

Who are we teaching and how do we teach them?

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Mathematics Partnership

Motivating Questions

- How should pre-calculus (service/general education) courses be taught?
- What is the teaching role that one should model for future elementary and secondary teachers?
- How do we encourage reflection upon the professor's role as a teacher of teachers?

The Big Picture

- “The Wu Li master does not teach but the student learns”
[Gary Zukav , *The Dancing Wu Li Masters*]
- Challenge the traditional paradigm of the sagacious mathematician delivering knowledge to the eager (or not so eager) student.

Topic Outline

- Part 1: Recent influences on Math Pedagogy at UAB
 - Greater Birmingham Mathematics Partnership (NSF Math/Science Partnership)
 - Quantitative Literacy (QL)
 - Course Reform: Active vs Passive Learning
- Part 2: Finite Mathematics (MA 110) at UAB
 - Wiliam Bond

Greater Birmingham Mathematics Partnership

- Partners in GBMP
 - 9 Birmingham area school districts
 - University of Alabama at Birmingham
 - Birmingham Southern College
 - Mathematics Education Collaborative (WA)
- Summer courses for in-service teachers
- Internal and external leadership development
- Parent and community awareness
- Course revision in higher education
 - Middle school mathematics certification
 - New mathematics major track at UAB

Challenging Courses and Curriculum (CCC)

- Deepening knowledge of important mathematical ideas
- Productive disposition
- Inquiry and reflection
- Communication

Quantitative Literacy at UAB

- UAB SACS Re-Accreditation 2004
- Quality Enhancement Plan (QEP)
- Shift of General Education Focus
 - From: Checklist of courses
 - To: Shared Vision for a UAB Graduate
- Areas of QEP Emphasis in Shared Vision
 - Communication through writing
 - Ethics and civic responsibility
 - **Quantitative literacy (QL)**

Course Reform: Active vs Passive Learning

- How to turn passive learners into active learners?
 - Engage them
 - Keep them motivated
 - Pay them with grades
- First Step
 - Reduce didactic instruction
 - Adopt computer-assisted instruction
 - Variety of problems (on the computer)

GBMP Summer Courses

- Longitudinal data on teachers' mathematics content knowledge
 - CKTM is a (algebra) teaching/content knowledge test largely based on Deborah Ball's work
- Analysis of middle school student test data
 - SAT 10

Center for Educational Accountability (CEA) at UAB
Rachel Cochran, chief GBMP evaluator

CKTM Longitudinal Data

- n=21 teachers
- **Pre** = day before Patterns (1st course)
- **Post** = last day of Patterns
- **Long** = at least one year after Patterns and last day of second or third course

Pre-Post

- Median increase: + 3 points
- Range of increase: -2 to +10
- IQR: +2 to +5
- Two decreased, two stayed the same, rest went up

CKTM Longitudinal Data

Post-Long

- Median increase: +2 points
- Range of increase: -3 to +5
- IQR: +0 to +3
- Three decreased, five stayed the same, rest went up

Pre-Long

- Median increase: +5 points
- Range of increase: -2 to +10
- IQR: +2 to +7
- One decreased, rest went up

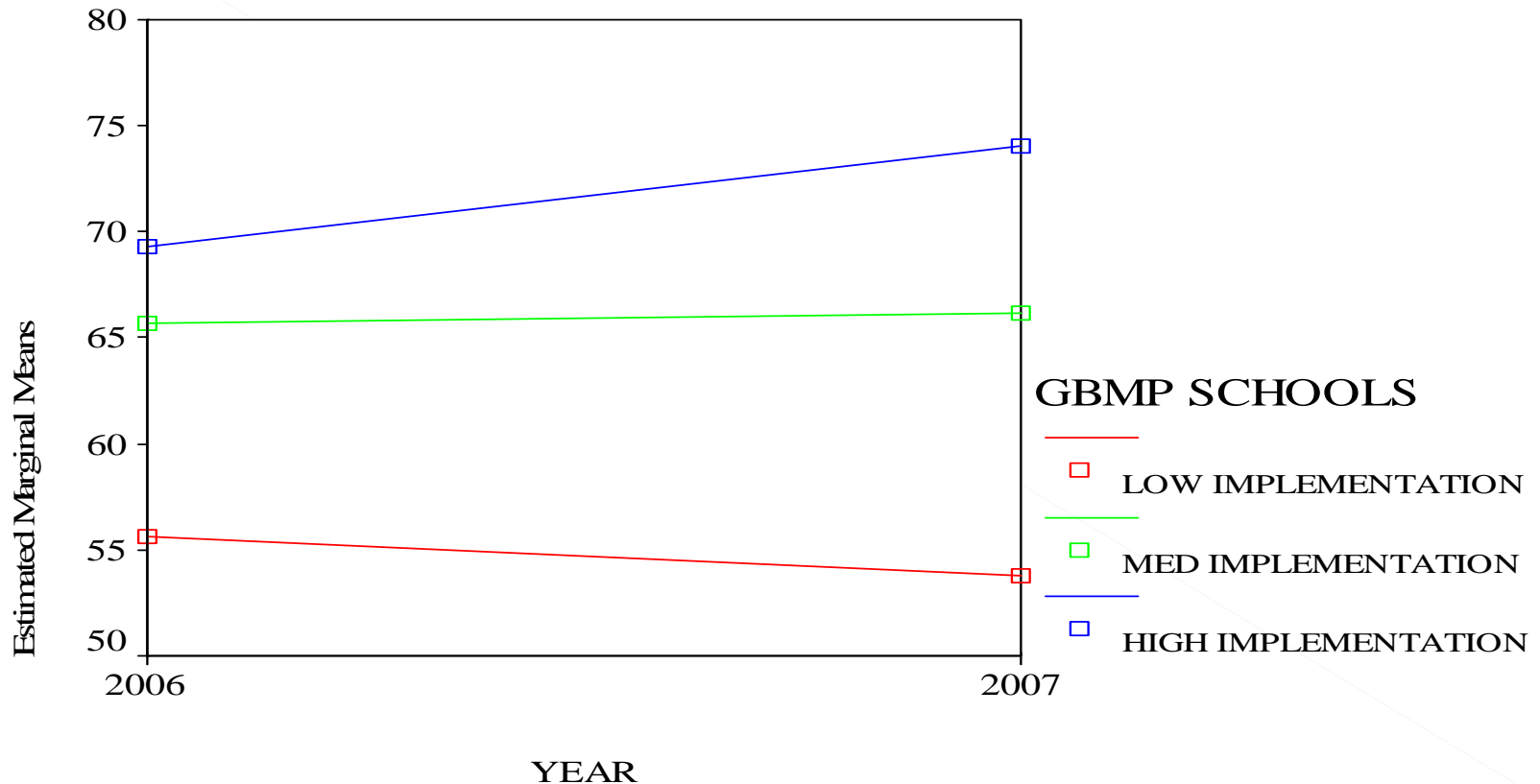
Changes in GBMP Schools by Implementation Level

- 3 systems for which SAT-10 scores available
 - High Implementing Schools
 - Medium Implementing Schools
 - Low Implementing Schools
- Changes in students' scores 2006\2007 compared
- Statistically significant interaction

Student Data

GRADE 4 TO GRADE 5

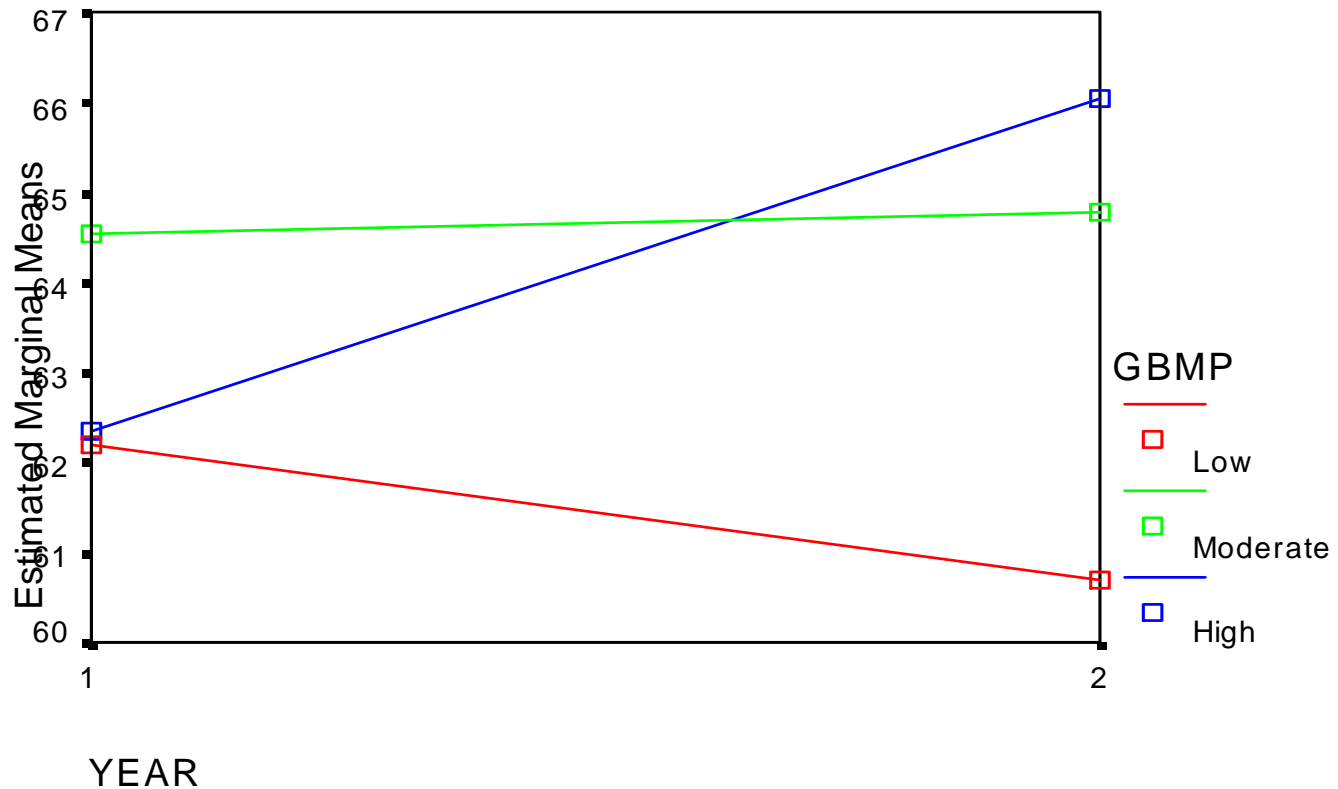
SAT 10 NORMAL CURVE EQUIVALENTS



Student Data

System B: 4th to 5th GR Schools

SAT 10 Scores



Finite Mathematics

MA 110 at UAB

- Base: Computer assisted instruction
- Power:
 - Why value group work?
 - What comes from frustration?
 - Comparative Study of Pedagogy Underway

Active Learning – Computer: All Pre-Calculus Classes

- 1/3: One class meeting per week
 - What do we do with this class meeting?
- 2/3: Assigned and self-selected time in Mathematics Learning Lab (MLL)
- Assessment
 - Attendance (class & lab) (14-28%)
 - 20-30 homework problems per week (7-10%)
 - Weekly quiz (7-10%)
 - Four tests per semester (and final) (60-70%)
- Variety of assistance on computer and in lab

Computer Assisted Instruction

- PROS

- Actively engaged with material
- More time spent on task
- On-demand help in lab

- CONS

- Algorithmic learning
- Emphasis on memorization
- Computation rather than thought
- Tenuous connection with QL

Group Work Class Format in MA 110

- Groups of three to four people are selected at random at the beginning of each class
- Each group is given the same in-class problem
- Group of Four Rules
- Groups write up a solution and explanation
- Groups volunteer to share their solution and reasoning with the class

Group of Four Rules

- Each member takes responsibility for his/her own learning
- Each member is willing to help every other member who asks for help
- Groups may ask the teacher for help only when all members have the same question
- There is always a further challenge!

Mathematics Education Collaborative

Why Value Group Work?

- Addresses cons of computer assisted instruction
 - Students construct their own mathematical understanding
 - Emphasis on problem solving, communication, and justification
 - Addresses UAB QL goals
- Ideas inspired by GBMP summer courses
 - Focus on “big” mathematical ideas
 - Expandable tasks
 - Importance of frustration to learning process

What comes from Frustration?

- Building of self-esteem and productive disposition
- Deeper understanding of content
- Long term retention
- Improved ability to communicate mathematical thinking
- Improved problem-solving abilities

We see all this in the GBMP summer courses for teachers.

Comparative Study, Fall 2008: MA 110 Class Formats

- Same computer assisted lab instruction
- Three different class meeting formats
 - Lecture on up-coming material
 - Lecture on up-coming material and weekly in-class short quiz
 - Group work with no prior instruction
- Random assignment of students to class formats

Why a Comparative Study?

- Previous data based on
 - GBMP summer courses for teachers
 - UAB mathematics courses for elementary teachers
 - No computer assisted instruction component
- Will the combined approach work for general studies students?

Comparative Study: Measurements

- Content pre-test and post-test
 - Problem identification
 - Problem-solving
 - Explanation
- Mathematics self-efficacy survey
- Course grades
- Focus groups at end of semester
- Delayed post-test (one year)

Comparative Study: Hypotheses

- Hypothesis 1: Classes will have similar grades regardless of class meeting format
- Hypothesis 2: Group work class will have improved mathematics self-efficacy
- Hypothesis 3: Group work class will have improved mathematics communication skills
- Hypothesis 4: General studies students will benefit from inquiry-based instruction in mathematics

Summary of Results

- Watch this space

Where to Get More Information

- <http://www.math.uab.edu/GBMP/>
- <http://gbmp.mspnet.org/index.cfm/>