Reflective Teaching and Mathematics

Technology provides many opportunities for mathematics teachers to use innovative and effective approaches to teaching and learning. Hartman (2010) poses the following questions: How can technology, such as videotapes and COs, and computer software such as spreadsheets and The Geometer's Sketchpad®, online tutorials, WebQuests, and graphing calculators help students become more reflective learners?

The first set of links is on the Common Core State Standards on Mathematics:

http://www.corestandards.org/

The Common Core State Standards provide a consistent, clear understanding of what students are expected to learn, so teachers and parents know what they need to do to help students. The standards are designed to be robust and relevant to the real world, reflecting the knowledge and skills that our young people need for success in college and careers. With American students fully prepared for the future, our communities will be best positioned to compete successfully in the global economy. This is a link to the Common Core State Standards Initiative website.

http://myboe.org/portal/default/Content/Viewer/Content?action=2&sclId=306591

This is a link to the State of California Department of Education's professional development website in implementing the Common Core State Standards, Brokers of Expertise.

http://www.smarterbalanced.org/

Smarter Balanced is a state-led consortium developing assessments aligned to the Common Core State Standards in English language arts/literacy and mathematics that are designed to help prepare all students to graduate high school as college- and career-ready.

http://www.susanohanian.org/core.php

Susan Ohanian's website for critiques of the Common Core of State Standards.

http://www.schoolsmatter.info/2012/08/what-can-we-do-about-common-core.html

This space School Matters explores issues in public education policy, and it advocates for a commitment to and a reexamination of the democratic purposes of schools. If there is some urgency in the message, it is due to the current reform efforts that are based on a radical re-invention of education, now spearheaded by a psychometric blitzkrieg of “metastasizing testing” aimed at dismantling a public education system that took almost 200 years to build.

These are links to state-of-the-art websites on teaching mathematics using technology:

https://www.khanacademy.org/

Khan Academy is an organization on a mission. We’re a not-for-profit with the goal of changing education for the better by providing a free world-class education for anyone anywhere. All of the site’s resources are available to anyone. It doesn’t matter if you are a student, teacher, home-schooler, principal, adult returning to the classroom after 20 years, or a friendly alien just trying to get a leg up in earthly biology. Khan Academy's materials and resources are available to you completely free of charge.

http://www.pbs.org/teachers/math/

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http://www.nctm.org/

The National Council of Teachers of Mathematics is the public voice of mathematics education, supporting teachers to ensure equitable mathematics learning of the highest quality for all students through vision, leadership, professional development, and research.

http://mathforum.org/

The Math Forum is the leading online resource for improving math learning, teaching, and communication since 1992. We are teachers, mathematicians, researchers, students, and parents using the power of the Web to learn math and improve math education. We offer a wealth of problems and puzzles; online mentoring; research; team problem solving; collaborations; and professional development. Students have fun and learn a lot. Educators share ideas and acquire new skills.

http://mathforum.org/t2t/

Teacher2Teacher is a resource for teachers and parents who have questions about teaching mathematics.

http://www.terc.edu/

Links to TERC, another online resource for mathematics teaching, kindergarten through college.

http://www.math.fsu.edu/Virtual/

This collection of Mathematics-related resources is maintained by the Florida State University Department of Mathematics as a free service to the online community.

http://www.mathematicallysane.com/home.asp

Responds to the "Math Wars." Seeks to help educators, citizens, and policy-makers at all levels make a stronger case for better mathematics programs and provides a forum for reform-minded mathematics educators. This site also provides a wealth of links that can support mathematics teachers with curriculum development.

http://www.goenc.com/

goENC.com is a subscription service affiliated with the discontinued “Eisenhower National Clearinghouse for Math and Science” that provides resources related to math and science teaching.

http://archives.math.utk.edu/

Extensive list of links to other math-and-science-related sites.


Home page of the "Excelling in Math and Science."

http://www.algebra.org/

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The Algebra Project was developed by civil rights leader Bob Moses and is a national network of sites striving to improve mathematics achievement for African American and other minority students who have not been reached by existing efforts at education reform. The Algebra Project works through materials development, teacher training, peer education, and school-community partnerships. The project is described in Moses’s book, *Radical Equations: Civil Rights from Mississippi to the Algebra Project* (Boston: Beacon Press, 2001), and it can found online at www.algebra.org/.

http://ltd.edc.org/mathematics

Deborah Shifter, a senior scientist with the Education Development Center in Newton, Massachusetts, has written helpful accounts of teachers who use constructivist approaches to mathematics. Her book *Reconstructing Mathematics Education: Stories of Teachers Meeting the Challenge of Reform* with Catherine Twomey Fosnot (New York: Teachers College Press, 1993), provides narratives from elementary teachers who are shifting their mathematics curriculum away from traditional lessons and focusing on understanding children’s mathematical thinking.

http://www.mathforamerica.org/web/guest/home

Math for America is a national nonprofit organization committed to improving mathematics education in public schools. Even if you are not a fellow of the organization, the website provides classroom as well as professional resources for math teachers.

http://www.mathsolutions.com/index.cfm?page=wp1&crid=298

Marilyn Burns, a math educator, has published numerous books and other resources for classroom teachers. Her work focuses on student-centered math lessons that lead to mathematical understanding. *About Teaching Mathematics* (Sausalito, CA: Math Solutions Publications, 2007) is an excellent foundational resource for math teachers. Burns also has a website that lists her other publications and includes additional resources for teachers.

http://www.terc.edu/newsroom/880.html

InspireData: Giving Students the Power to Visualize, Investigate, and Understand Data

http://www.sosmath.com/

MathMedica. SOS MATHematics,

http://www.ncrel.org/sdrs/areas/issues/content/cntareas/math/ma1algeb.htm

North Central Regional Educational Laboratory. The Algebra Project.

http://nces.ed.gov/timss/

Trends in International Mathematics and Science Study.

http://archives.math.utk.edu/

University of Tennessee, Knoxville. Math Archives.

Videotapes of cross-cultural eighth-grade mathematics teaching were a major source of data for the classic TIMSS studies, which enabled examination of teaching and learning from alternative points of view, © 2014 Taylor & Francis
including the perspectives representing each of the seven participating countries. In each country in the TIMSS studies, most mathematics teaching and learning was characterized by students independently solving mathematics problems. How were you taught to solve mathematical problems? To what extent do your students solve math problems cooperatively? What are the advantages and disadvantages of each? (Hartman, 2010).

Videotapes of your own teaching can be a major stimulus to your ability to reflectively teach mathematics. Often teachers are unaware of some of the ways they come across to students, for example, how a look on their faces can discourage students. Videotapes preserve classroom activities so that they can be analyzed in detail and viewed by others to obtain additional feedback. Novice teachers can benefit from experts providing them with specific comments and recommendations about their teaching when having students work independently and cooperatively on solving problems.

The Jasper Woodbury series is an excellent example of how technology can demystify mathematics and make it exciting and meaningful for students grades 5 and above. Using the series can improve solving multi-step word problems and decrease math anxiety. This series of real-life adventure stories show students how mathematics is vital for solving important, realistic problems in everyday life. Students become motivated to learn mathematics as they are engaged in authentic problem solving situations. Reflection is promoted by Jasper's problem-based approach to problem solving, which emphasizes the importance of identifying the problem, communicating with other students about the problem, and making connections to other subjects in the curriculum, including history, literature, and science. Mathematical topics include algebra, geometry, and statistics.

As noted above, The Algebra Project, created by Bob Moses, a civil rights activist, is designed to promote mathematical literacy in urban and rural students. It begins with students having an experience, such as a field trip, then informally developing a model of it or pictures of it, next formalizing their experience with language, and finally creating symbolic representations of it using mathematics. Consequently, mathematics is constructed out of students' reflections on their own experiences, so students understand the role of mathematics in their everyday lives. To see videotapes of the approach, visit the National Headquarters website at http://www.learningpt.org/

Another videotape series for mathematics teaching is Project Mathematics, an animated video approach to teaching basic topics in high school mathematics that can't be taught as effectively with traditional teaching methods using a textbook and blackboard. It also includes material on the history of mathematics. Color, motion, and sound are used to demonstrate mathematical concepts, which are connected to actions in everyday life experience. Each module has an associated workbook. Although developed in the USA, it is now used in other countries around the world and is appreciated by both teachers and students.

Geometer's Sketchpad allows students to explore and discover geometric characteristics and properties in ways that are not possible without technology. By using the mouse to manipulate figures, students can visualize and analyze them from different perspectives, which greatly improves their understanding. Another advantage is that it helps students become more reflective about mathematics by promoting awareness of how geometry is related to algebra and trigonometry. Graphing calculators are now available online so students do not necessarily have to purchase hand-held versions of them. They are especially useful in promoting reflective learning of algebra because they promote deeper understanding of equations and how they are plotted, which enables students to solve algebraic problems by reasoning instead of memorization. The Cool-math website, which has a free, online graphing calculator, has a link to Webgraphing.com, which shows how graphing calculators promote learning in pre-calculus and calculus in addition to algebra.

Obviously, the Internet has voluminous and diverse resources for mathematics teaching and learning. One comprehensive site is Mathematics Archives. It has a database that is searchable by topic and

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has K-12 teaching materials, plus it recommends software and sponsors contests and competitions. There are numerous free online tutorials to help middle and high school students learn mathematics. Topics include fractions, decimals, units of conversion, quadratic equations, factorization, polynomials, geometry proofs, sines and cosines, logarithms, linear equations, and differential equations. Web-based tutorials for algebra and math fundamentals are available at [http://www.mathpower.com/](http://www.mathpower.com/).

**Studies on Reflective Teaching of Mathematics**


**Resources in Technology and Mathematics**


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