

Promoting Reasoning and Inquiry in Mathematics Education
PRIME

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North Harrison R-III
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Form 2 - Project Abstract

Project Title: Promoting Reasoning and Inquiry in Mathematics Education (PRIME)

Lead Institution: Northwest Missouri State University

	Project Director	Co-Director
Name	Dr. Margaret Buerman	Mrs. Jennifer Wall
Institution	Northwest Missouri State University	Northwest Missouri State University
Department	Mathematics and Statistics	Mathematics and Statistics
Title	Assistant Professor	Instructor

Partnerships : (Please expand or condense appropriate rows as needed)

	Institution/District/Organization	Location/Contact Person
Education Division	Levels 4-8	
Arts & Sciences Division	Mathematics	Northwest Missouri State University Margaret Buerman
High-Need School District(s)	1. North Harrison R-III 2. North Daviess R-III	
Additional Partner(s)	1. North Kansas City School District	

Project Information :

Grade-level focus (Note: one or more from grades 4 to 8):	Levels 4-8
Project area(s) of focus	<input checked="" type="checkbox"/> Math <input type="checkbox"/> Science <input type="checkbox"/> Integrated Math and Science
Anticipated number of participants	30
Anticipated number of participants from high-need districts	
Anticipated Start Date of Actual Project Activities	July 2006
Anticipated number of students directly impacted	750
Total number of contact hours per project year	65
Number of credit hours to be provided:	
Undergraduate	
Graduate	3
Continuing Education Units (CEU)	

Project Summary (300 words, single-spaced):

PRIME was developed with the intention of addressing the needs of area schools to improve teacher quality and the level to which all Grade Level Expectations (GLE) are being met. Specifically, the districts felt the teachers needed a higher level of understanding of the mathematics they teach and improved skills in using inquiry learning in their classrooms. To achieve these goals, participants in PRIME attended a 2 week institute in July 2006. The institute focused on GLEs determined by partner school districts and project coordinators. The morning sessions focused on the higher level mathematics related to the target GLEs, and project coordinators presented the higher level mathematics using inquiry learning and other researched teaching techniques. A discussion of the components of each technique used throughout the lesson followed. During the afternoons, participants developed lessons and activities they can use in their classrooms to address GLE currently not being met. They did so collaboratively with other participants.

To ensure districts are supporting the new teaching techniques, administrators of participating schools attended an Administrator's Academy in the Fall of 2006. Also, participants met in March, 2007 at which time they discussed the use of the techniques throughout the fall in their classrooms.

PRIME provided participants with a stipend, subsistence and certain materials for their classrooms. Administrators participating in the Administrator's Academy received a stipend to be used to purchase additional materials to further the support of PRIME in their districts.

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List of School Districts and Participants

School District	Number of Participants
North Kansas City	5
Maryville R-II	3
Nodaway-Holt R-VII*	1
North Daviess R-III*	1
Jefferson C-123*	2
Stanberry R-II	3
Mid-Buchanan R-5	1
Northeast Nodaway	1
North Harrison R-III*	3
Tarkio R-1	1
St. Joseph School District	3
Cainsville R-I*	1
Savannah R-III	3
Breckenridge R-1*	1
North Andrew R-6	1

* indicates high-needs school district

Contact Hours

Face-to-face contact hours (summer institute – July 10-21, 2006; final meeting – March 3, 2007): 62 hours per participant

Online contact hours (eCompanion – Fall 2006): 3 hours per participant

Description of project activities

Summer institute:

Ten morning sessions consisted of content in the form of an inquiry lesson. Each participant was involved in these lessons. The content of these lessons was aligned with selected Grade Level Expectations for grades 4-8.

Ten afternoon sessions consisted of teams of 3-4 participants writing inquiry lesson plans using that day's Grade Level Expectation. These lessons were for later use within participant classrooms.

Four sessions consisted of familiarizing participants with the use of selected manipulatives to teach mathematical concepts connected to the targeted GLEs.

Three discussion questions were posted on eCompanion (the course's website), and the participants responded to these questions. The questions were:

1. Before attending PRIME, had you ever written and/or used a lesson with the 5 E's (Engage, Explore, Explain, Elaborate, Evaluate)?
2. Choose one of the following topics and share how you, your textbook, other resources you might use approach this GLE. Be sure to state the grade level and how you might develop an exploration in an inquiry-based lesson (5 E's).

M2A: Use standard and non-standard measurement

M2C: Apply geometric measurements

M2D: Analyze precision

3. a) Make an appointment with your principal or assistant principal, the one that came to the October 4 meeting. If your administrator could not come, do this anyway. Spend time talking about what you have learned from the PRIME experience and how you think it has and will impact your teaching. Ask them what they know about inquiry-based teaching. Tell them what they can do to support you in your efforts to implement inquiry in your class.
- b) Report in the threaded discussion how your discussion went and what things you would like to share about the time you spent with your administrator.

Description of Substantive Modifications to the Original Project

We planned to have our final meeting and dissemination at the Missouri Council of Teachers of Mathematics meeting in December. However, due to weather conditions, we had to cancel our meeting at the conference. Instead, a final meeting was held in March, and our dissemination will be preparing an article to submit for publication.

List of PRIME Objectives:

1. Improve student achievement in mathematics.
2. Increase teacher participants' knowledge and understanding of key mathematical concepts.
3. Improve teacher participants' practices in inquiry-based instruction.
4. Enhance participant use of assessment data to monitor the effectiveness of their instruction.

5. Improve the preparation of pre-service teachers.
6. Increase appropriate use of technology and manipulatives to promote reasoning, inquiry and problem solving.

List of State Objectives

1. To improve student achievement in math and/or science content areas.
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.
3. To improve teachers' pedagogical knowledge and practices that utilize scientifically based research findings and best practices in inquiry based instruction.
4. To enhance participants' use of assessment data to monitor the effectiveness of their instruction.
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.

Evaluation of Success of Project Objectives

1. Improve student achievement in mathematics. Since MAP scores have not been released as of this writing, other methods of assessing the success of this objective were used. In a survey completed by 24 participants at the March meeting, responses to a question asking how they measured PRIME's affect on the success of their students included; Benchmark and chapter tests scores are higher, level of discussion in class is deeper, better questions are being asked by students, students are better able to complete the MAP released items used in preparation for the MAP test.
2. Increase teacher participants' knowledge and understanding of key mathematical concepts. To evaluate this objective, a pretest at the beginning of the institute was given to assess content knowledge in algebraic relationships, geometric and spatial relationships, and data analysis and probability. At the end of the institute a posttest was given to measure content knowledge in these same strands. In November, participants completed a post-posttest containing questions similar to the ones in the pre- and posttest. These tests were prepared by the Center for Research in Mathematics & Science Teacher Development at University of Louisville, Louisville, Kentucky. A matched pairs design t -test was used to compare the scores on the pre- and posttests using the hypotheses; $H_0 : \mu = 0$ vs. $H_a : \mu > 0$. The t for the mean differences was $t = 3.28$ with a $p = .001$. This indicates that the null hypothesis should be rejected at the $\alpha = .05$ level and there was an indication that there was an increase in content knowledge. The post-posttest was completed to assess continuing content knowledge. This test was completed by participants and mailed to project personnel in November. A simple t -test of the difference of mean scores between the posttest and the post-posttest with hypotheses; $H_0 : \mu_1 = \mu_2$ vs. $H_a : \mu_1 < \mu_2$. The $t = 3.34$ and $p = .00007$ indicate a significant difference at the $\alpha = .05$ level. This test was chosen

because the n for the posttest was 30 and the n for the post-posttest was 27. There is a realization that one glaring variable which could not be controlled for in the post-posttest situation was access to outside help in completing the test. Since we were not able to meet in December as planned, having participants complete the test at home and mail it back was our only other alternative. Table 11.10 of the external evaluator indicates that participants felt that their content knowledge had increased.

3. Improve teacher participants' practices in inquiry-based instruction. Of the 24 surveys completed at the March meeting, 19 indicated they were using inquiry more than before, one (1) indicated using inquiry significantly more. The one who responded significantly more had participated in another PD project at Northwest Missouri State University in which inquiry was a strong component. She wrote; "... I now see that inquiry can be incorporated into more everyday type lessons instead of only being major once in a while lesson that take tons of prep time." In table 11.8 of the external evaluators report, 22 of 28 respondents indicated "very much" in their perceived improvement in using inquiry/problem-centered teaching.
4. To enhance participants' use of assessment data to monitor the effectiveness of their instruction. Our goal was to have someone from the Northwest RPDC come to class and work with participants on using MAP data to make decisions about classroom curriculum emphases. Time did not permit this to take place. Instead we had a discussion among participants about how they used the data and project personnel gave suggestions about how to use MAP data and pretest data to make decisions about curriculum. An assessment of this objective was not appropriate given the small amount of time spent in attaining the goal.
5. Improve the preparation of pre-service teachers. This objective requires more time to assess given its nature. Placing student teachers in classrooms led by participants is a step toward accomplishing this objective. Three of the participants work in the Maryville School District where Northwest Missouri State University is located. Very frequently these teachers have practicum students and student teachers in their classrooms. Northwest is currently working to create a partnership with the North Kansas City School District which will ultimately result in more of our pre-service students having experiences in classrooms in that school district. Five (5) of the PRIME participants are from North Kansas City. St. Joseph School District is 45 miles away from Maryville. Some of our pre-service teachers are from St. Joseph and often they return there to student teach. Having teachers in these school districts who are using what we teach our students, inquiry-based instruction, will provide opportunity to practice inquiry learning in mathematics.

Description of connection to Grade Level Expectations

GLEs used in the summer institute's lessons:

Algebraic Relationships 1B, 1A, 4A

Geometric and Spatial Relationships 3A, 2A

Data Analysis and Probability 1A, 2B, 3A

Participants wrote lessons using these GLEs after participating in an inquiry lesson presented by project staff.

Disseminations

The original dissemination plan at the December meeting was for participants to share lessons with conference attendees in a session. It was not possible to attend due to weather. However, various lessons were selected to share with teachers at an elementary school in St. Joseph School District as part of professional development. Participants were encouraged to share their lessons with teachers in their schools. Lessons created by participants are being used in methods classes as examples of inquiry lessons.

Proposed dissemination:

We submitted a proposal for a presentation to the NCTM regional conference in Kansas City. Considerations are being given to publishing an article about the PRIME experience.

Conclusion

It is the belief of the project personnel that PRIME was successful. Indications from the external evaluators report and the survey as well as conversations with participants are that the knowledge of and comfort level with teaching mathematics using inquiry has increased. These same indicators lead us to believe that students are responding positively to the use of inquiry by having improved grades and by engaging in more informed discussions in the classroom. Moreover, participants have a perception that the level of success in mathematics for their students is increasing.

Should we at Northwest Missouri State University engage in another project similar to PRIME, there are some improvements to be made. Dividing into two groups, one for teachers with an elementary certification and another for those with a middle school certification, might help in creating lessons directed towards improving content knowledge. The lesson writing portion of the institute could be better directed with more help from project personnel. It might also be useful to increase the number of content

strands for middle level teachers but decrease the number for the elementary. More time might also be given to practicing the lessons written in an effort to make improvements before trial in the classroom.

Please note:

The Compliance Audit Checklist has been completed and sent prior to the submission of this report.