The Essential Elements of Effective Math Programs

Matt Larson
Writing Team for Principles to Actions
K-12 Curriculum Specialist for Mathematics
Lincoln Public Schools, NE
@mlarson_math

A 25-year History of Standards-Based Mathematics Education Reform

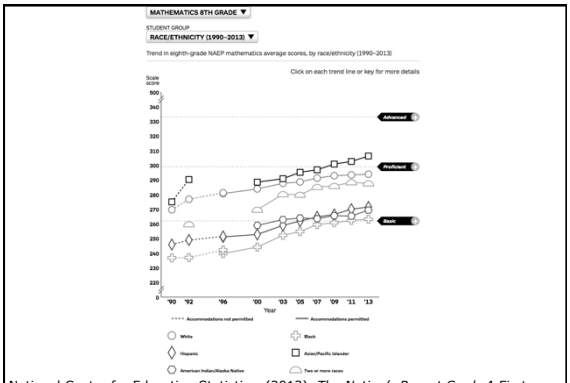
1989 *Curriculum and Evaluation Standards for School Mathematics*

2000 *Principles and Standards for School Mathematics*

2006 *Curriculum Focal Points*

2010 *Common Core State Standards for Mathematics*

2014 *Principles to Actions: Ensuring Mathematical Success for All*



National Center for Education Statistics. (2013). *The Nation's Report Card: A First Look: 2013 Mathematics and Reading* (NCES 2014-451). Institute of Education Sciences, U.S. Department of Education, Washington, DC.

Principles to Actions [PtA]: Ensuring Mathematical Success for All

The primary purpose of PtA is to fill the gap between the adoption of standards and the enactment of practices, policies, programs and actions required for successful implementation of those standards.

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.

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.

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.

Beliefs about teaching and learning mathematics

Unproductive beliefs	Productive beliefs
Mathematics learning should focus on practicing procedures and memorizing basic number combinations.	Mathematics learning should focus on developing understanding of concepts and procedures through problem solving, reasoning, and discourse.
Students need only to learn and use the same standard computational algorithms and the same prescribed methods to solve algebraic problems.	All students need to have a range of strategies and approaches from which to choose in solving problems, including, but not limited to, general methods, standard algorithms, and procedures.
Students can learn to apply mathematics only after they have mastered the basic skills.	Students can learn mathematics through exploring and solving contextual and mathematical problems.

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

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 so that students, over time, become skillful in using procedures flexibly as they solve contextual and mathematical problems.

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

Build procedural fluency from conceptual understanding
Teacher and student actions

What are *teachers* doing?	What are *students* doing?
Providing students with opportunities to use their own reasoning strategies and methods for solving problems.	Making sure that they understand and can explain the mathematical basis for the procedures that they are using.
Asking students to discuss and explain why the procedures that they are using work to solve particular problems.	Demonstrating flexible use of strategies and methods while reflecting on which procedures seem to work best for specific types of problems.
Connecting student-generated strategies and methods to more efficient procedures as appropriate.	Determining whether specific approaches generalize to a broad class of problems.
Using visual models to support students' understanding of general methods.	Striving to use procedures appropriately and efficiently.
Providing students with opportunities for distributed practice of procedures.	

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

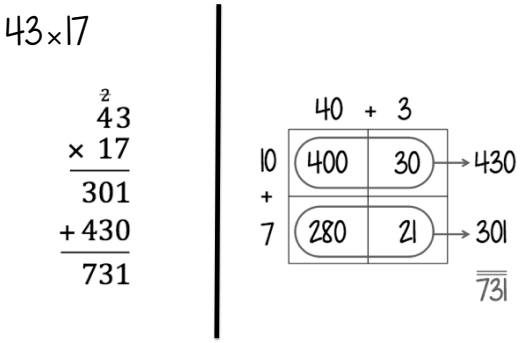
Put Standard Algorithms in Historical Perspective

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, in order to make pencil-and-paper calculation most efficient.

Put Standard Algorithms in Historical Perspective

Standard algorithms sacrifice ease of understanding in favor of computational efficiency, and that made sense once. In today's world we have readily accessible machines to do calculations, so we can turn the educational focus on understanding the place-value system that lies beneath those algorithms … traditional algorithms offer little pedagogic value beyond variety.

The Area Model Builds Understanding of the Traditional Algorithm



Beliefs about teaching and learning mathematics	
Unproductive beliefs	**Productive beliefs**
The role of the teacher is to tell students exactly what definitions, formulas, and rules they should know and demonstrate how to use this information to solve mathematics problems.	The role of the teacher is to engage students in tasks that promote reasoning and problem solving and facilitate discourse that moves students toward shared understanding of mathematics.
The role of the student is to memorize information that is presented and then use it to solve routine problems on homework, quizzes, and tests.	The role of the student is to be actively involved in making sense of mathematics tasks by using varied strategies and representations, justifying solutions, making connections to prior knowledge or familiar contexts and experiences, and considering the reasoning of others.
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.	An effective teacher provides students with appropriate challenge, encourages perseverance in solving problems, and supports productive struggle in learning mathematics.

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

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. As a result, they jump in to 'rescue' students by breaking down the task and guiding students step-by-step through the difficulties.

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

Support Productive Struggle in Learning Mathematics

Struggle does not mean needless frustration or extreme levels of challenge. It means students expend some effort to make sense of mathematics. Unproductive struggle is a situation in which students make no progress towards sense making.

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

Warshauer, H. K. (2011). *The Role of Productive Struggle in Teaching and Learning Middle School Mathematics.* Doctoral Dissertation, University of Texas at Austin.

Productive Struggle Can Lead to a "Growth Mindset"

Teachers must acknowledge and value students for their perseverance and effort in reasoning and sense making in mathematics in order to develop in students a "growth mindset."

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

Avoiding Productive Struggle Decline

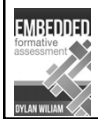
There are three common teaching moves that generally lead to teachers taking over a student's thinking.

1. **Interrupting the child's strategy**
2. **Manipulating the tools**
3. **Asking a series of closed questions**

These moves can result in leading a student to an answer without engaging him her in the reasoning about mathematical ideas.

Jacobs, V. R., Martin, H. A., Ambrose, R. C., & Philipp, R. A. (2014). Warning signs! *Teaching Children Mathematics*, 21(2), 107-113.

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.

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 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.

Access and Equity Obstacles

A range of obstacles exists … one of these involves the quality of instruction available to different groups of students … another involves differential opportunities to learn high-quality grade level mathematics content and to be held to high expectations for mathematics achievement.

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

Beliefs about access and equity in mathematics, *continued*

Unproductive beliefs	Productive beliefs
Mathematics learning is independent of students' culture, conditions, and language, and teachers do not need to consider any of these factors to be effective.	Effective mathematics instruction leverages students' culture, conditions, and language to support and enhance mathematics learning.
Tracking promotes students' achievement by allowing students to be placed in "homogeneous" classes and groups where they can make the greatest learning gains	The practice of isolating low-achieving students in low-level or slower-paced mathematics groups should be eliminated.
Only high-achieving or gifted students can reason about, make sense of, and persevere in solving challenging mathematics problems.	All students are capable of making sense of and persevering in solving challenging mathematics problems and should be expected to do so. Many more students, regardless of gender, ethnicity, and socioeconomic status, need to be given the support, confidence, and opportunities to reach much higher levels of mathematical success and interest.

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

Different Opportunities for Different Students

The learning opportunities provided for low-ability, average-ability, and high ability-grouped classrooms are hierarchically different. Students in these different groups are offered very different tasks, curriculum, and instruction.

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

Educide by the Low-Slow Group

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.

Educide by the Low-Slow Group

Too often, schools serving large populations of minority students emphasize "slowing down" or providing less mathematics content, rather than providing more challenging content.

Walker, E. N. (2007). Why aren't more minorities taking advanced math? Educational Leadership, 65(3), 48-53.

Different Opportunities for Different Students

In general the research indicates that students in lower-achieving classrooms are exposed to more slowly paced instruction, less advanced mathematics topics, and less emphasis on problem solving.

Stein, M.K., Kaufman, J. H., Sherman, M., & Hillen, A. F. (2011). Algebra: A challenge at the crossroads of policy and practice. *Review of Educational Research*, 81(4), 453-492.

On Paper We've De-Tracked High School

Even with universal algebra policies, there is the real possibility that 'tracking' will create different 'algebras' for different populations of students.

Stein, M. K., Kaufman, J. H., Sherman, M., & Hillen, A. F. (2011). Algebra: A challenge at the crossroads of policy and practice. *Review of Educational Research*, 81, 453-492.

Tracking Persists in New Forms

Although many schools have done away with traditional three-track sorting, hidden forms of tracking persist … <u>For example, an algebra course might sort students into fast and slow speeds of learning, so that by the end of the year students in the same class have not had the same opportunity to learn.</u>

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

Is it Even Really Algebra?

Nearly all of the class of 2005 graduated having taken "Algebra 1." However, based on the course materials, fewer than one in four studied the kind of challenging topics needed to prepare for college-level mathematics.

Nord, C., Roey, S., Perkins, R., Lyons, M., Lemanski, N., Brown, J., and Schuknect, J. (2011). *The Nation's Report Card: America's High School Graduates* (NCES 2011-462). U.S. Department of Education, National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.

Are the Teachers Tracked?

Evidence suggests that teachers themselves are tracked, with those judged to be the most competent, experienced, or high status assigned to the top tracks and those with the least experience and training assigned to the lower tracks.

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.

Teacher Assignments Can Exacerbate "Gaps"

The assignment of less experienced teachers to lower achieving students is likely to exacerbate within school achievement gaps given that new teachers, on average, are less effective in raising student achievement than their more experienced counterparts.

Kalogrides, D., Loeb, S., Beteille, T. (2013). Systematic sorting: Teacher characteristics and class assignments. *Sociology of Education*, 86, 103-123.

We expect that the very best doctors will treat the most grievously ill patients. It should be no different in education. Great teachers have the skills to help the students who struggle the most.

Education Trust. (2005). *Gaining traction, gaining ground: How some high schools accelerate learning for struggling students*. Washington, DC: Education Trust.

The Document is Entitled Principles to *Actions*

For the Access and Equity Principle:

- Develop socially, emotionally, and academically safe environments for mathematics teaching and learning.
- Model high expectations for each student's success.
- Promote the development of a growth mindset among students.

Guiding Principles for School Mathematics: Curriculum

Curriculum. An excellent mathematics program includes curriculum that develops important mathematics along coherent learning progressions and develops connections among areas of mathematical study and between mathematics and the real world.

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

A Curriculum Obstacle

Grade level mathematics curriculum standards are often treated as a checklist of topics. When conceptualized as such, mathematics content becomes nothing more than a set of isolated skills, often without a mathematical or real-world context and disconnected from related topics.

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

Curriculum Coherence is Critical to Support Teachers & Students

A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades (p. 14).

NCTM. (2000). *Principles and standards for school mathematics.* Reston, VA: NCTM.

The Document is Entitled Principles to *Actions*

For the Curriculum Principle:

- Engage in dialogue with colleagues who teach other mathematics courses or grade levels to understand the mathematical horizon.
- Sequence tasks and activities with long-term goals in mind – focus on connections among key mathematical ideas.

Guiding Principles for School Mathematics: Tools and Technology

Tools and Technology. An excellent mathematics program integrates the use of mathematical tools and technology as essential resources to help students learn and make sense of mathematical ideas, reason mathematically, and communicate their mathematical thinking.

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

Obstacles to Tools and Technology

Having students watch a computer presentation or tutorial in which mathematical facts and examples appear, no matter how visually engaging, is not significantly different than having students watch a teacher write the same information on a white board.

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

No single piece of technology has yet to change the basic nature of teaching and learning. Yes, technology can make an endless supply of images, books, and instructional videos available to students any time, anywhere. But learning is about engaging with that material in deep, essential ways that help build, extend, and ultimately create new knowledge.

Technology Can Evolve Education, but it is Unlikely to Revolutionize Education

The premise that traditional teachers will no longer be relevant is based upon the false notion that the primary role of the teacher is the transmission of information. In reality, effective educating and learning is much more – it is based on the social interaction between teachers and students.

Raju, S. (2014). Guest blog post, "This is the technology idea that will revolutionize education." *Education Week*, December 22.

The Document is Entitled Principles to ***Actions***

For the Tools and Technology Principle:

- Plan carefully for the use of classroom technology to ensure that it builds student understanding and reasoning.
- Incorporate mathematical tools and technology as an everyday part of learning mathematics.

Guiding Principles for School Mathematics: Assessment

Assessment. An excellent mathematics program ensures that assessment is an integral part of instruction … and informs feedback to students, instructional decisions, and program improvement.

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

Assessment Obstacle

Traditionally assessment tends to emphasize the evaluation of student achievement (e.g., assigning grades), and more recently, the rating of schools and the performance of teachers – the cultural perception that links assessment to grading and rating …

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

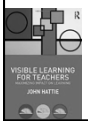
Overcoming the Obstacle

Work in collaborative teams, grade level or subject-based, to develop common assessments that will be used formatively, commit to their use, and use the results to advance student learning and improve instruction.

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

Who Gets the Most Valuable Feedback from Assessments?

The major reason for administering tests in classrooms is for teachers to find out what they taught well or not, who they taught well or not, and where they should focus next. If a test does not lead to a teacher evaluating these claims, it was probably a waste of everybody's time and effort.



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

Assessment is How We Cover it All and Cover it Well

Based on its review of research, the Panel recommends regular use of formative assessment, particularly for students in elementary grades … for struggling students, frequent (e.g., weekly or biweekly) use of these assessments appears to be optimal, so that instruction can be adapted based on student progress …

National Mathematics Advisory Panel. (2008). Foundations for Success: The Final Report of the National Mathematics Advisory Panel. U.S. Department of Education: Washington, DC.

Instructional Interventions that Make a Difference

Frequent monitoring (at least weekly) of student progress.

Results of frequent assessment are used to form small groups of students for instruction, practice, and reinforcement in the skills and concepts with which they are struggling. <u>Small group support takes place in addition to whole class instruction</u>.

Baker, S., & Gersten, R., & Lee, D. (2002). A synthesis of empirical research on teaching mathematics to low-achieving students. *The Elementary School Journal*, 103(1), 51-73.

Time Must Become the Variable, Not Learning

Time and support must become variables. Some students will require more time to learn, and so the school must develop strategies to provide students with that time during the school day.

DuFour, R., DuFour, R., Eaker, R., & Karhanek, G.. (2004). Whatever it takes: How professional learning communities respond when kids don't learn. Bloomington, IN: National Education Service. p. 35.

Doing More of Less

One of the characteristics of the most effective schools is their willingness to declare that some things are more important than others; they are willing to abandon some less important content so as to be able to have enough time dedicated to those areas that are valued most.

Lezotte, L. W. (1991). Correlates of effective schools: The first and second generation. Okemos, MI: Effective Schools Products.

Focus on What is Most Important Across Subjects

All of the world's top systems place a strong focus on numeracy and literacy in the early years based, in part, on substantial research evidence which shows that early ability in core skills is strongly correlated with a range of future outcomes.

Barber, M., & Mourshed, M. (2007). How the world's best performing school systems come out on top. www.mckinsey.com/clientservice/socialsector/pdf/worlds_school_systems_final.pdf

Early Intervention

There is ample evidence that achievement trajectories are quite stable as children begin middle school … by the end of third grade school achievement over the long term is highly predictable.

Pianta, R. C., Belsky, J., Vandergrift, N., Houts, R., & Morrison, F. J. (2008). Classroom effects on children's achievement trajectories in elementary school. American Educational Research Journal, 45(2), 365-397.

Math is a Powerful Predictor

Early mathematics competence predicts later achievement even into high school … with persistent difficulties with mathematics one of the strongest predictors of failure to graduate high school and enter college.

Clements, D. H., Sarama, J., Wolfe, C. B., & Spitler, M. E. (2013). Longitudinal evaluation of a scale-up model for teaching mathematics with trajectories and technologies: Persistence of effects in the third year. *American Educational Research Journal*, 50(4), 812-850.

The Document is Entitled Principles to ***Actions***

For the Assessment Principle:

- Work in collaborative grade-level or subject-based teams to develop common assessment to be used formatively.
- Provide students with descriptive, accurate and timely feedback.
- View assessment results as supplying part of the picture of instructional effectiveness.

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.

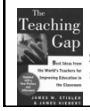
Professionalism Obstacle

In too many schools, professional isolation severely undermines attempts to significantly increase professional collaboration … some teachers actually embrace the norms of isolation and autonomy. A danger in isolation is that it can lead to teachers developing inconsistencies in their practice that in turn can create inequities in student learning.

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.

Lesson Preparation

A Chinese teacher sees a lesson as a performance and puts in many hours of preparation to cover the standard forty-five minute period … the lesson plan serves not only as a play for the teacher to act out during the lesson, but it also documents the teacher's professional performance

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.

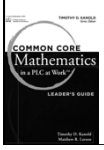
Lesson Planning is Cultural

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 for 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.

Why 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.

Continuous Improvement is the Goal

If all teachers accept the need to improve practice, not because they are not good enough, but because they can be even better, and focus on the things that make the biggest difference to their students, according to the research, we will be able to prepare our students to thrive in the impossibly complex, unpredictable world …

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

Collaboration Can Improve Learning

Students whose teachers regularly collaborate and participate in professional communities show more growth in mathematics achievement than those whose teachers are more isolated professionally … in addition, teachers' participation in such communities leads to smaller learning gaps between diverse racial and socioeconomic groups.

Moller, S., Mickelson, R. A., Sterns, E., Banerjee, N., & Bottia, M. C. (2013). Collective pedagogical teacher culture and mathematics achievement: Differences by race, ethnicity, and socioeconomic status. *Sociology of Education*, 86, 174-194.

The Document is Entitled Principles to *Actions*

For the Professionalism Principle:

- Continually grow in knowledge of mathematics for teaching, mathematical pedagogical knowledge, and knowledge of students as learners of mathematics.
- Collaborate with colleagues.
- Assume collective responsibility for the learning of all students in your school.
- Join and participate in local, state, and national professional organizations.

It Can All Seem Overwhelming and 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 Old 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. It may be that mathematics instruction is an example of a cultural trap: routines that may have been adaptive a century ago appear to have persisted, even when it is clear that they are not accomplishing the goals we have for mathematics education.

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.

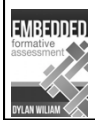
Start Small, Build Momentum, Persevere

The process of creating a new cultural norm characterized by professional collaboration, openness of practice, and continual learning and improvement can begin with a single team of grade level or subject-based mathematics teachers making the commitment to collaborate on a single lesson plan.

NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All.* 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. My advice is that each teacher chooses one or two techniques and tries them out in the classroom. If they appear to be effective, then the goal should be practice them until they become second nature.



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

We Know What to Do – We Just Need to Do It!

It is critical that schools learn the lesson that "best practice" in effective organizations is rarely new practice … the most effective actions are well-known practices, with the extra dimension that they are reinforced and carried out reliably.

Schmoker, M. (2011). *Focus: Elevating the essentials to radically improve student learning.* Alexandria, VA: ASCD.

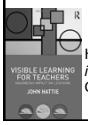
We Know What Best Practice is for School Mathematics

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

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

YOU Can Make it Happen!

[Effective] Teachers and 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, J. (2012). *Visible learning for teachers: Maximizing impact on learning.* New York: Routledge, Taylor & Francis Group.