PROMISING PROGRAM

Middle-school Mathematics through Applications Program (MMAP)

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Program Description

The Middle-school Mathematics through Applications Program (MMAP) is a comprehensive set of middle school materials based on projects. The projects, which utilize software tools, engage students with real-world problem solving and require them to learn mathematics and to apply what they have learned. MMAP, started in 1992, addresses the needs of students in grades 6 through 8 with a series of units that emphasize proportional reasoning, algebraic expressions, and functions. It also covers statistics, probability, measurement, and geometry. The materials are designed to increase students' conceptual understanding of mathematics, their competence with standard symbolic notations for mathematical concepts, and their ability to communicate their mathematical ideas to others. They also learn mathematical practices such as making conjectures, coming up with counter examples, and writing proofs.

For example, with the design unit Antarctica and the software ArchiTech, sixth- and seventh-grade students play the roles of architects who design an ideal living space for themselves or a client; seventh- and eighth-graders design a scientific research station in Antarctica. Thus, students learn about scale and standard proportional notation; learn to represent the real world symbolically; research Antarctica and the needs of their clients; consider the building and heating costs of their design; and present their floor plans, budget, and a written report to their class. These same skills are approached from a different perspective with the design unit Guppies and the software Habitech, for which students play the roles of population biologists who research, analyze, model, and make predictions about guppy behavior. They research behavior, reproductive habits, and life cycles of guppies; organize their data; model guppy breeding and feeding behavior; design a sustainable tank environment for guppies; and share their findings and suggestions with each other.

Quality and Educational Significance

Learning

Central to MMAP is the way in which the program engages students by placing them in software environments to solve open-ended design problems requiring the use of mathematics concepts. For example, Coding Toolbox allows students to use shift cipher, function, matrix, analysis, and

Program Costs

For cost information, please contact program designee.

compression tools to develop and test privacy and efficiency codes. The software complements, rather than dominates, the classroom activities. As students strive to improve their designs, they find themselves using sophisticated combinations of math tools, representations, and techniques.

By applying concepts to find solutions to relevant problems, MMAP students appreciate the power of mathematics. Their responses can be mathematically complex as well as tied to real concerns. Real-life contexts for learning and work-world technology tools help prepare students for the workplace.

MMAP's use of design processes, ongoing embedded performance assessments, and technology-based tools help students make explicit links between informal and formal mathematics. In the course of the Antarctica unit, for example, students are asked to compute the average yearly temperature in coastal Antarctica (computational skills, developing equations); furnish their floor plan design using resizable furniture icons in the ArchiTech software (scale and proportion); as well as graph and compare the relationship of building costs, heating costs, and insulation costs (patterns and functions). Other activities include building biological models and building digital maps with data layers.

Excellence for All

The overall design of MMAP is intended to engage more students successfully with mathematics, particularly students traditionally underserved in school math or those who find themselves alienated from it. The software and topics were designed to be equally unfamiliar but engaging to most middle schoolers (i.e., the simulation context of Antarctica, the professions of population biologist or architect). In addition, the technology is tool-oriented and relies on multiple representations; prior computer or math savvy is not necessary to achieve results.

The design process itself encourages the participation of many students as well as multiple solutions to a problem. Design begins with brainstorming, welcoming the different skills of different students and encouraging students to bring their personal experiences, skills, and identities to the task. For example, while working with ArchiTech on house design, one student compared the group's proposed design to the size of his own house and realized it was huge; the group revised its floor plan. Students work with others to learn what they need to know, rather than being singled out for not knowing something.

Organizational Change

Among MMAP's greatest accomplishments is that teachers—both those who are codevelopers as well as those who use the materials at a distance but participate in the ongoing online discussions and support activities—have rejuvenated their careers. Teachers report varied experiences that have helped

Usefulness to Others

MMAP has been successfully integrated in many settings and is currently used in racially, economically, and linguistically diverse communities in California, Alaska, New York, Florida, Michigan, Oregon, and Washington. It also serves students with learning disabilities.

The program is most successfully implemented in schools where students have constant access to a set of mathematical tools, including calculators and measuring devices, and where each MMAP class has access to at least four to six computers.

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them change and make changes. For some, it is seeing extraordinary things happen for students as they participate in new ways. Some are empowered when they start to use technology and find that it enables them and their students to improve. Teaching to standards and teaching with technology open teachers to new possibilities for student learning.

Evidence of Effectiveness

MMAP encourages flexibility in the ongoing assessment process, allowing teachers to gear their assessments to meet the individual needs of their students. The assessment process stresses the importance of a variety of means of communicating student understanding. Options include pre- and posttests, journals, log books, oral presentations, writing, peer reviews, teacher-student conferences, group meetings, and more. Progress reports can be given almost daily, affording the student immediate feedback.

A 1994 external evaluation surveyed 24 teachers and 42 students on program perception. Students, especially from traditionally underserved populations, indicated excitement and high motivation. Teachers also reported notable positive effects of MMAP on students' various skills in both cognitive and affective domains and on students' understanding of some mathematical topics. Results indicated a positive perception towards the program that was similar across gender and special education status. A 1995 teacher survey of 10 teachers provides some evidence that teachers have positive perceptions of the program and that they believe the program is beneficial to students.

An internal evaluation utilized classroom observation and videotape analyses, reviewed school test data from existing accountability assessments, and reviewed report card data to demonstrate student concept development and mathematical power (single group design). In 1997, program students in one classroom showed higher scores on algebra readiness tests in comparison to the same teacher's students in previous years with less usage of MMAP, and a 100 percent passing rate at mid-year in eighth-grade algebra, in comparison to the previous school average of 50 percent passing at mid-year. Anecdotal evidence also supports the claim of students' growth in mathematical understanding and improvement in student attitudes towards learning mathematics.

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