The Arizona Teacher Initiative at the Institute for Mathematics and Education

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MSP Learning Network Conference, 2008

- Middle school teachers with a profound understanding of middle school mathematics and with leadership skills
- A sustainable, replicable Master's program for producing middle school mathematics teacher leaders
- University faculty able so support effective teacher preparation and professional development
- A distance-learning version of the Master's program that can be implemented nationally
- A national corps of high school teachers and mathematicians who can implement courses for the Master's program in their areas

Components of ATI

- Master's Degree in Middle School Mathematics Leadership
- Certificate in Mathematics Mentoring
- Postdoctoral Fellowship in Teacher Preparation

Master's Degree

- Participants
  - Cohorts of 10–15 middle school teachers per year (mostly elementary certified)
- Program (part-time, 3 years)
  - Content courses (16 units)
    - Number and Operations
    - Algebra
    - Geometry
    - Probability and Statistics
  - Leadership and mentoring (3–4 units)
    - Mathematics Mentoring Methods
    - Mathematics Professional Development Models
  - Research (12 units)
    - Research on Student Learning
    - Methods of Research
    - Thesis or practicum integrated into classroom teaching

Number and Operations

- Yoga:
  - See the development of number systems as based on a small number of unifying mathematical laws
  - See underlying abstract mathematical constructions in middle school mathematics materials
  - Read and understand new materials at levels above and below the middle school curriculum, and adapt new approaches and ideas to the middle school curriculum
- Content:
  - The Natural Numbers
  - The Integers
  - The Rational Numbers
  - Irrational numbers
  - Real Numbers

Algebra

- Yoga:
    - Read, contemplate, and interpret expressions and equations
    - Develop algebraic intuition and foresight
    - Make connection between algebraic representations and graphical, numerical, and verbal representations
- Content:
    - algebraic expressions and equations
    - the coordinate plane and graphing
    - linear functions and equations
    - exponential functions and equations
    - quadratic functions and equations
    - logarithms
    - systems of linear equations.
- Sample activity

Sample activity from algebra course

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Goals

Components

Master's
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Number
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Postdoc
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Problem

The expression

$$0.6 \left(\frac{t_1 + t_2 + t_3}{3} \right)$$

is the contribution to a student's final score from three test scores. What is a different way of writing this? Which way should a student use in order to

- calculate the total test contribution to their final grade
- calculate the effect of getting 10 more points on test 2

Responses

$$0.6 \left(\frac{t_1 + t_2 + t_3}{3} \right), \ 0.2t_1 + 0.2t_2 + 0.2t_3, \ \frac{t_1}{5} + \frac{t_2}{5} + \frac{t_3}{5}, \ \ldots$$

$$(1)\ 0.6 \left(\frac{t_1 + t_2 + t_3}{3} \right) \qquad (2)\ 0.2t_1 + 0.2t_2 + 0.2t_3$$

Student A: I wrote (2) because I thought that the original expression said the average of the 3 tests was worth 60%, so each test was worth 20%. But I'm not sure it is right.

Student B: (1) and (2) are obviously the same!

Student A: How you can see that just by looking at them?

Student B: You just move the 3 over so it's dividing the 0.6, which gives you 0.2, then distributed the 0.2.

Instructor: How do you know you can move the 3 over? What rule says you can do that?

Student B: Isn't it because you only have division and multiplication, so it's the commutative law?

Instructor: But division isn't commutative.

Student C: But you can write division as multiplication. Just write it as multiplication by $1/3$.

Student A: Oh yeah! [Discussion shifts to associative law.]

- How do you measure this interaction?

Research on Student Learning

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- Course Structure
  - Organized so as to be responsive to participants interests
  - Focused on developing an investigative stance toward student thinking
  - Included individual and small group components
- Evaluation
  - Formative and summative components
  - Public presentation of knowledge
  - Assessment of oral and written communication

- Participants
  - Two secondary-certified mathematics teachers per year
- Program (full-time, 1 year)
  - Teaching/assisting in Master's courses
  - University mathematics course analysis
  - Apprenticeship in teacher mentoring program

- Participants
    - Two post-doctoral fellows (Ph.Ds in mathematics)
- Program (full-time, 3 years)
    - Teaching/assisting in Master's courses
    - Teaching departmental courses
    - Leading Certificate candidates' course analyses