

Empowerment through Access and Equity

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NCTM President

Disclaimers



- I am on my own journey to better understand issues of race, access, and equity.
- I am working to unpack my own privilege.

Disclaimers



- I may make unintentional errors in interpretation and misuse language. I welcome feedback from critical friends.

Goals

- **Make some connections between equitable instructional practices and *Principles to Actions***
- **Offer a perspective on why we teach mathematics**

Our Challenge

There is a long standing, thoroughly documented, and seemingly intractable problem in mathematics education: inequity. Children of certain racial, ethnic, language, gender, ability, and socio-economic backgrounds experience mathematics education in school differently and many are disaffected by their mathematics education experience.

Aguirre, J., Herbel-Eisenmann, B., Celedon-Pattichis, S., Civil, M., Wilkerson, T., Stephan, M., Pape, S., & Clements, D. H. (2017). Equity within mathematics education research as a political act: Moving from choice to intentional collective professional responsibility. *Journal for Research in Mathematics Education*, 48(2), 124-147.

The Need for Grace and Space

We have a duty, all of us, to understand race issues, especially with all that's going on in our nation today. We have a duty to approach it with a culture of inquiry ... in the mathematical community, let's provide each other the grace and space to talk about these difficult things

Francis Su, MAA Past President.

"Freedom through Inquiry." Address at the Inquiry-Based Learning Forum & 19th Annual Legacy of R. L. Moore Conference. August 4, 2016.

Some Connections Between *Principles to Actions* and Equitable Instructional Practices

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>.

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.

Defining Equity in Mathematics Education

Equity in mathematics education will not be achieved until it is no longer possible “to predict mathematics achievement and participation based solely on student characteristics such as race, class, ethnicity, sex, beliefs, and proficiency in the dominant language.”

Gutiérrez, 2002

Creating Equitable Structures

Current reform efforts that focus largely on standards, with some attention to improved instructional practice, are unlikely to address and alleviate equity concerns unless they also **address and dismantle the conditions and system structures** that stand as barriers to the creation of positive mathematical experiences for students.



NCTM. (2018). *Catalyzing change in high school mathematics: Initiating critical conversations*. Reston, VA: NCTM.

Mathematics education will likely always involve significant tensions.

Lawler, B. R., & Meyer, B. (2017, Nov.). *Tensions of teaching for positive mathematics identity*. National Council of Teachers of Mathematics 2017 Innov8 Conference, Las Vegas.

We Have to Confront Structural Obstacles

Even with the best-made plans, Herculean efforts, and supportive families, research shows how, more often than not, ... [some students] are often forced off their paths by structural and systemic barriers ...

Jilk, L. M. (2014). Everybody can be somebody: Expanding and valorizing secondary school mathematics practices to support engagement and success. In N. S. Nasir, C. Cabana, B. Shreve, E. Woodbury, & N. Louie (Eds.), *Mathematics for equity: A framework for successful practice* (pp. 107-128). New York: Teachers College Press.

Some Structural Obstacles

- **Student Tracking**
- **Teacher Tracking**

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.

Access Remains a Critical Issue

Across OECD countries, more than 70% of students attend schools whose principal reported that students are grouped by “ability” for math ... reducing ability-grouping can reduce the influence of socio-economic status on students’ opportunities to learn.

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 Remains a Critical Issue

In 2011, nearly two-thirds of fourth grade teachers reported using “ability grouping” in math instruction.

Loveless, T. (2013). *The 2013 Brown Center report on American education: How well are American students learning?* Washington, DC: Brown Center on Education Policy, Brookings Institution.

Who Teaches Whom What?

The power and status of school mathematics often manifest themselves in decisions about what content gets taught, to which students, and by which teachers... what gets taught in the mathematics classroom shapes the mathematics identities of both students and teachers.



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.

Different Opportunities for Different Students

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



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

Type and Quality of Instruction Matters

While marginalized students tend to learn simple facts and figures and are exposed to simple applied problems, their privileged counterparts experience mathematics instruction that help them think like a mathematician, develop deep conceptual understanding and advanced mathematical reasoning skills.

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

Tracking Begins Early

Although tracking is often viewed as a secondary concern, the reality is that “tracks” in mathematics are often established as early as the primary grades when students who struggled in kindergarten are placed in a “low-slow” mathematics group in first grade.

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” 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).

Tracking Persists in New Forms

Although many schools have done away with traditional three-track sorting, hidden forms of tracking persist ... 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.

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

There Are Differential Outcomes For “Different” Algebras

Students placed into less rigorous versions of Algebra 1 ultimately have lower math attainment in high school even if their performance in the less rigorous version of algebra is greater than that of students in more rigorous versions.

Tyson, W., & Roksa, J. (2017). Importance of grades and placement for math attainment. *Educational Researcher*, 46(3), 140-142.

Supporting Student Success in High School Mathematics

Double-period versions of a course **do not** represent lower-level versions of a course. Double-period versions of a course do not constitute tracking if the double-period version of the course has the same instructional objectives and expectations and uses the same core instructional materials and assessments.



NCTM. (2018). *Catalyzing change in high school mathematics: Initiating critical conversations*. Reston, VA: NCTM.

Distinguishing Tracking from Appropriate Acceleration

Acceleration may be appropriate if a student has **demonstrated deep understanding** of grade-level or course-based mathematics standards beyond his or her current level.



NCTM. (2018). *Catalyzing change in high school mathematics: Initiating critical conversations*. Reston, VA: NCTM.

Distinguishing Tracking from Appropriate Acceleration

Appropriate acceleration ensures that ...

- Opportunities are available to each and every prepared student and no critical concepts are rushed or skipped.
- Is along a single common shared pathway that provides each student an opportunity to learn the same Essential Concepts.



NCTM. (2018). *Catalyzing change in high school mathematics: Initiating critical conversations*. Reston, VA: NCTM.

Distinguishing Tracking from Appropriate Acceleration

Appropriate acceleration ensures that ...

- Opportunities are open to a wide range of students who express a higher degree of interest in mathematics, not just those who are identified through traditional assessment instruments.



NCTM. (2018). *Catalyzing change in high school mathematics: Initiating critical conversations*. Reston, VA: NCTM.

All Too Often the Teachers are Tracked

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.

We Need to Reflect on Course and Teacher Assignment Practices

Schools should carefully study whether their teacher assignments and tracking practices are helping or hindering equity ...

Lubienski, S. T. (2007). What can we do about achievement disparities? *Educational Leadership*, 65(3), 54-59.

Teacher Tracking

Whenever possible, high school mathematics teachers in the same department should have teaching assignments that are balanced to include both upper-level and entry-level mathematics courses.



NCTM. (2018). *Catalyzing change in high school mathematics: Initiating critical conversations*. Reston, VA: NCTM.

Balanced Teaching Assignments

Balancing teaching assignments deepens teachers' knowledge of the overall curriculum expectations, can reduce burnout among new teachers, can populate **collaborative teams with experienced teachers**, and can develop among teachers a **collective sense of responsibility for all students**.

Gutiérrez, 2002
Strutchens, Quander, and Gutiérrez, 2011

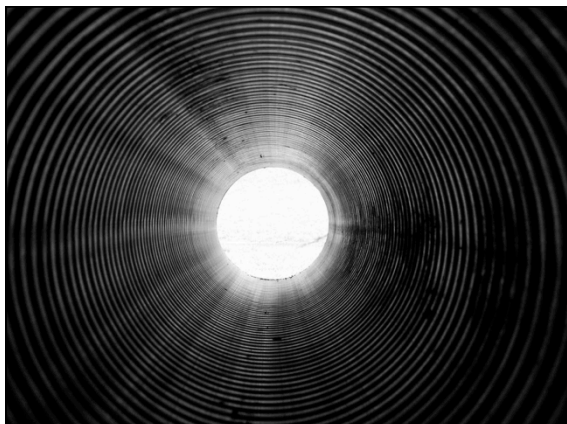
We expect that the very best doctors will treat the most grievously ill patients.

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.

Access and Equity is Necessary, but Not Sufficient





Access, Equity, and Empowerment

NCTM has re-framed its work to focus on Access, Equity, and Empowerment, to capture the critical constructs of *identity, agency, and social justice*.

Mathematical Identity

Mathematics identity includes beliefs about one's self as a mathematics learner, one's perceptions of being seen by others as a mathematics learner ...

Solomon, Y. (2009). *Mathematical literacy: Developing identities of inclusion*. New York, NY: Routledge.

Agency: Identity in Action

Mathematical agency is about participating in mathematics in personally and socially meaningful ways ... With a high sense of agency students can resist negative identities imposed on them by having a sense of control over their academic success.

Berry, R. Q. III. (2016). Informing teachers about identities and agency using the stories of Black middle school boys who are successful with school mathematics. In E. A. Silver & P. A. Kenney (Eds.), *More lessons learned from research: Helping all students understand important mathematics* (pp. 27-54). Reston, VA: NCTM.

Teachers are Identity Builders

Teachers can cultivate mathematical abilities by providing opportunities for students to make sense of and persevere in challenging mathematics. That is, students should be engaged with mathematics that requires active participation, asking questions, problem posing, and reasoning.

Berry, R. Q. III. (2016). Informing teachers about identities and agency using the stories of Black middle school boys who are successful with school mathematics. In E. A. Silver & P. A. Kenney (Eds.), *More lessons learned from research: Helping all students understand important mathematics* (pp. 27-54). 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, p. 10



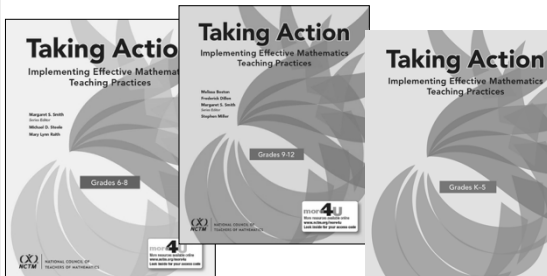
Eight Research-Informed Instructional Practices

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

—NCTM, 2014, p. 10



New Series: Taking Action



A Framework for the Eight Instructional Practices

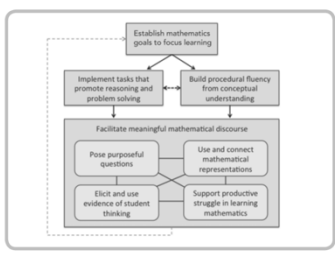


Fig. 10.1. A framework for mathematics teaching that highlights the relationships between and among the eight effective teaching practices

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 Mathematics Teaching 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.




Eight Research-Informed Instructional Practices

“Build procedural fluency from conceptual understanding.

“Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding. . . .”

—NCTM, 2014, p. 42



Building Positive Mathematics Identities

Low-level tasks, that rush procedural fluency without first establishing a foundation of conceptual understanding can “damage students’ identities as mathematical knowers and doers and can promote increased mathematical anxiety.”



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. 73.

Promoting Equity by Building Procedural Fluency from Conceptual Understanding

When instruction focuses on building conceptual understanding by using multiple mathematical representations and multiple solution paths, students have a wider range of options for entering a task and building mathematical meaning.



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. 74.

Eight Research-Informed Instructional Practices

Implement tasks that promote reasoning and problem solving.

Effective teaching of mathematics engages students in solving and discussing tasks that promote mathematical reasoning and problem solving and that allow for multiple entry points and varied solution strategies.



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

Task Selection Can Build Identity

Teachers mitigate issues arising from status by utilizing mathematical tasks that require a range of strengths and strategies to solve and by seeking out opportunities to publicly position students considered to be of low status with mathematical competence ...

Langer-Osuna, J. M. (2017). Authority, identity, and collaborative mathematics. *Journal for Research in Mathematics Education*, 48(3), 237-247.

Promoting Equity By Implementing Tasks that Promote Reasoning and Sense Making

“Engaging students in high-level tasks affords them the opportunity to *go deep with mathematics*, one of the five equity-based mathematics 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. 51.

Key Question: Does Each and Every Student Have an Opportunity to Go Deep with Mathematics?

Inequitable learning opportunities can exist in any setting, diverse or homogeneous, whenever only some, but not all, teachers implement rigorous curricula.



NCTM. (2014). *Principles to actions: Ensuring mathematical success for all*. Reston, VA: NCTM.

Eight Research-Informed Instructional Practices

Facilitate meaningful mathematical discourse.

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.

Supporting Equity through Facilitating Meaningful Mathematics Discourse

By eliciting students' own ideas and strategies and creating space for students to present their ideas and strategies during the whole-group discussion, the teacher communicates that students' ideas matter.



Boston, M., Dillon, F., Smith, M. S., & Miller, S. (2017). *Taking action: Implementing effective mathematics teaching practices grades 9-12*.

Eight Research-Informed Instructional Practices

Pose purposeful questions.

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.

Promoting Equity By Posing Purposeful Questions

“Teacher questioning and positioning of students influences how students view themselves as members of the mathematics learning community in the classroom.”



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. 95.

Promoting Equity By Posing Purposeful Questions

- Are all students' ideas and questions heard, valued, and pursued in the mathematics classroom?
- Who does the teacher call on to answer questions?
- What mathematical ideas does the class examine and discuss?
- Whose thinking does the teacher select for further inquiry, and whose thinking does the teacher disregard during small-group and whole-class discussion?"



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. 95.

Supporting Identity

The questions a student is asked, and how a teacher follows up on the student's response, can support the student's development of a positive mathematical identity and sense of agency as a thinker and doer of mathematics.



Boston, M., Dillon, F., Smith, M. S., & Miller, S. (2017). *Taking action: Implementing effective mathematics teaching practices grades 9-12*.

Eight Research-Informed Instructional Practices

"Elicit and use evidence of student thinking."

Effective teaching of mathematics uses evidence of student thinking to assess progress toward mathematical understanding and to adjust instruction continually in ways that support and extend learning."

—NCTM, 2014, p. 53



Supporting Equity by Eliciting and Using Evidence of Student Thinking

Eliciting student thinking and making use of that thinking during a lesson can send important and powerful messages about students' mathematical identities.



Boston, M., Dillon, F., Smith, M. S., & Miller, S. (2017). *Taking action: Implementing effective mathematics teaching practices grades 9-12*.

Supporting Equity by Eliciting and Using Evidence of Student Thinking

By carefully listening to and interpreting student thinking, teachers position students' contributions as mathematically valuable and contributing to a broader collective understanding of the mathematical ideas at hand.



Boston, M., Dillon, F., Smith, M. S., & Miller, S. (2017). *Taking action: Implementing effective mathematics teaching practices grades 9-12*.

Why Teach and Learn Mathematics?

Why Learn Mathematics?

This is a simple question, but worth considerable reflection. Because how you answer this question will strongly determine **who** you think should be doing mathematics, and **how** you will teach it.

Su, F. (2017). *Mathematics for Human Flourishing*. Presidential Address, AMS-MAA Joint Math Meetings, Atlanta, January 6, 2017.

Traditionally Math Education Reform Has Been Driven by Economic Concerns

Traditionally, mathematics education has been connected to issues of national economic survival, rather than to the development of democratic citizenship through critical thinking in mathematics.

Tate, W. F. (2013). Race, retrenchment, and the reform of school mathematics. In E. Gutstein & B. Peterson (Eds.), *Rethinking mathematics: Teaching social justice by the numbers, second edition* (pp. 42-51). Milwaukee, WI: Rethinking Schools.

The Common Core [Current Standards] Initiative Continues the Same Narrative

The standards are designed to be robust and relevant ... reflecting the knowledge and skills that our young people need ... With American students fully prepared for the future, our communities will be best positioned to compete successfully in the global economy.

National Governors Association Center for Best Practices and Council of Chief State School Officers. 2010a. Common Core State Standards Initiative, Mission Statement. <http://www.corestandards.org/>.

An Agenda for Action Pointed to Mathematics Learning for More Than Economic Reasons

All reasonable means should be employed to assure that everyone will have the foundation of mathematical learning essential to fulfilling his or her potential as a productive citizen.



NCTM. (1980). *An agenda for action*. Reston, VA.

In PSSM NCTM Argued There Are Multiple Reasons to Learn Mathematics

The need for mathematics in a changing world:

- *Mathematics for Life* – knowing mathematics can be personally satisfying and empowering.
- *Mathematics as a part of cultural heritage.*
- *Mathematics for the workplace.*
- *Mathematics for the scientific and technical community.*



NCTM. (2000). *Principles and Standards for School Mathematics*. Reston, VA: NCTM. (p. 4)

We Should Learn Math for Multiple Reasons

Students need full opportunities to learn mathematics for many reasons – economic survival for themselves, their families, and their communities; future education and meaningful vocational or career plans; reading and writing the world (use mathematics to comprehend and change the world); and full actualization of their human potential.

Gutstein, E. (2016). "Our issues, our people – math as our weapon: Critical mathematics in a Chicago neighborhood high school. *Journal for Research in Mathematics Education*, 47(5), 454-504.

Traditional Goals Remain Important

It is equally important to recognize that improving opportunities for employment is a real expectation that students and parents have of school. But preparation for the job market is indeed preparation for the capability of dealing with new challenges.

D'Ambrosio, U. (2012). A broad concept of social justice. In A. A. Wager & D. W. Stinson (Eds.), *Teaching mathematics for social justice: Conversations with educators* (pp. 201-213). Reston, VA: NCTM.

Never Has Broadening the Goals of Mathematics Learning Been More Important

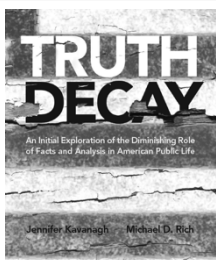
Today, more than ever, it is insufficient to just teach and learn mathematics in mathematics class ... we live in a time of deep, sustained, global crises – sociopolitical, economic, and ecological ... If young people are to be prepared for the challenges of the future, involving them in reading and writing the world today is essential for tomorrow.

Gutstein, E. (2016). "Our issues, our people – math as our weapon: Critical mathematics in a Chicago neighborhood high school. *Journal for Research in Mathematics Education*, 47(5), 454-504.

Never Has Broadening the Goals of Mathematics Learning Been More Important

Mathematics literacy is essential to informed and active engagement as a member of our society. We live in a world where mathematics is increasingly used to characterize societal problems and formulate solutions.

Mathematics Education Can Help Combat Truth Decay



- Increasing disagreement about facts and analytical interpretation of facts and data.
- A blurring of the line between opinion and fact.
- The increasing relative volume, and resulting influence, of opinion and personal experience over fact.
- Declining trust in formerly respected sources of factual information.

Kavanagh, J., & Rich, M. D. (2018). *Truth decay: An initial exploration of the diminishing role of facts and analysis in American public life*. Santa Monica, CA: RAND Corporation.

Why I Believe We Teach Mathematics

Students must be able to identify, interpret, evaluate and critique the mathematics embedded in social, scientific, economic, commercial and political systems, as well as the claims made in the private and public sector and in public interest-group pronouncements.

Adapted from: Ernest, P. (2010). Why teach mathematics? *Professional Educator*, 9(2). 45-47.

Catalyzing Change in High School Mathematics

Initiating Critical Conversations



- Explicitly broaden the purposes for teaching high school mathematics.
- Catalyze a serious discussion of the challenges facing high school mathematics.
- Define equitable structures, instructional practices, curriculum, and pathways.
- Identify essential concepts for focus that all high school students should learn at a deep level of understanding.

Call to Action

- Confront structural obstacles to equity, including student and teacher tracking.
- Support each and every student in building a positive mathematics identity and high sense of agency.
- Emphasize to students (and parents) the multiple reasons for learning mathematics.

To remain indifferent to the challenges we face is indefensible. If the goal is noble, whether or not it is realized within our lifetime is largely irrelevant. What we must do therefore is to strive and persevere and never give up.

Dalai Lama XIV