Date: Wed, 19 Mar 2003
From: Jane Jackson <Jane.jackson@asu.edu>

CLOSING THE GAP BY INTEGRATING 9TH GRADE ALGEBRA AND PHYSICS using MODELING INSTRUCTION

We have some evidence that an integrated 9th grade algebra and physics course can contribute to closing the achievement gap among Anglos, Hispanics and blacks and reducing the dropout rate. The central elements are Modeling Instruction, true course integration, students who are willing to work, and extended daily time with students in a learning community.
cheers,
Jane Jackson

DETAILS:
In 2000-01 a team of two Phoenix area high school teachers, each of whom had participated in 3 or 4 weeks of Modeling Workshops, taught a successful integrated algebra and physics course (it was called a Math & Science Academy) to 9th grade Hispanic and black students at Tolleson High School, a largely minority public school in urban Phoenix. Three students were classified as ESL, and only one student had a college-educated parent.

The teachers used Modeling Instruction in a full year course of 2 consecutive 90-minute blocks daily. For the first block, both instructors taught. For the second block, only one teacher taught.

The teachers identified use of Modeling Instruction, the integrated approach, and the extended time (thus enabling the students to become a learning community) as the three most important factors in their success. "A crucial element was that we rarely differentiated the allotted time. We didn't do 1 1/2 hours of algebra followed by 1 1/2 hours of physics. It was truly, and as much as possible, an integrated approach", they said. "You can't do science without being proficient in the language of science, which is math."

Their students, who tested into REGULAR algebra at the beginning of the year, scored higher in the district's end of year achievement test than the traditionally taught HONORS 9th grade algebra class. The students' Force Concept Inventory posttest scores averaged about 61%; these scores are comparable to those for typical honors physics courses of high school seniors that are taught by Modeling Instruction, and to Arizona State University's (ASU's) calculus-based physics course for engineers, which is taught traditionally.

At the end of the year, ten students took an ASU placement exam for Prof. J. Bustoz's summer math/science honors program for disadvantaged minorities in high schools. All but one of those students placed into pre-calculus. The next fall, as sophomores, they enrolled in a Tolleson High School junior-level course: "Math Analysis".

The two Academy teachers told us that, in their experience, Hispanic and black children's lack of school achievement is "a family environment problem, not a cultural problem." "Their parents are getting by, surviving, without an education. There are no books in the house, no quiet place to work at home, their parents can't help them. Put them in a good environment and they'll learn", they said. "The extended time with the students was important!" "One student was ripe to be a gang member, and he turned completely around. He scored 97% on the FCI", they said.

We believe that similar excellent results with such "Math-Science Academies for minority students" can occur at other schools if they are preceded by sufficient teacher training and have school administration support.

This report and descriptions of other 9th grade implementations of Modeling Instruction are online in pdf format at <http://modeling.asu.edu/listserv.html>.

Notes and supplementary information. Statements in quotes are comments by either of the two teachers.

1. The Force Concept Inventory (FCI), the most widely used test of conceptual understanding in physics, is online at <http://modeling.asu.edu>. Click on "Research and Evaluation."
2. Students' pretest FCI scores averaged 19%, a random score.
3. The teachers wanted 28 to 30 students but, due to computer problems and privacy issues, had to start with only 22 students. "The students were selected for this program. We asked for recommendations from the 8th grade teachers for students who met basically three criteria: a) "disadvantaged" student, b) average or below in algebra, c) students who would work hard. We also encouraged teachers to recommend students who had the ability and, without this program, might fall through the cracks. We need to be honest and realize that this program will not work unless the students are motivated and willing to work. ... Also noteworthy is the fact that the majority of the students had sub-par math scores, but average or above average reading scores."
4. Sixteen students completed the year. "A couple refused to work; one withdrew because his parents wanted him to 'have fun' in high school and thought he had too much homework from us; one transferred to a different school." Of the 16 who finished, three were black and the rest Hispanic; 7 were girls, 9 were boys.
5. Each unit started with labs, to show the NEED for math: math was a language for the science that they did. Computers were used with MBL probes. Science content was mechanics. (Modeling Workshop participants can freely download instructional materials.)
6. "We had lots of discourse: we forced kids to talk science." They used a variety of strategies: circle whiteboarding, Socratic questioning, and team presentations.
7. Mandatory tutoring was enforced.
8. Parental involvement consisted only of an initial agreement to allow their child to be in a "special class" and a requirement that the student attend tutoring sessions.
9. "The students felt special; they knew that they were getting background knowledge for any career, they knew that they were doing junior and senior level work. We had high expectations of them." The ability to take a summer school class at ASU was important for the motivation of a few students.
10. "The district has a criterion reference math test; it was too easy - the students scored in the 90%'s. Class averages of students in other regular 9th grade algebra were in the 60% to 70%'s. Our students did better than the honors algebra class of about 20 freshmen."
11. "It is important to note that the administration provided the financial support for this program. It was not difficult to obtain the necessary equipment for the most part. And they were willing to spend extra money to allow two teachers to teach a small class (an added cost of over $10,000). The support in other areas was poor..."
12. "I can't begin to describe the amount of respect and admiration I have for the lead instructor. He really made the difference with the program. He works very well with the students and makes the concepts very easy to comprehend. I learned a tremendous amount from him and am a better teacher because of this association."