Problem Solving: A 21st Century Education

Richard Rusczyk
www.artofproblemsolving.com

Math Prize for Girls
November 14, 2009
Result of relying on the Standard Curriculum

“I certainly wish your website and materials existed when I was in high school. I went through junior high and high school without ever missing a question on a math test, and then took [Math] 103 and 104 at Princeton, which was one of the most unpleasant and bewildering experiences of my life and poisoned me on math for years.”

-Princeton University alum
Three general areas in which the standard curriculum is not designed to allow students to reach their full potential:

• Depth
• Delivery
• Subject Coverage
Lack of Depth in the Standard Curriculum

- Problems are too easy
- Tyranny of 100%
- Encourages memorization
Poor Delivery in the Standard Curriculum

• Little exposition, lots of fluff
• Drill and kill is boring
• Drill and kill is counterproductive
• Lesson – problem structure is backwards
Inadequate Subject Coverage in the Standard Curriculum

• Discrete math almost entirely ignored
• Calculus over-emphasized
• Problem solving treated as a supplemental topic
“While challenging and improving the mathematical problem-solving skills of high-performing students are surely every-day objectives of those who teach such students, it is not a problem, relatively speaking, of major import in American education.”

-Department of Education Grant Reviewer
Acceleration Alone is Not the Answer

• It doesn’t solve the problem
• Solving hard problems is more important than using advanced tools
Why Challenging Problem Solving is Important

- Presents challenges like the ones students will face in college
- Prepares students for the intellectual challenges of many different careers
Keys to Developing Strong Problem Solving Skills in the Early Years

- Read
- Play
Two Strategies for High-performing Middle and High School Students

- Extracurricular Programs
- Independent Study
Benefits of a Math Club

• Offers more challenging mathematics
• Signals the importance of math to students
• Establishes a culture of excellence
• Provides social interaction among students with common interests
Contests

MOEMS
Math Olympiads in
Elementary and Middle School

www.moems.org

Grades 4-8.
Emphasis on problems with many solutions.
Contests

MathCounts

www.mathcounts.org

- Premier contest for students in grades 6-8
- School, Chapter, State, National levels
- Annual training packet of 300 challenging problems
- Club program with group activities
Contests

American Mathematics Competitions
www.unl.edu/amc
AMC 8
AMC 10 and AMC 12
American Invitational Math Exam (AIME)
USA Math Olympiad (USAMO)
Math Olympiad Summer Program (MOSP)
China Girls Math Olympiad
International Math Olympiad (IMO)
Contests

ARML
American Regions Math League
www.arml.com

Mandelbrot Competition
www.mandelbrot.org

USAMTS
USA Mathematical Talent Search
www.usamts.org

Purple Comet
www.purplecomet.org
Many colleges ask for AMC scores and some even offer scholarships.
Math Circles

Local opportunities for students to learn outside their schools

Cities with Math Circles include:

Albany, Austin, Berkeley, Boston, Boulder, Charlotte, Dallas, Los Angeles, Mobile, New York, Palo Alto (Stanford), Salt Lake City, San Diego, San Francisco, San Jose, Seattle, Tucson
Merits of Independent Study

- Structured more like college and careers
- Removes the ceiling of the standard curriculum
- Less likely to bore students into losing interest in math
- Creates more mature learners
- Gives students time to indulge their academic passions
Summer Programs

MathPath
www.mathpath.org

AwesomeMath
www.awesomemath.org

MathZoom
www.mathzoom.org

PROMYS/Ross
www.promys.org
www.math.ohio-state.edu/ross

MathCamp
www.mathcamp.org

Hampshire
www.hcssim.org

RSI
www.cee.org/rsi
Research Competitions

• Siemens Competition (www.siemens-foundation.org)
• Intel Science Talent Search (www.intel.com/education/sts)
• Davidson Fellows Scholarship Program (www.davidsongifted.org)
• International Science & Engineering Fair (www.sciserv.org/isef/)
Other Olympiads

• USA Computing Olympiad (www.usaco.org)
• USA Physics Olympiad (www.aapt.org/Contests/olympiad.cfm)
• USA Chemistry Olympiad (url too long to list)
• USA Biology Olympiad (www.cee.org/programs/usabo)
• North American Computational Linguistics Olympiad (www.naclo.cs.cmu.edu/)
Challenges to Serving the Top Students

• Convincing schools there’s a problem
• Equity issues
• Convincing students there’s a problem
• Calculus! Calculus! Calculus!
Resources for a Math Problem Solving Education

Books

Classes

Website
Resources for a Math Problem Solving Education
Books

Art of Problem Solving Intermediate Series

**Intermediate Algebra** by Richard Rusczyk and Mathew Crawford

**Intermediate Counting & Probability** by David Patrick

**Precalculus** by Richard Rusczyk

**Calculus** Expected January, 2010

- Modern mathematics curriculum for high-performing math students
- Integrates problem solving with the mathematics curriculum
- Includes over 2000 problems, many chosen from prominent contests
Resources for a Math Problem Solving Education

Books

Awards won by the authors of Art of Problem Solving textbooks:

• National MATHCOUNTS Test Champion
• National MATHCOUNTS Team Champion
• Two perfect scores on the AMC exam
• Three perfect scores on the AIME exam
• Two USAMO winners
• 9 invitations to the Math Olympiad Program
Resources for a Math Problem Solving Education

Books

Art of Problem Solving Volume 1 and 2
by Richard Rusczyk and Sandor Lehoczky

• Emphasis on problem solving and contest preparation
• Used by top MATHCOUNTS and AMC students and teams for over 16 years
• Authors earned the only perfect scores on the AIME in 1989 (Rusczyk) and 1990 (Lehoczky)
Resources for a Math Problem Solving Education

Books

*Mathematical Circles* by Fomin, Genkin, Itenberg

*Art and Craft of Problem Solving* by Paul Zeitz

*Problem Solving Strategies* by Arthur Engel

Olympiad problem books and preparation texts by Titu Andreescu and/or Zuming Feng
Resources for a Math Problem Solving Education

Classes

Online classes for problem solving available at:

• Art of Problem Solving
• Belin-Blank
• CTY
• EPGY
• TIP
Resources for a Math Problem Solving Education

WEBSITE

www.artofproblemsolving.com

• Books
• Classes
• Articles on problem solving topics
• LaTeX tutorial for typesetting mathematical writing
• AoPSWiki
• Lists of and links to many other resources, such as books, programs, contests, scholarships, and more!
Resources for a Math Problem Solving Education
WEBSITE
www.artofproblemsolving.com

AoPS For the Win!
A FREE online multi-player game.
Thousands of MATHCOUNTS and AMC problems.
Countdown Round format.
Resources for a Math Problem Solving Education

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A New Online Adaptive Learning System
FREE!

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Resources for a Math Problem Solving Education

WEBSITE

www.artofproblemsolving.com

Largest online community of problem solvers in the English-speaking world

Tens of thousands of members

Over one million posts
Opportunities in College

• Internships
• Research Experiences for Undergrads (REUs)
• Budapest Semesters in Mathematics
• Work for Art of Problem Solving
Developing Problem Solving Skills
Strategies for Parents

Organize

Agitate

Contribute
Technology now allows us to leverage the efforts of a few to the benefit of the many.
Our tomorrow is in the hands of the best students today.