participants implemented these units during the academic year, and in most cases the project directors were able to observe some of the lessons as they were implemented. Given the usual mode of teacher as curriculum consumer rather than developer, the quality of work and success at implementation was good. All developed materials that included a legitimate attempt to address appropriate GLEs, and all made good progress in the development of assessment tools that measured higher-order thinking. During observations, student engagement during these developed lessons was very good. The intent was that this limited exposure to teacher as curriculum developer would translate into further development and or modifications of current publisher curriculum to better meet the needs of students.

Participants did collect some data on student achievement gains through pre- and post-tests associated with the developed lessons and units, and reported those results during follow-up sessions. It is not surprising that there was significant growth in knowledge after exposure to the lesson. This would have likely been the case for even very traditional lessons. To do a formal and meaningful analysis of impact would require that there was a control group, and this design was not possible in this project. However, one key to potential impact was to observe, at least in some cases, pre- and post-tests that included MAP-like items and assessment that required higher-order thinking. It should be considered meaningful progress when teachers are adjusting their assessments in this manner.

Participant-Generated Units With Lessons

Mathematics Focus

Decomposing & Composing Numbers – Grades 3-4 – Deanna Allen, Anita Collins, Carla Harrison
Proportions, Scaling, and Equivalent Ratios – Grade 7 – Heather King, Jan LaFevers, Margaret LaCavera, Scott Twente

Science Focus

Force and Motion – Grade 4 – Melissa Bratten, Jeanette Felks, Kim Good, Sandy Humbyrd
Simple Machines – Grade 5 – Elaine Rhodes, Leslie Uder
Sound – Grade 6 – Jodi Minkler, Robin Swain, Tricia Weydert
Simple Machines – Grade 7 – Sheryl Cardenzana, Lindsay Harmon, Jason Walworth
Gravitational Force – Grades 7-9 – Sharon Blauvelt, Stephanie Mebruer, Jeanette Mullis,
Nature Savers – Grades 6-8 – Christine Thornton

Math and Science Combined Focus

Motion and Speed – Grades 6-8 – Shirley Brueggemann, Amanda Cook, Sarah Hazlett, Lannie Hinote, Cecilia Swain

Dissemination

Presentations of project success were made in sessions at both the Missouri Council of Teacher of Mathematics Annual Conference in Columbia Missouri (December 1, 2006) and at Interface 2007 (sponsored by Missouri Department of Elementary and Secondary Education) – 2 sessions at A (February 23 & 24, 2007) and 2 sessions at B (February 25, 2007). All three project directors participated in at least one of the sessions, with Dr. Lynda Plymate participating in all 5 sessions. Project participants made significant contributions to these sessions by sharing their curriculum units and perceived changes in approach to teaching. All presentations were well received by attendees, who asked numerous questions from both the directors and project participants and requested additional information about the project through follow-up emails. The title and short abstract from each conference program (abstracts were the same for all presentations) read:

SMART Teaching in Math and Science – MCTM Conference 2006
Lynda Plymate, Kurt Killion, Cecilia Swain and Jan LaFevers

SMART Teaching in Science and Math – Interface A 2007
Lynda Plymate, Kurt Killion, Elaine Rhodes and Leslie Uder

SMART Teaching in Science and Math – Interface B2007
Lynda Plymate, Cheryl Schaefer, Sheryl Cardenzana and Stephanie Mebruer

Abstract: Participants in a year-long project to enhance 4th-8th grade math and science performance, by focusing on inquiry-learning and MAP-like assessments, will share activities and perspectives of what they are learning through the SMART project.

Preliminary work on lessons and units was shared during the summer workshop. Copies of curriculum units, both paper and electronic, were shared during the first follow-up meeting with the intention that participants would be able to take advantage of lessons developed by other participants. Further, participants were expected to share lessons and ideas generated during the grant activities as they were involved in district professional development activities and through Moodle and Centra communications with others.

One exciting consequence of this project was that a participant was so inspired with the use of technology and inquiry for science instruction, she (with four other teachers from her building) applied for and received a $31,000 Hewlett Packard grant to integrate science with technology. The grant money supports the purchase of technology equipment and the offering of professional development on how to incorporate technology into the curriculum. Our grant participant selected our project's units on simple machines and force as their science inquiry components.

Conclusion

The efforts of the grant activities should be considered generally successful. Interactions with teachers and observations in classrooms indicated growth in teacher confidence and significant efforts in modifying the approach to learning in the classroom. Observations of students also indicted a significant level of engagement and progress toward development of higher-order thinking abilities when they were taught with an inquiry approach. Another measure of success, also of a qualitative nature but reasonably generalized to the impact on the group of participants, was the extremely competent presentation of results and change in approach demonstrated by participant presenters at state and national conferences. We continue to struggle with the timing and duration of a summer institute that will attract teachers from these rural schools, and will also not interfere with other professional development opportunities in our area, but we make adjustments as recommended by current and previous project participants. The payment of stipends, especially since they were linked to actual hours of participation, certainly helped our recruitment efforts for the summer workshops, but it was not enough to keep all our original participants active throughout the academic year. The addition of $500 of resource materials for schools where administrators participated in the project in a "significant way" also boosted the involvement we received from these school administrators. Support and cooperation from them was truly wonderful during this project. The impact of the project was potentially diminished by minimal participation in a large number of districts. The original design was to recruit a critical mass of teachers and administrators from a small number of high-need districts to change the culture in entire districts. The difficulty of recruiting, mentioned earlier, resulted in participation of a small number of teachers from a large number of districts, so that the best we could hope for was a change in the culture of isolated classrooms. The qualitative analysis did, however, indicate that the culture in those isolated classrooms was positively impacted by project activities. Curriculum units were well developed. Appropriate assessments were incorporated. Teachers saw themselves as professional in the classroom and were engaged in professional activities such as "teacher as curriculum developer" rather than just "teacher as curriculum consumer". There was evidence of continual impact, even when the participants were not teaching the developed lessons, from the journal we asked the teachers to keep documenting the times when their instruction was impacted by project activities. We were very pleased with results from the project.

MDHE Improving Teacher Quality Grant

Compliance Audit Checklist

This form, signed by the Authorized Officer of the lead or custodial institution, should be returned with the **final request for funds** during each project year. If "No" is checked for any item, **a full explanation** should be attached to this form.

Lead Institution: Missouri State University

Partnership Members: _____

Project Title: Sciere and Mathematics Achievement from Rural Teachers

	Yes	No
1. A copy of the institution's A-128 or A-133 audit has been submitted directly to the MDHE *Improving Teacher Quality Grant* Coordinator for each year in which the Title II grant funds were expended for this project.	✓	
2. All encumbrances were made after the authorized grant start-date, which was 2/15/06.	✓	
3. All encumbrances for materials and supplies were made prior to the authorized grant end-date, which was 6/30/07.	✓	
4. All services were completed and paid for prior to the authorized grant end-date.	✓	
5. The final request for funds was submitted no later than 30 days after the authorized grant end-date.	✓	
6. There is evidence that the MDHE *Improving Teacher Quality Grant* funds were used to supplement, and not supplant, nonfederal funds.	✓	
7. There is evidence that funds were expended in accordance with the MDHE *Improving Teacher Quality Grant* purposes and the approved application.	✓	

Signature of Authorized Officer

Date: 7/26/07

Chief Financial Officer

Title

SUMMER WORKSHOP SCHEDULES

Science and Mathematics Achievement from Rural Teachers (SMART)

Lynda Plymate, Kurt Killion and Cheryl Schaefer, Co-Principal Investigators
Roberta Aram, Debbie Powell and Jill Black, Key Project Leaders
Cycle 4 Teacher Quality Grant, DHE

Friday and Saturday Initial Session Agenda – June 16-17, 2006

Time and Activity Schedule		
Time	**Leader**	**Activity**
Friday (6/16/06)		
3:00-3:30	Plymate	Introductions
3:30-4:30	Killion	GLEs and Math/Science Texts
4:30-6:00	St. Clair	Catapult Activity
6:00-6:30		*Dinner (Cheek 5)*
6:30-7:30	St. Clair	Discussion about Activity
7:30-8:00	Schaefer, Plymate	Formative Assessment Probes
Saturday (6/16/06)		
8:00-8:30		Coffee and Scones (Cheek 5)
8:30-9:00	Plymate, Schaefer	Community Building & Set-Up Activities
9:00-9:50	Plymate	Pre-Assessments
9:50-10:00		*Break*
10:00-11:00	St. Clair	Planning Backwards
11:00-12:00		*Lunch (Blair-Shannon Cafeteria), Check-Out*
12:00-1:50	St. Clair	MAP Scoring, Real Alignment
1:50-2:00		*Break*
2:00-3:00	Plymate, Killion	Shadows – Mathematics Perspective
3:00-4:00	Schaefer	Shadows – Science Perspective
4:00-4:10		*Break*
4:10-5:00	Plymate	Project Information and Paperwork

Science and Mathematics Achievement from Rural Teachers **Lynda Plymate, Kurt Killion and Cheryl Schaefer, Co-Principal Investigators** **Roberta Aram, Debbie Powell and Jill Black, Key Project Leaders** **Cycle 4 Teacher Quality Grant, DHE, 6/16/06-5/1/07** *Daily Schedule for Immersion Week: 7/10-14/06*	
8:00-8:30	Coffee, pastry, discussion
8:30-10:00	Morning Session 1
10:00-10:10	Break
10:10-11:40	Morning Session II
11:40-12:40	Lunch (Blair-Shannon Cafeteria)
12:40-2:00	Afternoon Session 1
2:00-2:10	Break
2:10-3:30	Afternoon Session 2
3:30-3:40	Break
3:40-5:00	Afternoon Session 3
5:00-6:00	Dinner (Blair-Shannon Cafeteria)
6:00-8:00	Evening Session

SUMMER AGENDA – Week 1 (7/10/06-7/14/06)
(Includes short mental arithmetic and formative assessment sessions throughout the days.)

Date	**Session**	**Leader(s)**	**Topic(s)**
Monday, 7/10	M1	L	Reacquaint activity Fraction – Decimal – Percent (understanding and comparison)
	M2	K	Number Representations (include scientific notation)
	A1	C	Planetary Conventions
	A2	C	Seasons
	A3	L & K	Shadows lesson
	Eve	Lynda	TI-83/84 Plus Viewscreen Calculator
Tuesday, 7/11	M1	L	CBL (temp & walk line together; book drop)
	M2	R & C	Pulleys
	A1	R & C	Pulleys
	A2-A	R & C	Pulleys
	A2-B	L & K	Administrators' session
	A3	L	Graphs (includes motion), tables, scenarios
	Eve	Amy & Mike Garton	Introduction to Moodle, InQsit, Centra
Wednesday, 7/12	M1	L	Curriculum Unit
	M2	R & C	Pulley Debriefing
	A1-A	R & C	Gears I
	A1-B	K	Fraction Operations I
	A2-A	R & C	Gears II
	A2 - B	K	Fraction Operations II

	A3-A	R & C & L	Falling Objects (include CRB book drop)
	A3 - B	K	Fraction Assessment (last 50 minutes)
	Eve-A	Mike & Amy Garton	Sign-Up on Moodle, Explore Centra
	Eve-B	Participants	Lesson Development (second hour)
Thursday, 7/13	M1	K	Alternative Algorithms
	M2-A	C & R	Levers
	M2-B	K	Fractions III
	A1-A	C & R	Inclined Plane
	A1-B	L	Number as precursor to Algebra
	A2-A	C & R	Machine Wrap-up
	A2-B	L	Discrete mathematics / Plots on TI-84
	A3	L	Scale and Conversions
	Eve-A	Participants	Lesson Development
	Eve-B	Mike & Amy Garton	Explore InQsit and Moodle
Friday, 7/14	M1	Jane	Differentiated Instruction, Inclusion
	M2-A	C	Sound
	M2-B	L	Chart and Calculator Plot Interpretations
	A1	K	Models of Multiplication and Division
	A2	Participants	Lesson Development
	Final	L, K, C	Wrap-Up Activities

SUMMER AGENDA – Week 2 (7/17/06-7/21/06) – 8:00 a.m.-3:30 p.m. Daily
(Includes short mental arithmetic and formative assessment sessions throughout the days)
Wednesday and Thursday (7/19-7/20) will be at school sites (**Reeds Spring and Niangua**).

Date	**Session**	**Leader(s)**	**Topic(s)**
Monday, 7/17	M1	C	Sound
	M2-A	C	Sound Lab
	M2-B	K & J	Math Topic
	A1	All	Lesson Presentations
	A2	All	Lesson Presentations
Tuesday, 7/18	M1	K	Compose and Decompose Numbers M.A. wrap-up
	M2-A	C	Video Analysis (and United Streaming)
	M2-B	K	Kamii Tape (and United Streaming)
	A1-A	C	Science Topic
	A1-B	K	Math Topic
	A2	Participants	Grade-Level Pre/Post Test Development
Friday, 7/21	M1	All	Curriculum Unit Presentations
	M2	All	Curriculum Unit Presentations
	A1	All	Grade-Level Pre/Post Test Development
	A2	All	Participant surveys and Post-tests
	Final	K & C	Wrap-Up Activities

SATURDAY REGROUP SCHEDULES

Science and Mathematics Achievement from Rural Teachers

Lynda Plymate, Kurt Killion and Cheryl Schaefer, Co-Principal Investigators
Roberta Aram, Debbie Powell and Jill Black, Key Project Leaders
Cycle 4 Teacher Quality Grant, DHE

Saturday Regroup Agenda – September 23, 2006

Schedule		
Time	**Activity**	**Leader(s)**
8:00-8:30	Coffee, Pastry, Discussion	
8:30-9:30	Administration, Moodle, Equipment, Stories	Plymate, Killion, Schaefer
9:30-9:45	Break	
9:45-11:30	"Illustrate the Point" Using Technology	Plymate
11:30-12:00	Centra	Plymate, Killion
12:00-12:30	Lunch (Cheek Basement)	
12:30-2:15	"Water and Ice" Using Temperature Probes	Killion, Schaefer
2:15-2:30	Break	Break
2:30-3:15	Teacher Use of Technology	Plymate
3:15-3:30	Wrap Up	Plymate, Killion, Schaefer

1. **What's New?**
   Individual Information (address, e-mail, courses taught, …)
   NCTM Curriculum Focal Points
   Opportunity for annual conference presentations (MCTM, 12/1-2, Columbia; Interface, 2/22-24 (K-6) or 2/25-27(7-12), Lake Ozarks) – "SMART Teaching in Math and Science Classrooms"

2. **Administration**
   Project Questions and Concerns (Moodle, Visits/Centra, Administrative Resources, Assessment Forms, Other Resources, Reimbursements)
   Course (Sign-Up at November 11 Regroup)

3. **Participant Stories of Implementing Project Ideas and Curriculum**

4. **Getting Onto Computer Resources From School: (see back of your coversheet)**
   - **Moodle: http://mo-ap.missouristate.edu/moodle (userid: LPlymate; password: SMART)**
   - **InQsit: http://learning.missouristate.edu/inqsit (name: SMART; password: smart)**
   - **Centra: http://centra.missouristate.edu (name: LPlymate; password: SMART)**

5. **Activities of Day (Focus on Instructional and Teacher Resource Uses of TI-84 and CBL/CBR)**
   - Downloading and Sharing Programs/Data for the TI-84
   - Built-in Function Features of TI-84 (recursion, fractions, powers & roots, mean/median)
   - Built-in Graphing Features of TI-84 (histograms, scatterplots, box-and-whisker plots)
   - Built-In Application Features of TI-84 (finance, dynamic geometry/measurement – CABRI Jr)
   - Using temperature probes – EasyTemp probe OR temperature probe with the CBL
   - Using CBR to detect motion (slinky, sound, exercise) then analyzing that data
   - Downloading calculator pictures/graphs/data to a Word document for tests/problems/presentation
   - Using random numbers and statistics for assessment purposes

6. **Wrap Up Items**
   Check Moodle regularly and be prepared for visits (real or via Centra)
   November 11, 2006 Regroup – special 6-hour presentation (Roberta Aram)

Saturday Regroup Agenda – November 11, 2006

Schedule		
Time	**Activity**	**Leader(s)**
8:00-8:30	Coffee, Pastry, What's New	Everyone
8:30-8:45	Welcome, Project Questions and Concerns	Plymate
8:45-3:00	Project Learning Tree	Roberta Aram Jay & Frances from the MO Dept. Conservation
12:00-12:30	Working Lunch (Cheek Basement)	
3:00-3:15	Post-Test Items Revisited	Plymate
3:15-3:30	Wrap Up	Plymate, Schaefer
3:30	Distribution of Resources (as a result of administrator participation)	Plymate, Gannott

1. **What's New?**
2. **Project Questions and Concerns**
3. **Activity of the Day – Project Learning Tree (Missouri Department of Conservation)**
4. **Wrap Up Utems**

Saturday Regroup Agenda – March 10, 2007

Schedule		
Time	**Activity**	**Leader(s)**
8:00-8:30	Coffee, Pastry, Discussion	
8:30-9:30	Administration, Participant Tips	Plymate, Killion, Schaefer
9:30-9:45	Break	
9:45-11:00	CSI – Springfield	Plymate
11:00-12:00	Assessment – Misconception Probes	Killion
12:00-12:30	Lunch (Cheek Basement)	
12:30-1:30	Break-Out Group Discussion – Topic Enhancements, Suggestions, Preferences	Killion, Schaefer
1:30-1:45	Break	Break
1:45-3:00	Whet Your Whistle – Next Year's Project	Plymate, Killion, Schaefer
3:00-3:30	Wrap Up	Plymate, Killion, Schaefer

1. **What's New?**
2. **Project Questions and Concerns**
3. **Activities of Day**
   - CSI – Springfield (uses TI-84 calculator and EasyTemp temperature probe)
   - Assessment – Misconception Probes
   - Discussion within Break-Out Groups
     - Additional help needed on topics we have worked on this year
     - Suggestions for ways to present these topics more effectively
     - Preferences for next year's project – timing, topics in Geometry/Earth Science, break-outs
   - Whet Your Whistle –Next Year's Project
     - Use of CABRI (on the TI-84 calculator) in geometry
     - Activity from Mathematics Mission II – resource books
5. **Wrap Up Items** – Project Evaluation Instruments **(code: MSU)**
   - Classroom Practices Instrument – Post (http://apps.arc.missouri.edu/PD_CPIpost_cycle4.tp3)
   - Professional Develop. Evaluation Survey 2 (http://apps.arc.missouri.edu/evaluation1_cycle4.tp3)

Year 2 of This Three-Year Grant

At the writing of this report, all summer workshop activities for year 2 of this SMART grant project have been completed. Project personnel and participants have completed 100 hours of content instruction – mathematics (focus on geometry and measurement) and science (focus on Earth science topics – training to employ effective higher-order instructional and assessment strategies (with the use of technology and manipulatives) in the classroom, develop curriculum units to pilot this year and share with others, and form lasting collaborative groups of teachers for support and professionalism. The format of the summer workshop was similar to that in year 1 with two exceptions, the immersion 11-hour-day week was week 2 (to promote curriculum development time) and all sessions were held on the campus of Missouri State University (including curriculum development time). Follow-up sessions and classroom visitations throughout the academic year will continue for this year of the project.

Thirteen of our 30 active participants were also part of last year's project, so they served as mentors for new participants this year. The content focus in both math and science was different this year from last, so returning participants had much to learn and do. But, their expertise with some of the technology and writing expectations certainly aided in the overall effectiveness of this year's project and help build one year's activities onto the next. We did not expose participants to "integrated instruction" this year, but we did spend more time on improving our "writing for learning" component of the project. Assessment was once again a large focus of our project, with several sessions devoted to it. Also, we have backed away from using Moodle and Centra this year because of the problems we are currently experiencing with the school districts' firewalls. We are, however, using Blackboard (Internet-supported classroom management system) to communicate with each other and share documents and ideas.

The focus of the 2-day June session was to introduce participants to some of the technology and manipulatives they would use to explore math and science, including: TI-84 calculator (with CABRI and mini-USB port that accepts data probes), CBR, CBL and Vernier probes, Geometer's Sketchpad, individual markerboard, color tiles, geoboard, tangram, and multilink cubes. During most mornings of our 2-week July workshop, participants remained together to study both mathematics and science. Then in afternoon sessions they were often divided into break-out groups to focus on mathematics or science topics specific to their grade-levels. Curriculum development time occurred regularly throughout the two weeks, with more time given in the second week. Specific content topics presented are listed below:

Mathematics	Science
Area and Perimeter -- Several Explorations	Water pH and Quality
Triangles and Quadrilaterals	Soil pH and Nutrients
Circles and Lines	Light reflection and absorption
Visualization, MAT Plan, Isometric Drawing	Experimental Design/Reporting your Lab
Circular Measurement	Seasons -- Intensity of the sun
Polydron Pieces – Polyhedra and Nets	Moon on a Stick
Sketchpad Extensions - Triangle Centers	Angle of Insolation
Measurement Stations	Rocks/Minerals
Similarity	Seasons
Finite Graphs – Routes, Networks	Mapping – Including Contour Maps
Pythagorean Theorem (some Sketchpad)	Shadows
Transformations – Terminology/Draw/Sketchpad	5E Seamless Assessment
Coordinate Geometry–Games, Graphs Probes	Soils
Symmetry (geoboards and MIRA)	Rock Cycle
Cross Sections & Contour Lines/Maps	Unit Conversions
Periscopes & Billiards, Networks	Moon Extensions