

Questions & Responses from AZIMASE Breakout Sessions
10/25/06

1. **Persistence in math and science:** International comparisons suggest that low quality instruction in mathematics and science in middle and high school is a central reason that students discontinue studying mathematics. Also, failure to succeed in mathematics is a primary reason that students do not enter science or engineering careers.

1. From your experience, why do high school students quit taking mathematics?
2. What changes are needed to correct this problem?
3. What should middle and high school mathematics instruction emphasize so that students are prepared to succeed in calculus and continue in mathematics, science, or engineering?

- Only take what is required
- Lack of applicability plus utility
- Under prepared, turn kids off to the subject
- Lack of personal relevance
- Lack of support/understanding on the part of the parents
- Low expectations
- Other competing constraints, basic needs/time/support/economics

Question #1

#1 Why students quit math?

- Not required for more than 2 classes
 - 1/3 are taking 3 or less in senior year in 6,000 HS's
- Most students are working
- Get kids to understand math is a method to solve problems
- Interest in math
- GPA is reduced w/ kids who take over 21 credits
 - No rewards
 - Heavy concern w/ GPA
 - Our system sets up slackers

#1 Persistence

- More math courses, lower scores
- Look at experience of Eastern districts/high-stakes
- Not what but how teach
- Need to know what students need/who they are

- Identify how to address network of issues
- Teachers need support to be able to deliver content
- Involve parents/community with expectations and support
- Total success cannot focus only on 7 hours of school a day
- Cannot be restricted to education system, must be national dialogue
- Limited pipeline/capacity for teachers
- Require innov. Prep. Teachers
- Pre-hs-poor, differentiated aptitude and preparation, not algebra reading
- Eliminate General math
- AIMS test, domino effect
- Outcome based model
- Student based, teacher driven
- 8/9 week modules
- 5 years to implement change in HS math delivery
- Must address elem/ms qualified teachers (must be math majors) before 4 yr HS math
- Systemic issue- not necessarily Math major, but competence/commitment, # of credit hours: 24

#1a Persistence in math and science

Who do HS students quit taking math? And what changes are needed to correct this?

- Bad math experiences for students professional development for teachers
- Difficulty in seeing application (real world) time for teachers to learn
- Bureaucracy? AIMS push systematic review of standards
- So many performance objectives

#1b

- Stop looking at international models exceptional
- Teacher salary at market value
- Provide summer support
 - Financial gain
 - Content development
 - Industry exposure
- Students “get bored” (student engagement) use technology to reach teachers
- Expectations are not high enough
- “pieces” approach to C&I-rather than systemic
- Other topics discussed
- AIMS-purpose?

- Does “AIMS” stifle excellence/creativity?
- AIMS- a “sampling” of standards
- “wrong incentives” for teachers. Teaching to test.

2. **Teacher shortage:** there is currently a severe shortage of secondary and middle school mathematics teachers. The three Arizona state universities graduated only 50 secondary mathematics teachers last year, with an average of 46 per year over the past 10 years. Also, a majority of our best math teachers leave the field within 5 years

What populations should be targeted for recruitment into middle and secondary mathematics teaching? How might we attract them? What resources are needed? What mechanisms are needed to support their transition into teaching and to keep them in the teaching profession?

#2 changes in system

- ABEC encourage AZ scholars
- Match math requirement @ HS level
- Need more parent support
 - Sec. gap between parents/businesses
 - Gaps in course taking an issue
 - GPA concerns w/ students
- Getting kids excited about M/S
 - A problem?
 - Time limitations to teach math
 - What will legislature do?
 - Computer in classrooms
 - Teachers trained in technology

3. **Time:** US secondary mathematics and science teachers typically spend 25 to 35 hours per week in front of a class. Secondary teachers in Singapore, Japan, and other countries typically spend 16 hours per week in front of a class. They use non-instructional time to mark papers and to collaborate with colleagues in maintaining and improving the quality of instruction, curricula, and assessments.

What changes are needed in the AZ education system so that math teachers can have the time necessary to work collaboratively and improve their instruction? What resources will be needed to make these changes?

#3a Teacher shortage

Recruitment

- ASU plan great-free tuition for those wanting to become math teachers
- Move elementary teacher into content areas, i.e. math and science
- Money \$\$\$ (consider tax incentives for business/industry)
- Work on those recovering

Resources needed

- Incentives for elementary teachers moving to content areas
- Make programs available through “lots of companies”
- Offer courses (paid for)

3b Incentives

- Raise salaries- subversion of legislative intent in buying out retirees
- Differentiated pay- teacher union pushback must be met “head-on”
- Districts pay for course credits for teacher to be “highly qualified” (EX. Chandler)
- Signing bonus (EX. PUHSD)
- RETENTION

3c Other Issues

- Elementary teacher preparation-is there a “thrust” for math/science?
- Conditions for teaching need improvement
- Innovate for teacher “release time” without “releasing students”
- Consider use of time
- Reduce costs for teachers continuing education
- TIME- integrated work with districts on summer calendars, should be more creative

#3 what changes in AZ system needs?

- Need new and different approaches
- Time constraints-how to allure
- Offer more flexibility, look at various models, hours of teaching for teachers and students
- More cohesion in classroom/school set-up/communication
- Include more access to technology
- Peer relationships among teachers as coach/presenter and peer relations among students
- Extending school year?
 - 10 month calendar
 - Teachers work before students arrive and after they leave

Offer other alternative to learning to free up time

4. **Incentive and retention:** Many bright, qualified, young people interested in teaching mathematics or science decide against it because of low entering salaries and lower advancement opportunities when compared to other fields they can enter. Also, high percentages of math and science teachers leave teaching within their 5 years to take higher paying jobs. In contrast to this, in Singapore the average starting salary of a high school math teacher is higher than the average starting salary of an engineer. In china, careers as middle school mathematics teachers are highly coveted because of their high salary.

What obstacles must be overcome to make mathematics and science teachers' salaries more competitive with private industry? How might they be overcome? What resources will be needed to do this?

#4

- Shorter day will increase # of teachers needed
- Give kids an opportunity to learn things so when they leave school it is with their minds thinking
- Kids leave math because of boredom, overwhelmed
 - Need to offer ways for teacher/kids to transform ideas of math
 - New models to stimulate kids in the classroom-more participation

Teacher Salaries

- Many people resent pay raise for 10 month job
- Need to challenge perception that teachers don't work hard
- Don't tie to test scores-tie to professional leadership
- Need an effective/appropriate way to measure results

5. Meaningful Involvement of Mathematics and Scientist: Mathematicians and Scientist across the nations have expressed interest in contributing to the improvement of mathematics and science instruction. Currently there are many successful programs; however, there is little opportunity for scaling up or institutionalizing programs that are making a difference. Also, there is no strategic plan for their work.

How might this work be focused and supported to maximize their contributions? What new university programs or policies are needed to support their efforts? What might mathematicians and scientist do to ensure that university instruction in freshman STEM courses are also delivering high quality Instructions?

#5 Professional Involvement

- Faculty reward
- Prestige/longevity
- Teach fewer, more spec. students
- K-16:redfine problem
- Interest in impacting undergrad education
- Culture-change in dept. values, commitment
- Legislative/policy role
- Acknowledge challenge of heterogeneity
- Cultivate science/math interest early elem.
- Currently kill off interest, high school too late
- Must address multiple entry points
 - Early elementary
 - Ms
 - Hs
 - Undergrad
- Cannot shift responsibilities
- Draw-in industry/practitioners
- Need structure/support to bridge goodwill, action
- Pittsburgh model: CMU/UPiH/Acula/K-12/Westinghouse
 - Mini-fellowships
 - ½ day alt. jobs, scientist, teacher
- Continuous partnerships with mathematics/science/math education/teachers
- Univ. instruction
 - Freshman courses taught by faculty, not lecturers
 - Relevant/aligned to standards
- *faculty reward system (p/t, raise, mentor pay)
 - Univ. dept. culture change
 - Create prestige for K-12 inv.
- Traditionally. Divide math educators/mathematicians, science educators/scientists
- Math culture-contempt for math ed., create hostile environment. For would-be teachers

- Retraining- on “gender-sensitivity” model
- Model of Jaime Escalante
 - System revolt
 - Difficult to scale-individual. Strengths
 - Too dependent on individual.
- No forum to share
- Systemic analysis

J. Zabais #5

Companies hire 100 math/science teachers, move salaries up
Have engineers team teach in classroom

6. Preparing Middle School Teachers to Teach Algebra: Our state has taken a bold move to require all eighth grade students to take algebra

- a. What changes are needed to assure that students are ready for algebra in the eight grades?
- b. How must teacher preparation programs change to assure that the algebra course students take is of high quality and to assure that we have enough teachers to deliver the instruction?
- c. What resources will be required to prepare and support these teachers?

Question #6

Raise teachers' salaries

- All
- Differential for different prep.
- Merit

Cultural Campaign

- Public/media
- STEM literacy
- Resources

Use what (who) we got

- ID great teachers
- Spread their impact
- Technology

Put the right tools in the people's hands

Reg. a cognate for Elementary Certification

- Ongoing technical/professional support
- Up to date
- Tech integrated
- Assessment system to guarantee each and all students regularly receive H.Q. teaching in STEM.

Question #7

- Ensure teachers have appropriate levels of content knowledge
- Accountability
- Reform efforts need to start at elementary levels
 - Content 1st
 - How 2nd
- Not have elementary teachers teach everything
 - Too much breadth, not enough depth
 - Have specialties in subject areas
- Revisit elementary school/model as a whole education
- Reform curriculum to have greater interactivity
- A new definition of certification
 - Highly qualified vs. certified
- “Authentic” science experiences
- Learn through activity, by doing
- Include: outside students
 - Graduate
 - Doctoral
 - Undergrad
 - Outside businesses
- Help to create passion and excitement in the subject area for the students
 - Need support from higher-up in company, Education Dept. to spend time on these activities
- “letters” for math and science activities/programs