Kansas City Geoscience and Mathematic Advancement Partnerships (KC-GeoMAP)

Final Report – July 25, 2007

Lead Institution: University of Missouri-Kansas City (UMKC)

Project Director(s), Title(s), and Department(s)

1. Dr. Jimmy Adegoke, UMKC, Department of Geosciences, Assistant Professor (PI/Project Director)
2. Dr. Rita Barger, UMKC, School of Education Assistant Prof. (co-PI)
3. Dr. Tina Niemi, UMKC, Department of Geosciences Associate Prof. (co-PI)
4. Mr. David Ketchum, KCMSD, Curriculum, Instruction, and Assessment, Science Coordinator (co-PI)
5. Mr. Thomas E. Sullivan, KCMSD, Curriculum, Instruction, and Assessment, Mathematics Coordinator (co-PI)

Partnership Organizations

School of Education, University of Missouri at Kansas City, MO	Dr. Rita Barger
School of Arts and Sciences, University of Missouri at Kansas City, MO	Dr. Jimmy Adegoke Dr. Tina Niemi
Kansas City #33, Kansas City, MO	Mr. Anthony Amato

Project Director Contact Information:

Dr. Jimmy Adegoke
Department of Geosciences
University of Missouri-Kansas City
5100 Rockhill Road
Kansas City MO, 64110
Tel: 816 235-2978; Fax: 816 235-5535
Email: adegokej@umkc.edu

Project Abstract:

GeoMAP is a collaborative project between the University of Missouri-Kansas City (UMKC) College of Arts and Sciences, School of Education, and the Kansas City, Missouri School District (KCMSD), focused on advancing geoscience and mathematics education at the elemental and early middle school levels via a year long teacher professional development program designed to achieve the following outcomes: 1) Improve teacher subject-matter knowledge and pedagogical preparation in geosciences and mathematics; 2) Assist teachers to gain requisite skills in constructing and implementing standards-based geosciences and mathematics content integration required in the new KCMSD science curriculum; 3) Assist teachers in gaining knowledge and skills for using constructivist-based and critical pedagogy, especially facilitating and engaging students in experiential, hands-on/minds-on learning activities using the standards based educational resources of GLOBE and IRIS; and 4) Improve teachers' competence in the use of technology for promoting active student learning in the classroom. GeoMap addressed these objectives through an intensive year-long professional development (PD) program for 20 science and mathematics teachers from multiple KCMSD school buildings using a "mentor-buddy" peer-mentoring model. The PD program included a pre-workshop phase in the spring of 2006, a 3-week intensive mid-summer workshop for "mentor" teachers, a two-day mini-workshop in late summer for "buddy" teachers, and a follow-up implementation phase during the fall and spring semesters of the 2006/07 school year for all project participants. The project provided teachers the opportunity to earn six UMKC graduate level credit hours at substantially reduced tuition rate.

Table of Contents

Cover Page	1
Project Abstract/Summary	2
Table of Contents	3
List of School Districts	4
Description of Project Activities	5
Description of Substantive Modifications	9
State & Project Objectives	10
How Project Objectives were Addressed	11
Project Connections to Show-Me Standards & GLEs	13
Dissemination	14
Conclusion	14

Attachments:

1. Project Data Profile from the External Evaluators
2. Participants Data
3. Compliance Audit Checklist (Not included – Will be provided by the UMKC ORS)

List of School Districts & Number of Participants:

School District	Number of Participants
Kansas City Missouri School District (High Need)	17
Center School District	2
North Kansas City School District	1

Contact Hours Per Participants:

The average number of contact hours between the Institute Directors and project participants from **July 2006 through May 2007** was **110 (one hundred and ten) hours per participant**.

Description of Project Activities:

Mid-Summer PD Workshop:

The mid-summer institute was held from Monday through Thursday over the course of three weeks – July 10 - 27, 2006. The focus of this institute is on geosciences for elementary and middle school science teachers in the Kansas City Missouri School District and includes integrated math components that are relevant to the teaching of these science topics. Math concepts addressed, in general, are related to the measurement and analysis of the data being collected as part of the summer institute science activities. Teacher participants instruction was via lecture combined with science experiments / activities or "protocols" that emphasize how science can be "fun" both for teachers and students, and emphasize collecting data that is relevant to the students' urban environments. The summer institute curriculum was based both on the 5E learning model as well as teaching science via inquiry. A significant component of the institute curriculum and the materials provided was based on the national K-12 science inquiry GLOBE Program -- Global Learning and Observations to Benefit the Environment (http://www.globe.gov). The GLOBE program includes many science standards-based teacher resources including detailed "protocols" on earth science topics. The project Director (Dr. Adegoke) is a GLOBE regional coordinator and a certified professional development trainer on various GLOBE science protocols. Other existing resources that are accessible to KC school district learners and teachers were emphasized including the "Stream Team" project (http://www.stream.fs.fed.us/ and http://www.mostreamteam.org/), and a list of science resources mapped to the KC MO school district science GLEs from the KCMO science curriculum. The project PIs worked extremely hard to put together the extensive resource base that we provided the teachers and we are particularly pleased that the project participants embraced and actually used these resources. A significant part of our PD model was designed to help improve the comfort level of the teachers with technology and hands-on-science by directly linking the science protocols to the math and science GLEs. We have found that this greatly helped classroom adoption. Additionally, each teacher developed 5 lesson plans on topic s of their choice from the content areas covered during the workshop. Each lesson followed the 5E learning model and incorporated significant hands-on learning activities.

The mid-summer PD workshop suffered from low enrollment as only 10 of the 24 teachers that were recruited in the spring finally showed up. Reasons for this low enrollment included multiple workshops in the Kansas City area, including two other projects funded by MDHE in summer 2006. Additionally, our project received final "go-ahead" approval from MDHE late due to funding uncertainties. This hindered the project implementation team from actively following up the recruited participants in the months leading up to the workshop since the fate of the project was still uncertain until a few weeks before the actual workshop start date. Nevertheless, we had a successful workshop with the 10 teachers that showed up and , together with them, the project directors devised a means to recruit 10 additional teachers using the "mentor-buddy" approach. The ten workshop participants in the July workshop agreed to each recruit one teacher from their school building or a nearby school and serve as "mentors" to the newly recruited "buddy" teachers.

GeoMAP Teachers assessing steam quality indicators on Brush Creek, Kansas City MO

Late-Summer PD Workshop:

We successfully recruited the 10 additional "buddy" teachers and conducted a two-day mini workshop for 8 of the buddy teachers on August 25-26, 2006. A special 2-day make-up workshop (identical to the mini workshop) was conducted for the remaining 2 "buddy" teachers on October 6-7, 2006. All the workshop materials developed for the 3-week July workshop were provided to the "buddy" teachers and each was matched to a "mentor" from our initial group of 10.

Fall and Winter Semester Regroup Sessions:

The project directors and all participants (mentors and buddies included) met at UMKC for 3 regroup sessions (four hours each), one scheduled during each quarter of the school year. Discussions during these regroups followed the Japanese lesson study model for professional development, dissecting and improving lessons based on actual experiences with actual students. In addition, time was spent reviewing test scores and assessment data with the participants. The first all-participant follow up activity was held on Friday, October 13, 2006. Seventeen participants attended along with the project PIs. Subsequent regroup sessions were held on December 9, 2006 and March 9, 2006 respectively.

GeoMAP Participants during one of the fall semester regroup sessions

Resource support and Follow-up:

The following resources and follow – up activities were planned for teacher participants. Dr. Barger was mostly in charge of the follow-up sessions.

- Dr. Adegoke visited classrooms for observations and to give presentations to classes, as requested. Dr. Tina hosted field trips throughout the year for teachers to sites of geological interest in the Kansas City area. They both hosted teacher and student teams were hosted in the Geoscience Museum at UMKC and assisted teachers with organization and student management issues on teacher-organized visits to the Discovery Center.
- Dr. Barger's math methods undergraduate students worked with the teacher participants in the following ways (Note that these partnerships are designed to benefit both the teachers and the undergraduate students):
    - One – two methods students were assigned to a pair of teachers in a building.
    - Teachers were encouraged to share the lesson plans they had developed with students – for benefit of students predominantly.
    - Students visited school buildings primarily for observation, but were sometimes available for "substitute" teaching to provide participant teachers with lesson development time or time to work with "buddy" teachers.

- The project organized three follow-up face to face sessions – four hours each. Sessions were focused on teacher implementation rather than new content.
- Teachers received classroom materials as part of participating in the institute including graphing calculator, infra red thermometer, GPS system, a book on foldables, weather station, heat lamps, stop watches, 30 meter measuring tapes.

Classroom Implementation Activities:

The primary focus of GeoMAP during the 2006-2007 school year was the implementation of units and lessons developed by participants during the summer workshop. Although several project participants were reassigned to teaching duties that did not allow for much science, many successfully taught the units that they developed during GeoMAP by incorporating them in both science and mathematics lessons, as appropriate. Several times during the school year the Project Directors, a UMKC graduate student advised by Drs. Adegoke and Barger, and several UMKC pre-service teachers were available to stand in for teachers as they observe and support each other in the implementation of project lessons.

Based on self-report data, the twenty participants did an amazing job of incorporating GeoMAP activities and materials into their classes, despite the changes in curriculum that were mandated by the school district. Classroom activities in science that were implemented by participants included:

- Making rocks
- Solar system
- Globe protocols in:
    - Soil
    - Clouds
    - Surface temperature
    - Water quality
- Weather movie
- Field trips
- Scientists in the classroom
- Weather stations
- Cloud cover
- Science night
- Chiseling fossils
- Rock cycle
- Air quality

Classroom activities in mathematics included:

- Bar graphs of weather station readings
- Finding mean, median, and mode
- Fractions via cloud cover protocol
- Elapsed time
- Computation
- Calculator usage

- Metric system
- Converstions

Connection with Pre-Service Teachers:

The GeoMAP participants interacted with a section of UMKC elementary pre-service teachers enrolled in a class taught by Dr. Rita Barger regarding their lesson plans. One assignment in the math methods class for the pre-service teachers was to review a lesson or unit plan created by participants in the summer institute. After reviewing and discussing the lesson plan as an assignment, the pre-service teachers contacted the author of their lesson plan and asked questions about the thinking and planning that went into the plan. These conversations took place via phone and Internet at the discretion of the practicing teacher. All together, 23 pre-service teachers participated in this phase of the project.

The original plan had been to have the pre-service teachers actually visit and assist in the classrooms of GeoMAP participants. However, the curricular changes set in place by the Kansas City School District made that extremely difficult. In the end, several of the participants went out of their way to find ways that the pre-service teachers could help, and six of the students actually visited classrooms. One pre-service teacher assisted a GeoMAP participant when she took her class to the Discovery Center on a field trip.

The pre-service teachers provided written analyses of the lesson plans. They also provided a written summary of their conversations with the practicing teachers. For those students who visited the classrooms, the GeoMAP teachers provided feedback either in person, or via phone or Internet.

In the future, this aspect of the grant could be improved. Ideally, we would have a “function” where the practicing teachers and the pre-service teachers came together for a light dinner and conversation. We would facilitate the dialogues so that both groups could gain more from the interactions. Additionally, schedules of the two groups proved very difficult to coordinate. More thought needs to be given to how to increase classroom involvement. The pre-service teachers are already required to spend 60 hours in assigned field placement. One possibility would be to co-ordinate the field placement of the targeted pre-service teachers with the participating practicing teachers.

Description of Substantive Modifications

Project personnel change:
Ms. Susan Bizorik, who was the KCMSD Math Coordinator at the beginning of the project, retired from the school district. Her replacement, Mr. Thomas E. Sullivan, replaced Ms. Bizorik as the second KCMSD co-director on this project.

Adjusted plan for recruiting additional teacher participants:
Although at one point prior to the start of the institute there were 27 participants enrolled (which represented an over-enrollment over the maximum of 24), only 10 participants attended the institute. Project personnel placed phone calls to the absent participants; they reached a few of

them who indicated that health problems had occurred, etc. – and others had committed to other PD workshops being offered in the Kansas City area that summer. The project directors contacted MDHE with a revised plan based on the 'mentor-buddy" approach described above and the two entities agreed upon the plan proposed by the project implementation team to recruit more participants and continue the project. The plan included the following elements:

- The 10 original attendees will each recruit one other teacher from his or her school.
- The new "buddy" teacher will attend at two-day shortened "institute" to provide some content knowledge but mostly experience with hands on protocols. At this writing, the additional workshop has not been scheduled.
- The teacher who attended the full summer institute – the "mentor" teacher - will work with the new "buddy" teacher to support them on the use of the protocols and other resources received. The original teacher will in essence be the content expert for the buddy teacher.
- The new buddy teachers will also participate in all planned follow – up activities.
- A reduction in the project budget to reflect the reduced number of participants (from 24 to 20)

As indicated in the preceding section, we successfully recruited the 10 additional "buddy" teachers and conducted a two-day mini workshop for 8 of the buddy teachers on August 25-26, 2006. A special 2-day make-up workshop (identical to the mini workshop) was conducted for the remaining 2 "buddy" teachers on October 6-7, 2006. The first all-participant follow up activity (regroup session 1) was held on Friday, October 13, 2006. Seventeen participants attended along with the project PIs. Mentor teachers were matched with their buddy partner teachers and , by all indication, the arrangement worked very well, especially for teachers in the same building.

List of State Objectives & Additional Project Objectives

Objectives:	Program Components:
Objective 1: To improve student achievement in math and/or science content areas	Participants will integrate scientifically based inquiry learning into their lesson plans, implement lesson plans aligned to new GLEs, and document the ability of these lesson plans to improve students' math and/or science achievement.
Objective 2: To increase teachers' knowledge and understanding of key concepts in targeted math and/or science content areas as aligned with each project's content focus	Improve teacher subject-matter knowledge and pedagogical preparation in geosciences and mathematics based on the GLEs in the new KCMSD science curriculum;
Objective 3: To improve teachers' pedagogical knowledge and practices that utilize scientifically-based research finding and best practices in inquiry-	Teachers will: understand and develop confidence in using constructivist-based critical pedagogy required for facilitating and engaging students in experiential,

based instruction	hands-on/minds-on learning; Improve their competence in the use of data gathering technology to promote active student learning in the classroom; integrate geoscience and mathematics content through engagement in conceptual learning.
Objective 4: To enhance participants' use of assessment data to monitor the effectiveness of their instruction	Participants will review test scores and assessment data during the quarterly regroups.
Objective 5: To demonstrate a measurable impact on the preparation of pre-service teachers through improvements in math and/or science content and/or pedagogy courses.	Project teachers will connect with pre-service students enrolled in the University's elementary mathematics methods classes and be guest speakers at one session of the methods classes. Pre-service teachers will review lessons designed during the project, write detailed reflections on one of the project lessons, and provide comments, ideas and suggestions with project teachers during regroup sessions.

Description of How Objectives Were Addressed

Objectives:	How Objectives were met or progress made toward each of the objectives
Objective 1: To improve student achievement in math and/or science content areas	This objective is clearly the most important but it also the most difficult to assess with empirical data in a one-year project that does not include an explicit control group. That notwithstanding, our carefully designed PD institute, which was based on the 5E learning model as well as teaching science via inquiry provided unique opportunities for GeoMAP participants to enrich their understanding of earth Science concepts and acquire new skills on how to integrate meaningfully instruction across the fields of mathematics and science. We believe that the shift in attitude with regard to inquiry and active learning that many teachers experienced through GeoMAP, and documented by the external evaluators – see Appendix 1 pgs. 28-29), if sustained over the coming years, will result in

	meaningful and measurable improvement in the achievement levels of students in the Kansas City Missouri School District taught by these teachers. This is further supported by anecdotal evidence provided by participants in their anonymously submitted post-project reflections, including comments such as "Having the GeoMAP program implemented in my classroom has assisted me in providing students a more exciting and rewarding learning environment" and "Using the hands-on materials helped my students master concepts that many of them struggled with"
Objective 2: To increase teachers' knowledge and understanding of key concepts in targeted math and/or science content areas as aligned with each project's content focus	Documented improvement in teacher subject-matter knowledge and pedagogical preparation in geosciences and mathematics (external evaluators project data profile– see Appendix 1; pgs. 28-30)
Objective 3: To improve teachers' pedagogical knowledge and practices that utilize scientifically-based research finding and best practices in inquiry-based instruction	Documented improvement in teacher pedagogical knowledge an practices through effective modeling of inquiry based instruction by the institute directors (external evaluators project data profile– see Appendix 1; pgs. 28-30)
Objective 4: To enhance participants' use of assessment data to monitor the effectiveness of their instruction	This objective was only minimally addressed because several of our participants had their teaching assignments changed just at the beginning of the school year because of school district mandates to building principals to concentrate attention on reading during the 2006-2007 school year.
Objective 5: To demonstrate a measurable impact on the preparation of pre-service teachers through improvements in math and/or science content and/or pedagogy courses.	Project teachers were able to connect with pre-service students enrolled in the University's elementary mathematics methods classes. Pre-service teachers reviewed lessons designed during the project, wrote detailed reflections on one of the project lessons, and provided comments; ideas and suggestions to project teachers during regroup sessions.

Description of how Project Connected with Show-Me Standards and GLEs

Our core strategy for implementing the GeoMAP PD institute involved developing and modeling inquiry-based lesson modules that geoscience GLEs. The table below shows the content and exploration activities conducted during the summer PD workshop mapped to the relevant GLEs. The GLEs are themselves based on the Missouri Shoe-Me Standards. *Principles and Standards for School Mathematics* (NCTM, 2000) identifies five process standards and six content standards for all grade levels, P-12. In the same way that the science standards build on each other, these mathematics standards and the Missouri GLEs which were developed using them, build on each other. The use of these standards moves smoothly through the grade levels and informed the design in this project. In particular, GeoMAP used the science curricular modules to teach the data and probability strand as well as parts of the measurement strand in the targeted grades. These are two areas that KCMSD scores have shown the need to improve. All of the NCTM process standards are directly applicable to this project; as students and teachers engage in inquiry-based, contextualized learning, they will be problem solving, communicating, representing, reasoning, and making connections.

		Monday	Tuesday	Wednesday	Thursday
Week 1: Air	9am-1pm	Introduction The Scientific method (7.1.A-E) Making observations & measurements (M.1.AB) (M.2.A,B,D,E)	Changes in State; Evaporation, Condensation (1.1.C/D) (M.1.AB) (M.2.A,B,D,E)	Collecting Weather Data (Build a weather station) (5.2.E) (D.1.A,C)	Manipulating weather data (D.1.A,C) (D.2.A,B) (D.3.A) (D.4.A)
	2pm-4pm	Teachers collaborating to develop lesson plan integration using GLOBE inquiry-based protocols and brainstorming on how math fits in science and how to teach them side by side			
Week 2: Water	9am-1pm	Earth systems (Insolation) (M.1.AB) (M.2.A,B,D,E)	Water Cycle and Erosion (5.1A, 5.2.E) (M.1.AB) (M.2.A,B,D,E)	Stream measurements (D.1.A,C)	Manipulating stream level data (D.1.A,C) (D.2.A,B) (D.3.A) (D.4.A)
	2pm-4pm	Teachers collaborating to develop lesson plan integration using GLOBE inquiry-based protocols and brainstorming on how math fits in science and how to teach them side by side			
Week 3: Earth	9am-1pm	Rocks & Resources 5.2.A; 5.3.A (M.1.AB) (M.2.A,B,D,E)	Fossils; Collecting data 4.3.A (M.1.AB) (M.2.A,B,D,E)	Weathering and Soil 5.1.A (D.1.A,C) (D.1.A,C) (D.2.A,B) (D.3.A) (D.4.A)	Integrating Science and Math
	2pm-4pm	Teachers collaborating to develop lesson plan integration using GLOBE inquiry-based protocols and brainstorming on how math fits in science and how to teach them side by side			Assessment & Conclusion

Our curriculum design for GeoMap embeds the teaching of the mathematics in real world projects – one way to take best advantage of the limited time teachers have with their students. The Global Learning and Observations to Benefit the Environment (GLOBE) curricular modules and Missouri Department of Natural Resources Stream Team protocols follow this scientific method and develop all of the abilities described in the Science Education Standards by applying a scientific approach to the investigation of earth science content. The earth and space science content standards for grades 5-8 stress the development of an understanding of the earth and

solar system as a set of closely coupled systems, the atmosphere being one of the four major interacting components of the earth system. As an example, the GLOBE temperature protocol incorporates elements of the quantitative study of the temperature of the atmosphere with associated weather patterns. The GLEs for grades 5-8 suggests that students investigate simple, familiar objects, such as a thermometer or temperature probe, through which students can develop powers of observation and analysis.

We introduced technology to aid specific investigations exploration. The students were able to see the value of technology in providing instruments, techniques, and communication capabilities that help them master content. Thus, the GLOBE modules and Stream Team rock, fossil and soil inquiry-based exercises all employed technology as a tool in the service of the learning of basic science and mathematic concepts. The guided pursuit of questions promoted through this project typically led students through a progression of resources: newspapers, television, thermometers, graphs, max- min thermometers, an electronic device (coupled with a computer) for the organized collection/display of data over extended periods of time, e-mail, a spreadsheet, and software for displaying and exploring both archived and real-time data

Project Dissemination

A dedicated website has been created for the project where all project related materials and lessons will be archived for future reference and use by all GeoMAP participants. Also, a list serve linking all project participants and project directors has been operation since inception of the project on Google (geomap2006@googlegroups.com). The list serve has allowed participants to share classroom practices, discuss implementation issues, describe successes, and problem-solve difficulties. The list serve will remain active as long as project participants wish to remain in contact one with another and with the project directors. Finally, all the individual school buildings represented in the project are also now formally recognized as GLOBE schools and accounts have been set up for the teachers so that their students can begin to report their own data and access data reported by students from across the world. This gives world-wide visibility to the work of the students and the teachers that support them.

The Project Director (Dr. Jimmy Adegoke) co-organized a special session at the National Science Teachers Association (NSTA) annual convention held in St. Louis, MO in April 2007. Two GeoMAP teachers were sponsored by the project to attend the meeting. They co-presented a paper with Dr. Adegoke on the implementation of GLOBE protocols within GeoMAP. Finally, Dr. Rita Barger of the UMKC School of Education is senior author on a manuscript that is currently in development to document the GeoMAP approach and lessons learned. All GeoMAP co-directors will contribute to the manuscript as co-authors. We will ensure that MDHE gets a copy of the paper after publication.

Conclusion

In the words of the External Project Evalutor (Dr. Rose Marra) in the post-summer PD Institute formative review “This project stands above others this evaluator has visited in its implementation of a true partnership between the partner school district – KC – 33, and the higher education institution – UMKC’s Geosciences department and the College of Education.

The working relationship between the two entities already existed before they responded to the DHE RFP and because the project only worked with teachers from a single school district, they were able to design a summer institute curriculum for the particular needs of science elementary and middle school teachers in this district (as defined by the science and math coordinators for the district)." The opportunities to work with these teachers in close partnership with the KCMSD has been extremely rewarding for the project directors.

The benefits are mutual as evidenced by the written comments from the participants submitted to the institute directors anonymously. **First, many of the participants felt the experience benefited them personally.** Some of the comments were: "The opportunity to participate in the program has been one of the most rewarding and educational experiences I've had."; "This professional development was fun and made me want to learn more in both areas because when I attended school I did not like either subject."; "This class has stretched my knowledge with the acquisition of the GPS, surface temperature gun and higher function calculators."; and "If I had not participated in this program I personally would not have learned how science applies to math." **Second, participants felt that their experience in GeoMAP helped their students.** We received comments like: "I feel my students have benefited because I have learned more. The exposure of students to the technology has helped them to be introduced to new concepts in this filed."; "My students are not afraid to use the tools that we have gotten."; "The activities were meaningful, and the students felt as if they were scientists."; "Using the hands-on materials helped my students master concepts that many of them struggled with."; and "This is the first year I have felt confident of my students' grasp of the scientific method." **Third, participants felt that GeoMAP made them better teachers.** We heard comments like this: "The supplies, content overview, the hands on activities really deepened my confidence in creating inquiry based instruction."; "Actually <u>doing</u> the activities helped in the planning and teaching of the lessons."; "Having the GeoMAP program implemented in my classroom has assisted me in providing a more exciting and rewarding learning environment."; and "My confidence and knowledge base have grown immeasurably. I am now looking for ways to continue my development as a math and science teacher and would love to specialize as a middle school math/science teacher … maybe even high school science."

The seeds sown through this project have blossomed into a fruitful and potentially long-term relationship between KCMSD and UMKC through initiatives that are currently being nurtured through grants provided by Federal funding agencies. We are grateful to MDHE for identifying with and financially supporting our vision of providing an engaging, rigorous and inquiry driven learning environment for urban students in the Kansas City metro area by implementing carefully targeted and challenging professional development programs for teachers in this high-need school district.