



Partnership to Rejuvenate and Optimize Mathematics and Science Education in Florida

Math and Science Matters

A Newsletter for Florida's Educators

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Enhancing Mathematics and Science Education in Year 2

The purpose of Florida PROMiSE is to support the implementation of the Next Generation Sunshine State Standards (NGSSS) by enhancing the mathematics and science knowledge of teachers so that they are better able to support student learning.

Florida PROMiSE is a three-year partnership among the three Florida Public Research Universities (USF, FSU, & UF), four large school districts (Miami-Dade, Hillsborough, Duval, & Seminole), educational consortia (Heartland Educational Consortium (HEC), North East Florida Educational Consortium

(NEFEC), & Panhandle Area Educational Consortium (PAEC)), Florida Virtual School, and Horizon Research, Inc. Throughout Year 2, PROMiSE has continued its progress with its ongoing projects. The focus of Year 2 has been teacher professional development in mathematics and science in order to prepare educators to align instruction with the new standards.

PROMiSE recently completed its series of Summer Institutes for mathematics and science teacher professional development with successful results (for detailed information,

please see page 2).

CPALMS is continuing to add and review resources for teachers and recently released QuickConnect in May (for detailed information, please see page 4). Also, PROMiSE Leadership in Mathematics and Science Instruction professional development is completing its final session for the 2009 cohorts (for detailed information, please see page 3).

For additional information on Florida PROMiSE and its ongoing efforts, please visit www.flpromise.org.

Preparing Mathematically Powerful Students: Developing Mathematical Habits of Mind

Thinking about the future is sometimes unsettling because it is so difficult to predict. Experience tells us that today's elementary students will enter the workforce in a world with problems that do not yet exist. Given the uncertain needs of the next generation of high school graduates, deciding what mathematics to teach can be challenging.

The real goal of mathematics education should be to produce mathematically powerful students – students who are flexible and fluent in their ability to do mathematics. Speakers of a second language are considered fluent when they can “think” in that language; they don't have to translate each word individually and lose the meaning and context of the thought. Athletes are considered flexible in their thinking when they consistently make appropriate decisions in reaction to unexpected plays made by an opponent. Mathematical flexibility and fluency comes from recognizing and understanding mathematical relationships, and using them to make sense of information, situations, and problems they encounter, not from simply

memorizing rules and procedures or practicing rote procedures until they can do them automatically. Certain lines of thinking, when used habitually, lead students toward specific learning outcomes. Real learning of mathematics is about developing these lines of thinking while understanding the established results in the discipline of mathematics.

To enhance the capacity of teachers to prepare students for the future, Florida PROMiSE will focus on developing these mathematical habits of mind in the follow-up to the summer mathematics institutes.

What Are Mathematical Habits of Mind?

Habits of mind are those well-established thinking behaviors and patterns characteristic of methodical and logical thinking. Habits of mind develop as the learner pays attention, over and over again, to “what works” (e.g., what helps in solving problems or what can explain the regularity in a particular pattern) and looks for cues in new situations that previously-used approaches may help.

Mathematical habits of mind are productive ways of thinking that support the learning and application of formal mathematics. Goldenberg, Cuoco, and Mark (1998) equated the notion of habits of mind with mathematical power:

Mathematical power is best described by a set of habits of mind. People with mathematical power perform thought experiments;...think about methods, strategies, algorithms, and processes;...seek to explain passionately about intellectual phenomena. (39).

Mathematical habits of mind represent mathematically important thinking, particularly as it contributes to problem solving. They connect to helpful findings in the research literature on the learning of mathematics and the development of mathematical thinking. Mathematical habits of mind lend themselves to instructional use and can be supported by evidence that appears often in work with teachers and students.

(continued on page 2).

Developing Mathematical Habits of Mind (continued from page 1)

There are content-specific habits of mind that make students flexible and fluent in a specific discipline of mathematics. Mark Driscoll and his colleagues at Education Development Center, Inc., have developed frameworks highlighting productive mental habits geared specifically toward geometry and toward algebra. They have identified four geometric habits of mind and three algebraic habits of mind (below). Using a framework for highlighting productive mental habits helps teachers focus on how students are thinking about the mathematics instead of just on the end result of that thinking.

Geometric Habits of Mind

Reasoning with relationships: looking for relationships (congruence, similarity, parallelism, etc.) within and between geometric figures in one, two, and three dimensions and thinking about how the relationships can help your understanding or problem solving.

Generalizing geometric ideas: wanting to understand and describe the “always” and the “every” related to geometric phenomena.

Investigating invariants: an invariant is something about a situation that stays the same, even as parts vary.

Balancing exploration and reflection: trying various ways to approach a problem and regularly stepping back to take stock.

Algebraic Habits of Mind

Doing—Undoing: reversibility— understanding a process well enough to get to a goal and to work backward from the answer to the starting point.

Building Rules to Represent Functions: input related to output—being able to recognize patterns and organize data to relate input to output by well-defined functional rules.

Abstracting from Computation: the capacity to think about computation independent of the numbers they are tied to in arithmetic— abstracting system regularities from computation.

Why Habits of Mind?

Mathematics is a dynamic discipline that continues to be developed in this century, mathematics that will be the basis for scientific innovations developed in the next century. Topics within mathematics will evolve with the new innovations, but the thought processes, the ways of looking at things, and the habits of mind used by mathematicians, computer scientists, and scientists will be evident and will influence almost every

aspect of our daily lives.

Preparing our students for life after school means equipping them with the ability to use, understand, control, modify, and make decisions about a class of technology that does not yet exist. That means we have to help them develop genuinely mathematical ways of thinking.

References

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PROMiSE Teacher Professional Development Summer Institutes

In order to improve mathematics and science student learning and achievement, PROMiSE provided teacher professional development Summer Institutes in mathematics and science. From June–August, a total of 26 (13 in mathematics and 13 in science) two-week Summer Institutes were held at various campuses and schools within partner districts.

The goal of these Institutes was to deepen the content-specific knowledge and skills of teachers of mathematics and science in order for them to effectively deliver the Next Generation Sunshine State Standards (NGSSS) to their students. Through the Summer Institute program, approximately 1,000 educators obtained inquiry-based experiences, activities and investigations in mathematics and science subject matter. The areas included were:

- ◆ Number and Operation (Teachers of grades K-5 mathematics)
- ◆ Rational Number & Proportional Reasoning (Teachers of grades 3-8 mathematics)

- ◆ Geometry & Measurement (Teachers of grades 3-8 mathematics)
- ◆ Algebra (Teachers of middle and high school algebra)
- ◆ Earth/Space Science (Teachers of middle grades (6-8) science)
- ◆ Force and Motion (Teachers of middle and high school science)
- ◆ Matter (Teachers of grades K-8 science)
- ◆ Scientific Theories (Teachers of science)

The experiences gained from these Institutes led to a statistically significant increase in participants' content knowledge (see page 3).



Force and Motion Summer Institute

The Summer Institutes were a successful collaboration among Colleges of Arts and Sciences (CAS), Colleges of Education and school districts and were a key element in helping PROMiSE achieve its mission. Through facilitator feedback and insights about this year's Institutes, PROMiSE will enhance and expand next year's Institutes.

Making Classroom Connections: Institute Follow-Up Sessions (4 days)

Four days of follow-up professional development will be offered during the academic year to teachers who participate in the Summer Institutes (Year 2 and Year 3). These follow-up activities will provide opportunities for teachers to engage in research-based activities that will enable them to connect the mathematics and science content gleaned from the Institutes to useable forms for classroom application.

For more information about the PROMiSE Summer Institutes and follow-up days, please visit www.flpromise.org and click on the *Professional Development Program* link.

PROMiSE Institute Outcomes: Significant Gains in Content Knowledge

A total of 955 teachers participated in the 26 Institutes conducted by Florida PROMiSE in summer 2009. As part of its evaluation of Florida PROMiSE, Westat developed pre- and post-institute assessments. The data provided information of value for assessing the effectiveness of the institutes in enhancing teachers' content knowledge in science and mathematics and identifying opportunities for their improvement.

Comparison of baseline and end of institute performance shows significant gains in knowledge, with effect sizes varying from .98 to .09. Larger gains were made at science institutes, where initial performance was generally lower than that at the mathematics institutes.

Figure 1: Number and proportion of teachers with a significant gain

<u>Institute</u>	<u>Number</u>	<u>Percent</u>
Algebra	73	39.9
Geometry and Measurement	29	47.5
Number and Operation	26	38.2
Rational Numbers	67	47.5
Earth and Space Science	45	76.3
Force and Motion	61	46.2
Matter and Energy	137	80.6
Scientific Theories: Naïve	44	59.5
Scientific Theories: Informed	42	55.3

The findings from the first offerings of the Florida PROMiSE Summer Institutes provide ample evidence that teachers who attended the institutes are making significant gains in their content knowledge. Further, teachers at all levels—elementary, middle, and high school—benefit from the content-rich institutes.

However, it is also clear that the participants could benefit from additional professional development building on the institute experience. The four follow-up days planned for the academic year will be important for consolidating and expanding the progress that has been made. For more information, Westat's complete report can be found by visiting PROMiSE at www.flpromise.org underneath the *Evaluation* link.

PROMiSE Leadership in Mathematics and Science Instruction PD

The purpose of the PROMiSE Leadership in Mathematics and Science Instruction project is to prepare Florida's educators to make changes in mathematics and science instruction aligned with the challenging Next Generation Sunshine State Standards (NGSSS).

The professional development takes place over the course of one year. Cohorts of up to 75 participants, consisting of elementary teacher leaders and their principals, attend four face-to-face sessions, each spanning two days, focusing on mathematics and science content, instruction, and assessment. Between each of the sessions, participants will engage all mathematics and science faculty in their schools in activities designed to enhance knowledge of the standards and how to teach them.

The PROMiSE Leadership in Mathematics and Science Instruction professional development team is completing the final sessions for the 2009 cohorts. Teacher leaders and their principals are continuing their training this fall with a strong focus on science content with integrated mathematics and literacy. The training dates for these cohorts are as follows:

2009 Updated Cohort Training Dates

COHORT #3, Session #4:

November 9 & 10 in Miami

COHORT #5, Session #4:

November 12 & 13 in Miami

COHORT #7, Session #4:

November 30 & December 1 in Celebration

COHORT #8, Session #4:

December 2 & 3 in Celebration



PROMiSE Leadership in Mathematics and Science Session # 4

PROMiSE has been receiving positive feedback about the Leadership professional development sessions that have been held thus far. Feedback indicates that sessions have been helpful in educating teacher leaders and their principals about the mathematics and science knowledge needed to support the NGSSS standards for their students.

School leaders who are interested in registering for the professional development are encouraged to register online. At this time all cohorts are full, but a waiting list for training that will begin in January 2010 is being maintained. Once assigned to a cohort, principals will be asked to identify a teacher leader to attend the training sessions with them as a school team. The 2010 Leadership Professional Development is supported by grant funds obtained from the Teacher Quality Enhancement grant program awarded by the Florida Department of Education to FSU.

For any additional questions about the PROMiSE Leadership in Mathematics and Science Instruction professional development project, please contact Project Director Christi Moss at cmoss@lsi.fsu.edu, or visit the PROMiSE Website, www.flpromise.org, and click on *Leadership* under the *Professional Development Program* link.

CPALMS

CPALMS is a project aimed to:

- Develop a dynamic and database-driven system that allows managing and disseminating information on the Next Generation Sunshine State Standards (NGSSS) and Courses
- Develop a flexible database-driven system to allow various resource types to be tied to the benchmark.
- Provide easy-to-use tools to enhance the teachers' understanding of the NGSSS and strengthen their skills in selecting and aligning resources that support student learning.

CPALMS is accomplishing its objectives by creating a system of standards-based resource tools and information that integrates with the state database of standards and course directory. The resource information

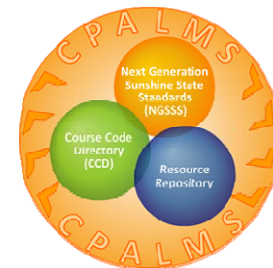
system currently provides free resources aligned to the NGSSS for math and science. Throughout 2009 and 2010, the resource system will provide authoring tools to create instructional resources (e.g. lesson plans and units), align them to the standards and share them with other Florida educators. All resources are reviewed by the CPALMS team of Math and Science content specialists, including practicing teachers, curriculum specialists, mathematicians, and scientists. Once approved, the resources are shared on the official NGSSS website (www.FloridaStandards.org) on the particular benchmark pages.

Florida educators have contributed more than 1,200 resources to CPALMS. All approved resources are now showing on the benchmark pages of the NGSSS official website.

CPALMS is also pleased to announce that

teachers can access related instructional resources from a course description page on the State's course directory. PROMiSE is currently working on the individual tools and will be releasing the first version of each of these tools this year.

You can learn more about CPALMS by visiting www.cpalms.org and www.floridastandards.org. For additional information or feedback, please contact us at cpalms@lsi.fsu.edu.



Program Components and Coordination

Florida PROMiSE

- Overall Project Management and Oversight: USF

Tier 2 Summer Institutes for Teacher Professional Development

- Mathematics: Development facilitated by USF
- Science: Development facilitated by UF
- Regional Development & Implementation Teams: UF, FSU, USF and FIU

Leadership in Mathematics and Science:

- Development and Implementation: Facilitated by FSU

CPALMS

- Development facilitated by FSU

Program Evaluation

- Internal Evaluation—Coalition for Science Literacy at USF
- External Evaluation—Westat

PROMiSE Mission Statement

To improve Florida student achievement in mathematics and science through professional development for Florida's educators and to build capacity to sustain quality implementation of the Next Generation Sunshine State Standards (NGSSS).

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For additional information about the Florida PROMiSE Project please visit:

<http://flpromise.org>