Overcoming Obstacles to Make Mathematics Work FOR Students

Matt Larson
NCTM President

Goals

- **Provide an overview of new resources related to *Principles to Actions***
- **Examine some of these concepts through the window of communication with parents.**
- **Respond to any questions.**

High Quality Standards are Necessary for Effective Teaching and Learning, But Insufficient

Standards do not describe or prescribe the essential conditions required to make sure mathematics works for all students.

NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All.* Reston, VA: NCTM.

Guiding Principles for School Mathematics

1. *Teaching and Learning*
2. *Access and Equity*
3. *Curriculum*
4. *Tools and Technology*
5. *Assessment*
6. *Professionalism*

→ Essential Elements of Effective Math Programs

NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All.* Reston, VA: NCTM.

Principles to Actions: Ensuring Mathematical Success for All

The overarching message is that effective teaching is the non-negotiable core necessary to ensure that all students learn mathematics.

NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All.* Reston, VA: NCTM.

We Must Focus on Instruction

Teaching has 6 to 10 times as much impact on achievement as all other factors combined ... Just three years of effective teaching accounts on average for an improvement of 35 to 50 percentile points.

Schmoker, M. (2006). *Results now: How we can achieve unprecedented improvements in teaching and learning*. Alexandria, VA: Association for Supervision and Curriculum Development.

Teaching and Learning Principle

Teaching and Learning. An excellent mathematics program requires effective teaching that engages students in meaningful learning through individual and collaborative experiences that promote their ability to make sense of mathematical ideas and reason mathematically.

NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All.* Reston, VA: NCTM.

Eight Research-Informed Instructional Practices

- Establish mathematics **goals** to focus learning.
- Implement **tasks** that promote reasoning and problem solving.
- Use and connect mathematical **representations**.
- Facilitate meaningful mathematical **discourse**.

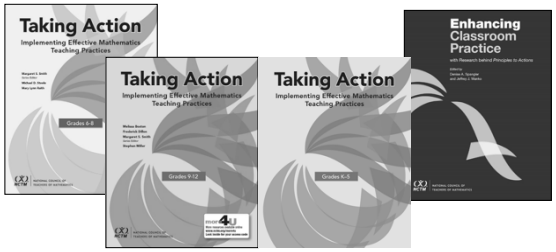
NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All.* Reston, VA: NCTM.

Eight Research-Informed Instructional Practices

- Pose purposeful **questions**.
- Build **procedural fluency** from conceptual understanding.
- Support **productive struggle** in learning mathematics.
- **Elicit and use evidence** of student thinking.

NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All.* Reston, VA: NCTM.

Taking Action with Principles to Actions



A Framework for the Eight Instructional Practices

The eight effective teaching practices are a coherent and connected set of practices.

Smith, M. S., Steele, M. D., & Raith, M. L. (2017). *Taking action: implementing effective teaching practices in grades 6-8.* Reston, VA: National Council of Teachers of Mathematics. P. 193.

A Framework for the Eight Instructional Practices

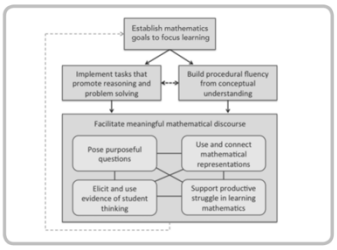


Fig. 10.1. A framework for mathematics teaching that highlights the relationships between and among the eight effective teaching practices

Smith, M. S., Steele, M. D., & Raith, M. L. (2017). *Taking action: implementing effective teaching practices in grades 6-8.* Reston, VA: National Council of Teachers of Mathematics. P. 194.

Equity-Based Instructional Practices

Go deep with mathematics. Develop students' conceptual understanding, procedural fluency, and problem solving and reasoning.

Leverage multiple mathematical competencies. Use students' different mathematical strengths as a resource for learning.

Affirm mathematics learners' identities. Promote student participation and value different ways of contributing.

Challenge spaces of marginality. Embrace student competencies, value multiple mathematical contributions, and position students as sources of expertise.

Draw on multiple resources of knowledge (mathematics, language, culture, family). Tap students' knowledge and experiences as resources for mathematics learning.

Aguirre, J. M., Mayfield-Ingram, K., & Martin, D. B. (2013). *The impact of identity in K-8 mathematics learning and teaching: Rethinking equity-based practices.* Reston, VA: NCTM. P. 43

Obstacles to Implementing Research-Informed Instructional Practices

Dominant cultural beliefs about the teaching and learning of mathematics continue to be obstacles to consistent implementation of effective teaching and learning in mathematics classrooms.

NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All.* Reston, VA: NCTM.

Discussion Question

With a shoulder partner:

What concerns do you hear parents (or other stakeholders) raise about math instruction today that you believe stand as obstacles to the implementation of effective teaching and learning in math classrooms?

Unproductive Belief

Students need only learn and use the same standard computational algorithms and the same prescribed methods to solve algebraic problems.

Eight Research-Informed Instructional Practices

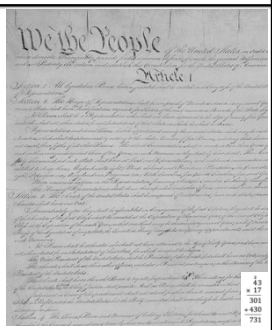
<u>Build procedural fluency from conceptual understanding</u>.

Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding …

NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All.* Reston, VA: NCTM.

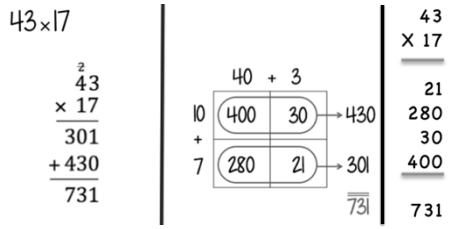
Our Founding Fathers Did NOT Establish the "Standard Algorithms"

Standard algorithms were developed in India in the first centuries of the modern era, and further honed by traders and engineers in the Iraq-Persia region.

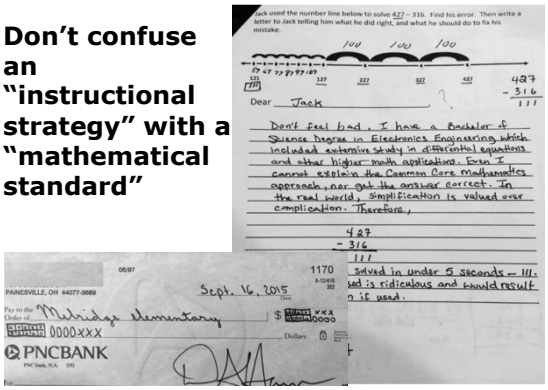


Show Parents the Strategies!

It is critical not to confuse instructional strategies intended to build understanding with end goals that include proficiency with traditional approaches.



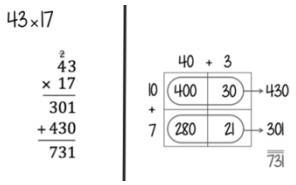
Don't confuse an "instructional strategy" with a "mathematical standard"



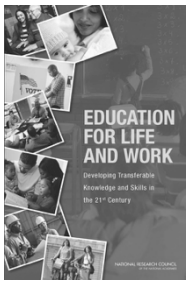
Moving Forward: Consider How you Communicate with Parents

We should emphasize **visual representations or models to build understanding** -- not "alternate" "different" or "new" algorithms

How, Why and When!



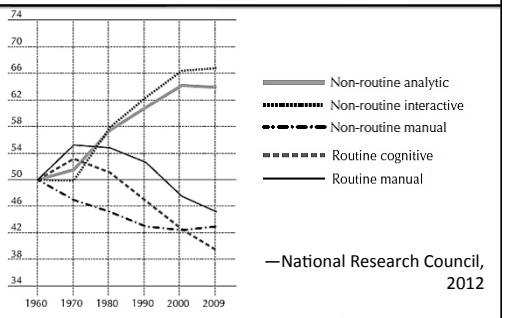
Why We Need Multidimensional Mathematics Learning



"The product of deeper learning is **transferable knowledge, including content knowledge in a domain and knowledge of how, why, and when to apply this knowledge to answer questions and solve problems**."

—National Research Council, *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century* (2012)

Trends: Skills Demand in the U.S.



—National Research Council, 2012

Average change in task inputs across education-industry cells, in percentiles of the 1960 task distribution

Emotional Connections Are Important

"Voters [citizens and parents] tend to resist change even when faced with facts."

—Hoschschild & Einstein, "Do Facts Matter? Information and Misinformation in American politics," *Political Science Quarterly*, *130*(4), 585–624

Mathematical Skills Are Highly Valuable

The median entry-level salary for college educated STEM majors is the highest of major groups and nearly twice that of high school graduates.

In addition, STEM majors experience the largest wage growth over the course of their careers.

(Carnevale, Cheah, & Hanson, *The Economic Value of College Majors*, 2015)

Two Numbers May Be More Meaningful

2030

65%

(Wolfe, "65 Percent of Today's Students Will Be Employed in Jobs That Don't Exist Yet," *Success Performance Solutions* [online], August 26, 2013)

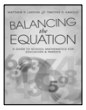
Multiple Methods Confuse Some Parents

The emphasis in learning multiple methods must be on how the methods are related to one another to build conceptual understanding and not on committing still more procedures to memory.

(Bay-Williams, Duffett, & Griffith, *Common Core Math in the K–8 Classroom: Results From a National Teacher Survey*, 2016)

Confront the Homework Issue

- It isn't parents' responsibility to "do" homework. In fact that can do more harm than good.
- Parents should support perseverance, monitor progress, and ask questions.



(Larson & Kanold, 2016)

Make Homework Comprehensible

Make homework assignments as straightforward and comprehensible as possible.

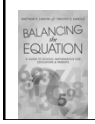
More important than teaching a method and practicing a method is ensuring that a student selects the method that makes.

Students should practice their preferred method at home.

(Bay-Williams, Duffett, & Griffith, *Common Core Math in the K–8 Classroom: Results From a National Teacher Survey*, 2016)

We Need to Be Clear: There is No "New Math"

At the K-8 level there is no "new math," but there are "new" research-informed instructional strategies!



Larson, M. R., & Kanold, T. D. (2016). *Balancing the equation: A guide to school mathematics for educators and parents.* Bloomington, IN: Solution Tree.

Unproductive Belief

An effective teacher makes the mathematics easy for students by guiding them step by step through problem solving to ensure that they are not frustrated or confused.

Eight Research-Informed Instructional Practices

<u>Support productive struggle in learning mathematics</u>.

Effective teaching of mathematics consistently provides students, individually and collectively, with opportunities and supports to engage in productive struggle as they grapple with mathematical ideas and relationships.

NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All.* Reston, VA: NCTM.

Support Productive Struggle in Learning Mathematics

Teachers sometimes perceive student frustration or lack of immediate success as indicators that they have somehow failed their students.

NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All.* Reston, VA: NCTM.

Struggle vs. Frustration

Struggle does not mean needless frustration or extreme levels of challenge. It means students expend some effort to make sense of mathematics.

Hiebert, J., & Grouws, D. A. (2007). The effects of classroom mathematics teaching on students' learning. In F. K. Lester (Ed.), *Second handbook of research on mathematics teaching and learning* . Charlotte, NC: Information Age Publishing

Successful Productive Struggle

- Engages students with a worthwhile task – one that captures the central idea of a lesson.
- Stretches students' thinking and performance just beyond the level they can do on their own.
- Teachers provide timely assistance.

Emerling, B., Hiebert, J., & Gallimore, R. (2015, December 7). Beyond growth mindset: Creating classroom opportunities for meaningful struggle. *Education Week Teacher.* Retrieved online at www.edweek.org/tm/articles/2015/12/07/beyond-growth-mindset-creating-classroom-opportunities-for.html

Perseverance: Learning from Our Mistakes

With parents we should talk about **perseverance and learning from mistakes**, not "productive struggle."

Larson, M. R., & Kanold, T. D. (2016). *Balancing the equation: A guide to school mathematics for educators and parents.* Bloomington, IN: Solution Tree.

If your students are going home at the end of the day less tired than you are, the division of labor in your classroom requires some attention.

Wiliam, D. (2011). *Embedded formative assessment.* Bloomington, IN: Solution Tree Press.

Eight Research-Informed Instructional Practices

<u>Facilitate meaningful mathematical discourse</u>.

Effective teaching of mathematics facilitates discourse among students in order to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments.

NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All.* Reston, VA: NCTM.

The Importance of Math Talk

- The heart of any lesson is the discussion. Discussions provide a forum in which students can share ideas and clarify understandings.
- Discussions offer an opportunity for the teacher to move both small groups and the entire class toward the mathematical understandings that are the target of the lesson.

Smith, M. S., Steele, M. D., & Raith, M. L. (2017). *Taking action: implementing effective teaching practices in grades 6-8.* Reston, VA: National Council of Teachers of Mathematics. P. 196.

Eight Research-Informed Instructional Practices

<u>Pose purposeful questions</u>.

Effective teaching of mathematics uses purposeful questions to assess and advance student reasoning and sense making about important mathematical ideas and relationships.

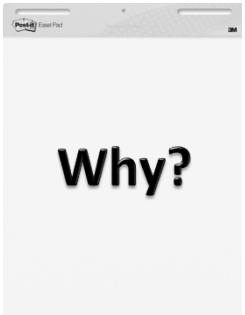
NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All.* Reston, VA: NCTM.

Effective Teachers are Effective Questioners

"Effective mathematics teachers … pose more questions with higher cognitive demand and ask more follow-up questions"

McRel. (2010). *What we know about mathematics teaching and learning*, third edition. Bloomington, IN: Solution Tree Press.

Make "Why?" "How do you know?" "Can you explain?" "Do you agree/ disagree?" Classroom Mantras



Leinwand, S. (2009). *Accessible mathematics: 10 instructional shifts that raise student achievement.* Portsmouth, NH: Heinemann.

Five Essential Elements of Effective Mathematics Programs

Effective teaching and learning, while the non-negotiable core of successful mathematics programs, are part of a system of essential elements of excellent mathematics programs.

NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All.* Reston, VA: NCTM.

Five Essential Elements of Effective Mathematics Programs

Access and Equity

Curriculum

Tools and Technology

Assessment

Professionalism

NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All.* Reston, VA: NCTM.

Guiding Principles for School Mathematics: Access and Equity

Access and Equity. An excellent mathematics program requires that *all* [each and every] students have access to high-quality mathematics curriculum, effective teaching and learning, high expectations, and the support and resources needed to maximize their learning potential.

NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All.* Reston, VA: NCTM.

We Must Face Hard Truths

Mathematics education often reinforces, rather than moderates, inequalities in education.

OECD. (2016). *Equations and inequalities: Making mathematics accessible to all.* Paris: PISA OECD Publishing. Downloaded at http://dx.doi.org/10.1787/9789264258495-en.

Access Is a Critical Issue

Students from marginalized groups not only attend schools with fewer qualified teachers but also have less access to college preparatory pathways.

Nasir, N. S. (2016). Why should mathematics educators care about race and culture? *Journal of Urban Mathematics Education,* 9(1), 7-18.

Different Opportunities for Different Students

The learning opportunities provided for low-ability, average-ability, and high ability-grouped classrooms are hierarchically different.

Boaler, J., Wiliam, D., & Brown, M. (2000). Students' experiences of ability grouping – disaffection, polarisation and the construction of failure. *British Educational Research Journal*, 26(5), 631-648.

"Educide" Via Tracking

Low expectations often result in self-fulfilling prophecies. Once placed in the low tracks, it is very difficult for students to move to a higher track.

Flores, A. (2008). The opportunity gap. *TODOS Research Monograph: Promoting High Participation and Success in Mathematics by Hispanic Students: Examining Opportunities and Probing Promising Practices*, 1(1), 1-18.

Beware Tracking in New Forms

- Different lengths of courses.
- Different versions of an Algebra or Algebra 2 course.
- Teacher Assignments.

Darling-Hammond, L. (2007). The flat earth and education: How America's commitment to equity will determine our future. *Educational Researcher*, 36(6), 318-334.

AERA. (2006). Do the math: Cognitive demand makes a difference. *Research Points: Essential Information for Education Policy*, 4(2).

- Explicitly broaden the purposes for teaching high school mathematics.
- Catalyze a serious discussion of the challenges facing high school mathematics.
- Define imperatives for high school mathematics in the areas of structures, instructional practices, curriculum, and pathways.
- Identify essential concepts for focus that all high school students should learn at a deep level of understanding.
- Provide examples of 4-year pathways that include 2.5 years of mathematical study expected of high school students followed by 1.5 of alternate paths of study.

Guiding Principles for School Mathematics: Professionalism

Professionalism. In an excellent mathematics program, educators hold themselves and their colleagues accountable for the mathematical success of every student and for their personal and collective professional growth toward effective teaching and learning of mathematics.

NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All.* Reston, VA: NCTM.

Professionalism Obstacle

In too many schools, professional isolation severely undermines attempts to significantly increase professional collaboration … A danger in isolation is that it can lead to teachers developing inconsistencies in their practice.

NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All.* Reston, VA: NCTM.

Overcoming the Obstacle: Professional Learning Communities

Teachers have a professional responsibility to participate in group decision making to improve the art and practice of teaching. One of the most powerful forums for teacher improvement is involvement in a professional learning community.

Stigler, J. W., & Hiebert, J. (1999). *The teaching gap: Best ideas from the world's teachers for improving education in the classroom.* New York: The Free Press.

But What Happens in Your PLCs?

A Chinese teacher sees a lesson as a performance and puts in many hours of preparation to cover the standard forty-five minute period …

Cheng, K. (2011). Shanghai: How a big city in a developing country leaped to the head of the class. In *Surpassing Shanghai: An agenda for American education built on the world's leading systems*. Ed. M.S. Tucker. 21-50. Cambridge, MA: Harvard University Press.

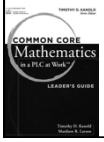
Lesson Planning is Cultural

The tendency to spend relatively little time developing lessons and to produce lesson outlines appears to be a cultural style specific to the U.S.

Ding, M., & Carlson, M. A. (2013). Elementary teachers' learning to construct high-quality mathematics lesson plans. *The Elementary School Journal*, 113(3), 359-385.

You Should Collaboratively Plan One Lesson in Each Unit

The lack of time to devote this careful planning and reflection to all lessons cannot be used as an excuse to never collaboratively learn, plan, and reflect on the effectiveness of key lessons.



Kanold, T., & Larson, M. R. (2012). *Common Core Mathematics in a PLC at Work™: Leader's Guide*. Bloomington, IN: Solution Tree Press; Reston, VA: NCTM.

President's Message

NCTM NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

What Constitutes an Effective Collaborative Team?

By Matt Larson, NCTM President
July 14, 2017

Over the past year, I have frequently referred to the importance of teachers of mathematics working collaboratively to improve teaching and learning. Over this same time period, many members have asked me what I think characterizes an effective professional learning community or collaborative team.

Experts in professional learning communities often emphasize various features, behaviors, or actions of effective collaborative teams. In this message I offer the perspective and characteristics of effective mathematics collaborative learning teams that I, along with colleagues, have promoted for the better part of a decade.

Why Focus on Lesson Planning?

… the co-planning of lessons is the task that has one of the highest likelihoods of making a marked positive difference on student learning.

Hattie, J. (2012). *Visible learning for teachers: Maximizing impact on learning*. New York: Routledge, Taylor & Francis Group.

It Can All Seem Overwhelming and Change Often Feels Sisyphean!

Change is Hard!

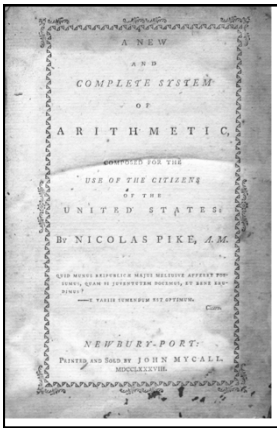
The most likely reason for the stability of teaching practices over time is that teaching is a cultural activity and cultural activities, by their very nature, are highly resistant to change.

Stigler, J. W., & Thompson, B. J. (2009). Thoughts on creating, accumulating, and utilizing shareable knowledge to improve teaching. *The Elementary School Journal*, 109(5), 442-457.

Some Practices are a Cultural Trap

Cultural routines evolve over time to enable adaptation to the environment. However, sometimes the environment changes, and yet, the cultural routine persists, even if it is now highly maladaptive.

Stigler, J. W., & Thompson, B. J. (2009). Thoughts on creating, accumulating, and utilizing shareable knowledge to improve teaching. *The Elementary School Journal*, 109(5), 442-457.

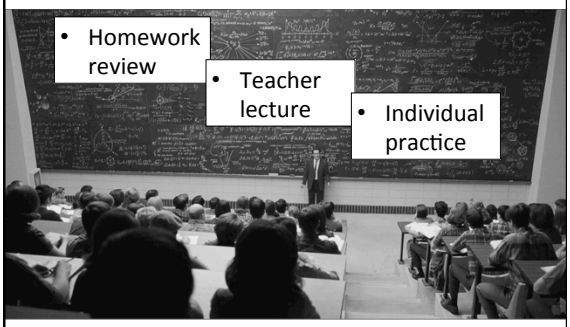

A NEW
AND
COMPLETE SYSTEM
OF
ARITHMETIC,
COMPOSED FOR THE
USE OF THE CITIZENS
OF THE
UNITED STATES.
By NICOLAS PIKE, A.M.
NEWBURY-PORT:
PRINTED AND SOLD BY JOHN MYCALL.
MDCCLXXXVIII.

We live in the educational shadow of the 18th century.

Nicholas Pike's 1788 *Arithmetic*

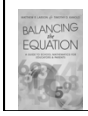
Cultural Teaching Script: State a Rule, Provide an Example, Practice the Rule

Traditional Mathematics Instruction



Moving Forward: Support Research-Informed Instructional Practices

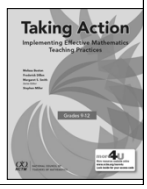
We expect physicians to use research-informed treatments. We must do the same.



Larson, M. R., & Kanold, T. D. (2016). *Balancing the equation: A guide to school mathematics for educators and parents.* Bloomington, IN: Solution Tree.

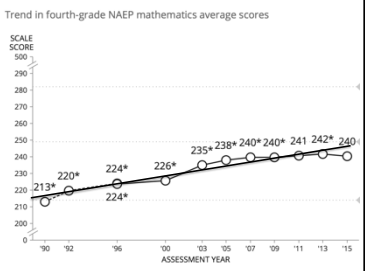
Moving Forward: Support and Implement Research-Informed Instructional Practices

The six guiding principles constitute the foundation of high-quality mathematics education.



Standards-Based Reform Has Improved Mathematics Learning

Math achievement in this country is up over the long-term … Since we've been doing Standards-based reform!



Standards-Based Reform Has Improved Mathematics Learning

Don't panic (yet) over the slight drop in 2015.

	Grade 4	
Subscale	2015	'15-'13
Composite	240	-1*
Number properties and operations	243	+1
Measurement	238	-1
Geometry	236	-5*
Data analysis, statistics, and probability	238	-4*
Algebra	243	-1*

* Statistically significant ($p < .05$).

Standards-Based Reform Has Improved Mathematics Learning

Based on the NAEP long-term trend assessment, initiated in 1973, today's fourth and eighth graders are performing at a significantly higher level than their parents and grandparents did in mathematics.

NCTM. (2016). *Mathematics education in the United States 2016: A capsule summary fact book.* Reston, VA: NCTM.

Change Takes Perseverance

"When teachers try to change more than two or three things about their teaching at the same time, the typical result is that their teaching deteriorates and they go back to doing what they were doing before."

—Wiliam, *Embedded Formative Assessment* (2011), p. 161

You Can Make It Happen!

"[Effective] teachers/leaders believe that success and failure in student learning is about what they, as teachers or leaders, did or did not do . . . We are change agents!"

—Hattie, *Visible Learning for Teachers: Maximizing Impact on Learning* (2012), p. 161

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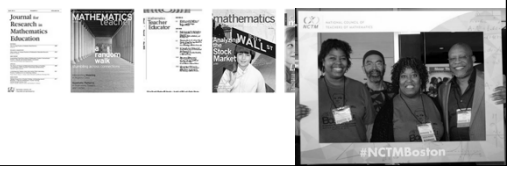


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