Improving Student Achievement in Math and Science

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INTRODUCTION

As the new millennium approaches, a long anticipated reckoning for the education system of the United States is forthcoming. Years of school reform initiatives have not yielded the anticipated results. A particularly perplexing problem involves the lack of significant improvement of student achievement in math and science. In addition, critical personnel shortages of secondary math and science teachers pose a formidable problem in the delivery of educational services throughout the nation.

The classrooms of the future will be vastly different. Education leaders in universities must vigorously accept the task of preparing teachers to work effectively with the learners of the next century in mastering math and science principles and concepts. Teachers cannot become the dinosaurs of the education process, unable to thrive in an environment in which they have not been prepared to even exist, much less prevail.

Three “Partnership” projects represent collaborative efforts between Xavier University (XU) of Louisiana, Southern University of New Orleans (SUNO), Mississippi Valley State University (MVSU), and the National Aeronautics and Space Administration (NASA), Stennis Space Center (SSC), to enhance student achievement in math and science. These “Partnerships” are focused on students and teachers in federally designated rural empowerment zones and urban enterprise communities.

XU and SUNO are located in New Orleans, Louisiana which is designated as an urban enterprise community. The potential for reaching at-risk students is almost unlimited. These partnerships provide this student population with needed opportunities to encourage self-improvement and assist them in discovering their talents, recognizing their potential and challenging their ability for achievement at a very early stage.

MSVU, Itta Bena, MS, is located in the Mississippi Delta, which is designated as a Rural Empowerment Zone. The Delta is primarily a rural agricultural farming region, producing crops such as catfish, cotton, soybeans, and corn. Students in this region historically perform poorly on standardized math and science tests. Teachers in this area have limited classroom resources but have been expected to face the difficult task of developing innovative methods for reaching these students. The general population served by these universities is socially and economically disadvantaged.

The major goals of the “Partnerships” are:

(1) Identification and dissemination of key indices of success that account for high performance in math and science.
(2) Education of pre-service and in-service secondary teachers in knowledge, skills, and competencies that enhance the instruction of high school math and science.
(3) Development of faculty to enhance the quality of math and science courses in institutions of higher education.
(4) Incorporation of technology-based instruction in institutions of higher education.

These goals will be achieved by the accomplishment of the following objectives:

(1) Delineate significant “best practices” that are responsible for enhancing student outcomes in math and science.
(2) Recruit pre-service teachers with undergraduate degrees in Biology, Math, Chemistry, or Physics for retention in a graduate program, culminating with a Master of Arts in Curriculum and Instruction.
(3) Provide faculty workshops and opportunities for travel to professional meetings for acquiring of NASA resources information.
(4) Implement methodologies and assessment procedures utilizing performance-based applications of higher order thinking via the incorporation of Global Learning Observations To Benefit the Environment (GLOBE), Earth Science curriculum support materials, and the use of Geographic Imaging Systems into the K-12th grade curriculum.

These three university partnerships are addressing the above stated objectives as described in the following brief partnership descriptions.
PARTNERSHIP 1

XU's Project Kaizen (PK) (Japanese meaning improvement) is involved with an ongoing process-oriented improvement strategy encompassing everyone in an educational environment (teachers, administrators and students).

PK will contribute to a better understanding of what policies, procedures and specific teaching methodologies should be integrated into high school math and science curricula to enhance student achievement. PK also addresses the role of institutions of higher education in educating future math and science teachers in methodologies that yield high student achievement.

PARTNERSHIP 2

The NASA/SUNO Partnership for Excellence in Education is a program of reform at both the institutional and academic levels. An electronic classroom will be established to improve the way mathematics and physics are taught by incorporating technology as a main tool for learning and teaching. The Faculty Development Program at SUNO will be expanded to enhance the quality of teaching in the Mathematics/Physics Department. The underlying premise and goal of this training is to equip the faculty with the ability to teach according to the recommendations made by the National Council of Teachers of Mathematics (NCTM) for implementing technology and writing in the classroom as an essential tool for learning.

The faculty will be trained to use questioning techniques that promote critical and analytical thinking, and to use alternative assessment to evaluate student progress and enhance learning. The faculty is also being trained to provide opportunities for the students to learn mathematics and science through discovery learning and hands-on experiments. Teachers are encouraged to engage students in research and provide assignments that require students to work collaboratively, thus producing life long learners.

PARTNERSHIP 3

MVSU/NASA Information Technology Partnership is an innovative two-year program using Global Learning and Observations to Benefit the Environment (GLOBE), Earth Science curriculum support materials and Geographical Information Systems to enhance the skills of in-service and pre-service teachers and the quality of instruction in mathematics and science in the Mississippi Delta. The major goal of the program is to educate in-service secondary teachers from public schools in the Mississippi Delta and pre-service secondary teachers from MVSU on the incorporation of technology-based instruction in secondary public school systems. In-service teachers and pre-service teachers receive rigorous academic experiences that integrate NASA resources, hands-on instructions, inquiry learning, lectures, and discovery activities during the intensive four-week program. The criteria for selection in the workshop is in-service participants must instruct in Biology, Chemistry, Physics, Mathematics, and Computer Science on the eleventh or twelfth grade level. Pre-service teachers must be enrolled in Biology or Mathematics Education and have completed the second semester of their junior year. Pre-service participants must also have a cumulative undergraduate GPA of 3.0/4.0.

Although each “Partnership” is unique, they all have common characteristics. They will each build electronic classrooms at the university, each introduce technology into the local high schools, participants are introduced to the Internet, NASA’s Earth Science Enterprise and Geographical Information Systems Technology. The GLOBE Program will be used by each “Partnership” as a means for teachers and students alike to continue using the skills they have acquired and stimulate interest in math, science, and their environment.

Teachers need to incorporate methodology that stresses hands-on learning, concept development, cooperative learning, higher-order thinking skills, and learner-centered activities that transmit information holistically, instead of discrete non-connected facts, formulas and procedures (Math, Sciences Education Board 1993[1], Loucks-Horsley et al 1990[2], National Center for Improving Science Education 1989[3] and Tobias 1992[4]).

The fundamental ideas, principles, and concepts of mathematics and the biological, physical, and environmental sciences can be taught by increasing the subject content information of the teacher. An emphasis on discovery and inquiry techniques is essential. Student outcomes in math and science can improve by: integrating essential content across disciplines; fostering problem-solving, promoting critical and analytical thinking; and encouraging learners to construct understandings of math and science processes for themselves. The goal is not to implement pedagogical strategies, but rather to structure, monitor, and adjust activities in which students engage (Rochler and Grouws 1992)[5].

Although most secondary math and science teachers may not be recipients of a Nobel Prize, they can be winners of a different kind. They can strive to be the best in their profession by educating and inspiring our most prized American possessions, the children of today who will be the teachers and leaders of tomorrow.

REFERENCES


