



FROM MEMORIZATION TO INQUIRY AND EXPLORATION

New Classroom Strategies Promote Science and Mathematics Literacy

By the Pacific Mathematics and Science Leadership Team

In the face of rapid scientific and technological development across the Pacific and throughout the world, all citizens need to be scientifically and mathematically literate. People today face a range of hard choices, from the personal (such as how to avoid disease) to the global (such as what to do about the greenhouse effect). People who understand science and mathematics are better prepared to sort fact from fiction, make sensible decisions, and urge their leaders to make informed public policy choices.

Literacy in science and mathematics is also economically important. The Pacific region needs workers who have the ability to solve problems and think creatively in all sectors of the economy and in a range of professions, including health, technology, finance, and economics.

Classrooms That Promote Science Literacy

Science includes a substantial body of knowledge, but it is more than that. It is a way of looking at the world and ordering one's experiences in it. A scientifically literate person is one who understands the key concepts and principles of science and uses scientific knowledge and ways of thinking in everyday life. Science education is most effective when it presents challenging content and helps students develop scientific methods of thinking. Science values inquiry – careful observation, thoughtful analysis, healthy skepticism, an approach that blends both logic and imagination, and the development of sound and coherent predictions and explanations.

Classroom Shifts That Support Literacy Development	
FROM	TOWARD
Science and mathematics as important only to some	Science and mathematics as necessary to all students
Lecture, reading, and language first	Instruction that meets the needs of diverse students
Teaching as imparting knowledge	Teaching as facilitating learning
Instructional decisions based on textbook content	Instructional approaches that build on students' prior knowledge
Treating students as passive learners	Engaging students in active learning
Learning as an individual process	Learning as collaboration
Focusing on theory	Applying knowledge to students' lives
Presenting ideas and concepts as disconnected pieces of knowledge	Connecting ideas in a holistic, integrated and thematic fashion
Presenting concepts only once or unnecessarily repeating similar content year after year	Employing a spiral curriculum that builds on prior knowledge
Memorizing of facts and information	Using inquiry to promote thinking skills and conceptual understanding
Measuring student achievement solely through pencil and paper tests	Using multiple assessment tools, including tasks, open-ended questions, and student portfolios

Good science teaching encourages students to be curious, creative, open-minded, willing to suspend initial judgments, able to collaborate with others and persist in the face of failure. In effective science classrooms, the activity

of finding out is as important as knowing the answer. Research has validated teaching strategies that help develop the values and thinking processes that define scientific literacy. These key strategies are listed in the sidebar that

accompanies this story.

In addition to a body of knowledge and a set of intellectual tools, science literacy means values. These include a deep caring for and commitment to people and the environment. The scientifically literate know, honor, and value the scientific wisdom of Pacific cultures. They honor the past, but are aware of the need to check knowledge and assumptions against new information. As they look ahead, they are ready to act upon their knowledge – of the living environment, human society, the universe, energy, and much more – to help preserve and improve our world.

Science literacy isn't just about what you know. It's about who you are.



Photo: Liame Shrig

▷ Active learning strategies like inquiry and exploration promote science literacy.

Classrooms That Promote Mathematics Literacy

In order to promote mathematics literacy, all students must have access to important mathematics. Students should not be separated into groups that study different content and are held to different expectations. Achievement in mathematics does not depend on innate talent. By opening important mathematics to all students, teachers and administrators ensure that all are intellectually challenged and have the same opportunities to develop mathematical power.

This approach to mathematical learning is characterized by dramatic shifts in mathematics education related to content, instruction, and assessment. Content that was once reserved for the top few is now accessible to all students. This includes probability, statistics, discrete mathematics, transformational geometry, functions, and algebra. Changes in instructional methods include the use of student language to develop ideas about these topics. Students are asked to demonstrate their mathematical understandings in a variety

of ways, including projects, journal writing, problem creation, and discussion.

With the proper instructional support, students will become mathematically literate, with the ability to find multiple solutions, problem-solve independently, and transfer knowledge to new applications. They will be able to use their mathematics thinking tools to solve problems not now in existence. They will make decisions based on an awareness of governmental, religious, economic, and other social trends and beliefs, and on an understanding of complex information, including environmental changes and their long-term implications.

Shifts in instructional methods and values require teachers to rethink how best to promote mathematics literacy. Lecture and practice, long the primary instructional approach in both elementary and secondary school, has produced students who depend on teachers to supply the “correct” problem-solving method and who have little experience in solving the kinds of problems they will encounter once they leave the classroom. With the new demands that are being placed on our students as they enter the workforce, we must restruct-

ture to provide mathematical experiences outside traditional curricula. By focusing on problem-solving activities, teachers can help prepare students to function in an ever-changing workplace. Even though the tasks students perform are mathematical, the solution strategies apply in everyday situations. Predicting, sorting necessary from unimportant information, and analyzing solutions in context are all important decision-making activities.

Mathematics is no longer just the language of specific fields like science, finance, economics, and accounting. While mathematical literacy makes it possible for students to maximize career opportunities, it also helps them grow into productive citizens capable of making informed decisions about their own lives, their government, and their global society.

This article is excerpted in part from the Pacific Standards for Excellence in Science and the Pacific Standards for Excellence in Mathematics, documents developed by the Pacific Mathematics and Science Leadership Team. Both are available at www.prel.org/work/ms/rsc/sf.asp. ★