

Modeling Instruction Program

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MEMO

To: Principals and science and mathematics teachers of grades eight and nine

From: Jane Jackson

Subject: Solving the math problem: AIMS math test gains due to modeling instruction and CIMM

Since solving the math problem is important and urgent, I share with you solid evidence for the effectiveness of Modeling Instruction and Cognitive Instruction in Mathematical Modeling (CIMM) for urban middle school students. This can improve the high school graduation rate, and it can contribute to Arizona's economic development; but best of all, it can enhance the well-being of our culture by making it possible for many more people to think, reason, and understand. **Results are so promising that schools should make every effort to have teachers take our graduate courses.**

Denis Lawton, an experienced and highly regarded 8th grade mathematics teacher in an urban Phoenix elementary school, reported that 65% of his students passed the 8th grade AIMS math test in spring 2007, the year after he took our graduate course, PHS534: "Methods of Physical Science Teaching." The previous year, only 48% of his 8th grade students passed that test. He reports that his 2007 students started out worse-prepared than the previous year's group. **This is a huge improvement: two-thirds of his students passed the AIMS math test, compared to only half in the year before he took our course.**

He states as chief reasons for his improved AIMS pass rate that he implemented his course learning from summer 2006 at ASU. Specifically, he did one-week modeling cycles eight or nine times during the year in his pre-algebra sections. These students were regular to low-level, he said; all but one were Hispanic, one-half were ELL, ten were SPED with learning disabilities.

Causes of success were, he said in a phone interview, "a deliberate focus on what concepts *mean*; repetition; modeling; kids having to verbalize and describe in whiteboard presentations, and me as the teacher going into the cycle with a crystal clear vision of what I wanted the students to produce at the end."

He began each modeling cycle with an activity in mathematical modeling that he learned in the course (modeling workshop); among them were measurement activities using Cognitive Instruction in Mathematical Modeling (CIMM) developed by our volunteer researcher, Dr. Robert MacDuff, and adapted by workshop leaders Patricia Burr and S. Lee Rodgers. He taught slope in connection with graphing and linear equations for the first time to his pre-algebra students.

Students prepared whiteboards and gave presentations for a couple of days in each cycle. He said, "Doing the math was only part of it; kids *thought deeply* when preparing whiteboards about what questions I'd ask them. They prepped one another for this."

Denis gathered evidence showing the progress of the 66 students (out of 90) in his 8th grade math classes who had also taken the 7th grade AIMS test at his school (from a different teacher). SPED students are included in the 66, he said. He wrote, "I looked at data analysis, algebra, and measurement -- the items we repeatedly explored in modeling." Here is a summary of some of his results. The number of those 66 students who got higher than 65% correct in each topic are:

AIMS test TOPIC	% CORRECT	7 TH grade AIMS Test	8 th grade AIMS test	gain
data analysis	66% & higher	35 students (53%)	49 students (74%)	20%
algebra -- overall	66% & higher	23 students (35%)	42 students (64%)	30%
geom. - measurement	70% & higher	24 students (36%)	36 students (55%)	20%

He wrote about these data, "I found that we were hitting almost one-half of the eighth grade standards with each modeling cycle. **I have no other explanation [than modeling instruction] for the incredible growth we saw.**"

Another way of looking at it is, for the 66 students who took both tests while at his school, their AIMS math scores in standard format are:

AIMS math test	7 th grade	8 th grade
Falls far below	14	11
Approaches	21	10
Meets	31	41
Exceeds	0	4

Again we see a huge improvement in math achievement from grade 7 to grade 8.

Denis is the only eighth grade math teacher in his school. He said that he hopes his district won't revert to more traditional 'drill and kill' methods; he wants to use his evidence to convince his district that modeling instruction is a better way. (He gave written permission to use his name.)

Commentary and further evidence:

We have similar evidence of astounding success from other experienced teachers. For example, Robin Inskip, an eighth grade *science* teacher at Gonzales Elementary School in Tolleson Elementary School District, wrote,

Date: Fri, 01 Oct 2004

From: "Inskip, Robin" <RINSKEEP@tesd.k12.az.us>

I truly believe that the two modeling classes that I have taken, Methods of Teaching Physical Science and CASTLE, have greatly improved my teaching methods, which have resulted in the students having a deeper understanding of the concepts being taught. Last year was the first year that this method was implemented with the entire 8th grade. Without a doubt, the skills that I learned through the modeling courses were the major reason that **this class' scores for math approximately doubled in the 'meets and exceeds' category on the AIMS test** spring of 2004. You have my permission to quote anything that I have said.

CIMM was piloted with tremendous success at Paradise Valley High School in 2006-2007 by Math Department chairman Robyn Rosenthal and two teacher colleagues. That district's expansion of the pilot program in CIMM to four more schools this year is overwhelming support for its effectiveness.

The need is urgent. We have a solution to the math problem. No only that, but it's connected to solving the science problem. They go together. **The work is so important and the results so promising that schools should make large efforts to have teachers take our graduate courses.**

Appendix: the modeling workshop at ASU

Denis Lawton took PHS 534/MTE 598: Methods of Physical Science Teaching (Physical Science with Math Modeling Workshop). The course provides 8th and 9th grade teachers of science and mathematics with education in Arizona standards-based content and instructional strategies. Participants are introduced to the Modeling Method as a systematic approach to the design of curriculum and instruction. The name Modeling Instruction expresses an emphasis on making and using conceptual models of physical phenomena as central to learning and doing science. Mathematics instruction is integrated seamlessly throughout the entire course by an emphasis on mathematical modeling. Anticipated student outcomes include improved understanding in geometrical and physical properties of matter, mathematics and reasoning skills such as algebraic proportions, independent & dependent variables, relation between graphs and equations, and measurement & estimations; energy and states of matter. The course was taught by Patricia Burr and S. Lee Rodgers, teachers of ninth grade physical science at South Mountain High School in the Phoenix Union High School District.

For information: <http://modeling.asu.edu/MNS/MNS.html>