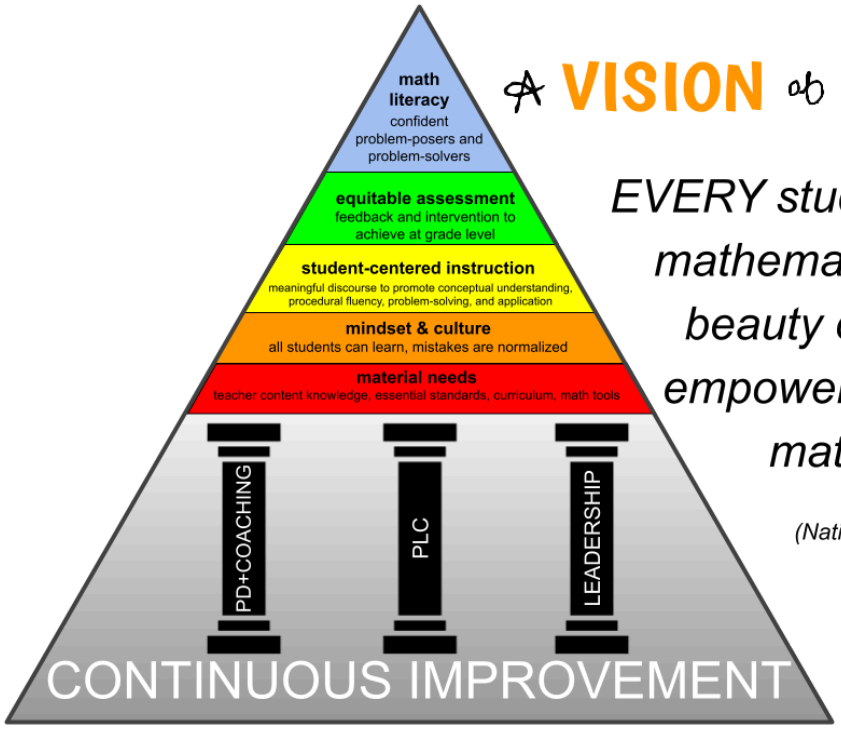
COMPREHENSIVE IMPROVEMENT PLAN



A VISION of MATH LEARNING

EVERY student is "enthused about mathematics, sees the value and beauty of mathematics, and is empowered by the opportunities mathematics affords."

(National Council of Teachers of Mathematics, 2016)

MERCED COUNTY Office of Education
NURTURE • SERVE • LEAD
Steve M. Tietjen, Ed.D.
County Superintendent of Schools

MCOE Mathematics

Introduction to the Comprehensive Improvement Plan

When it comes to improving mathematics instruction in the classroom, what, exactly, are we aiming for? How will we know when we have achieved it? Perhaps most importantly, how do we make it happen in every classroom?

The MCOE Math Team answers these questions with a vision statement that acts as our North Star, guiding every decision we make. Our statement, which comes directly from the National Council of Mathematics literature, situates Merced county not as a relatively small, isolated rural county, but as a valuable community that is intricately connected to the greater mathematical community. Our vision:

> *Every student is enthused by mathematics, sees the value and beauty of mathematics, and is empowered by the opportunities mathematics affords.*

Seeing this vision come to fruition will require a significant transformational change in culture.

The Learning Policy Institute defines Professional Development as "structured professional learning that results in changes in teacher practices and improvements in student learning outcomes."[1] For the past 150 years of public education, we in the educational community have been fairly successful at providing structured professional learning, but we have been woefully inadequate at ensuring changes in teacher practices or improvements in student learning outcomes.

Traditional professional development has failed to create meaningful changes in teacher practices and improvements in student outcomes because it is most often delivered workshop-style, in which teachers passively sit-and-get; and the measure of the workshop's success is usually teacher feedback indicating their enthusiasm for the speaker and the subject at the moment. Rarely, if ever, is the measure of successful professional development based on the implementation rate of the new strategies learned and their impact on student achievement.

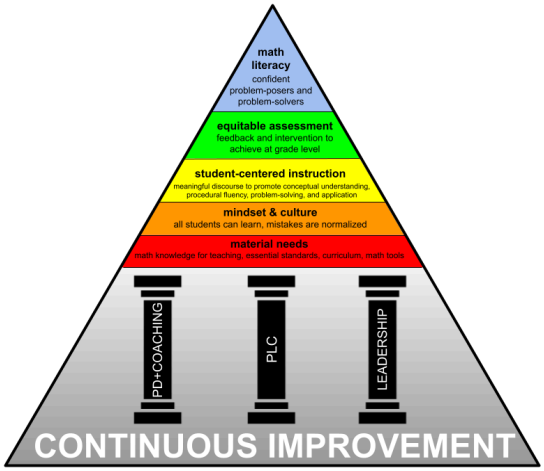
Moreover, traditional professional development fails to support teachers when they need it most: in the classroom during the initial implementation of the new skill in front of students. In the same way a child learning to ride a bike needs the most support during their initial attempts at bike-riding, the time when a teacher needs the most support is in the classroom during the initial implementation of the new teaching practice.

The MCOE Continuous Improvement Team seeks to address this long-standing failure of professional development by utilizing a comprehensive, ongoing, and sustainable plan that includes support for all stakeholders involved: teachers, site leaders, and district administration.

[1] "Effective Teacher Professional Development - Learning Policy ...." 5 Jun. 2017, https://learningpolicyinstitute.org/product/effective-teacher-professional-development-report. Accessed 23 Oct. 2020.

Our Comprehensive Improvement Plan has five key components to ensure authentic improvement in the quality of classroom instruction and an increase in student achievement:

1. ambitious instruction
2. job-embedded coaching
3. support for professional learning communities
4. building capacity of site and district leadership
5. implementation of continuous improvement



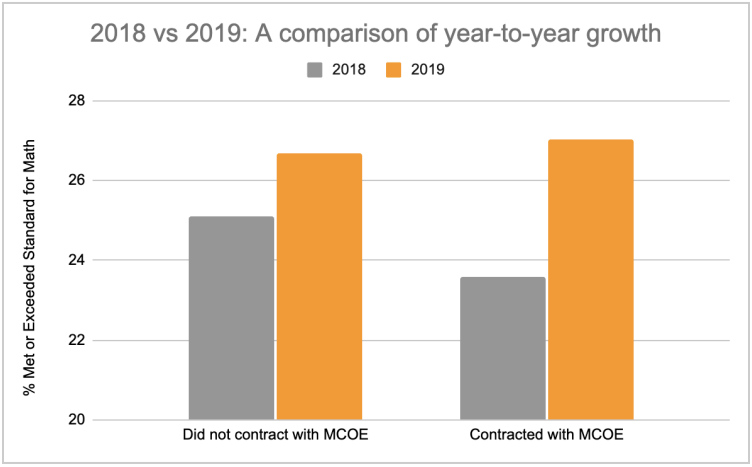
We begin by using the Math Hierarchy of Needs to describe ambitious instruction and identify the initial initiative(s) to focus on. We then provide high-quality professional development that includes both a workshop-style component and in-class demonstrations.

We then ensure successful implementation of the new instructional strategies through three pillars of support:

- Job-embedded professional development and coaching to assist the teacher implement the new strategy in the classroom with fidelity.
- Building the capacity of the local teacher PLC in taking ownership of developing a collective understanding of the ambitious instruction and collecting student feedback on its effectiveness.
- Aligning leadership with the instructional changes to ensure effective monitoring of classroom implementation.

Lastly, the principles of improvement science will be fully utilized when leadership – through their formal and informal monitoring and evaluations – notice any potential breakdowns in the implementation of the ambitious instruction.

RESULTS! During the 2018-2019 school year, districts who contracted with MCOE to receive our highest level of support experienced over TWICE the growth as compared to districts who did not contract with MCOE.



What follows is a more in-depth look into each of the five key components.

Ambitious instruction

The five key components of instructional improvement and implementation begins with a clear vision of the kind of instruction we are aiming for. Ambitious instruction deliberately creates an environment in which all students, regardless of ethnicity, race, socio-economic status, and gender, develop a deep and profound understanding of the content and are confident problem-posers and problem-solvers. There is ample evidence that students exposed to this sort of instruction make great progress in closing the achievement gaps that exist between categories of students.[2] Additionally, ambitious instruction requires that all students have equal opportunities to access rigorous grade-level curriculum. Simply by ensuring this access to high-quality curriculum, growth in student achievement increases by two months in a single year.[3]

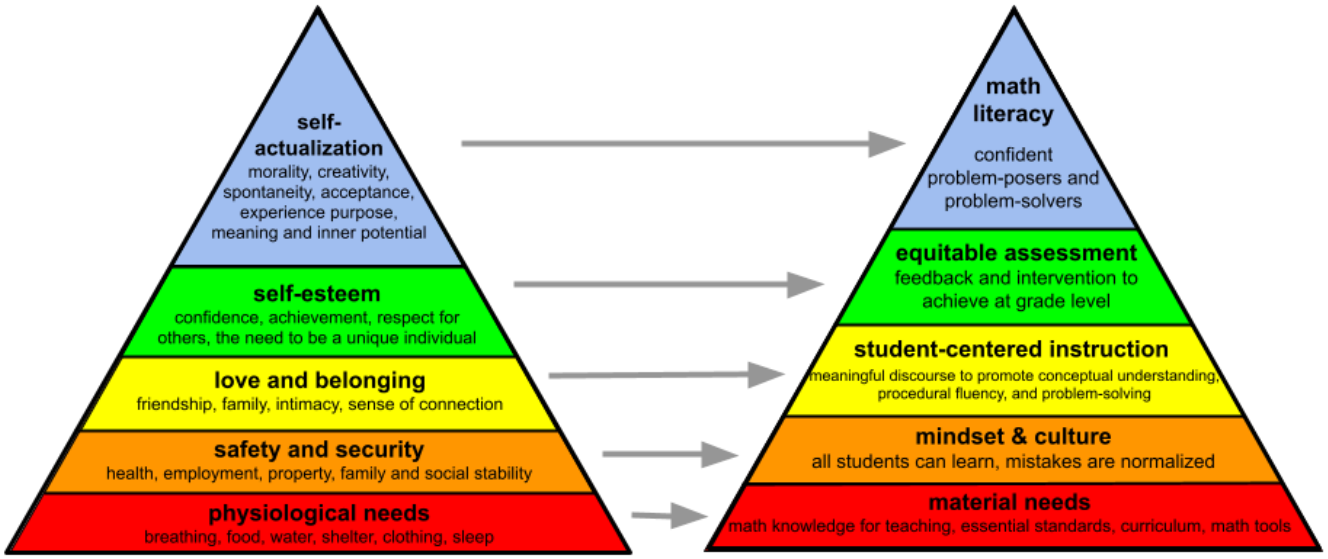
Almost by definition, ambitious instruction is likely to be very different from current practice in classrooms. This is because, as Stigler and Hiebert put it, teachers follow a cultural script for teaching that is so ingrained in their pedagogical DNA that they don't even know they are following a script.[4]

To improve instructional practices in the classroom, we must first understand the cultural script that we are following, the ramifications of that script on our students, and then we need to have a framework of instructional practices that are pieced together to create a new, more effective, cultural script for ambitious instruction. We have such a framework called the *Math Hierarchy of Needs*.

Math Hierarchy of Needs

Our vision is informed by the work of Abraham Maslow and his hierarchy of needs. Using his hierarchy as a model, we have created a mathematics hierarchy that guides our work in Merced County and acts as a roadmap for achieving our vision of creating empowered and confident problem-posing and problem-solving students.

[2] "The Opportunity Myth | TNTP." https://tntp.org/publications/view/student-experiences/the-opportunity-myth. Accessed 22 Oct. 2020.
[3] "Gathering Feedback for Teaching: Combining High-Quality ...." https://eric.ed.gov/?id=ED540960. Accessed 9 Nov. 2020.
[4] "Teaching is a Cultural Activity by James W. Stigler and James ...." https://www.kentuckymathematics.org/docs/Teaching_Is_A_Cultural_Activity_Teaching-Winter_98-Stigler.pdf. Accessed 23 Oct. 2020.



Maslow's Hierarchy of Needs **Math Hierarchy of Needs**

In the same way that Maslow's Hierarchy of Needs is a roadmap for how a person might experience the joy of experiencing self-actualization, with needs lower down in the hierarchy being satisfied before individuals can attend to needs higher up, the Math Hierarchy of Needs is a roadmap for how teachers and leaders might guide students towards becoming mathematically literate humans.

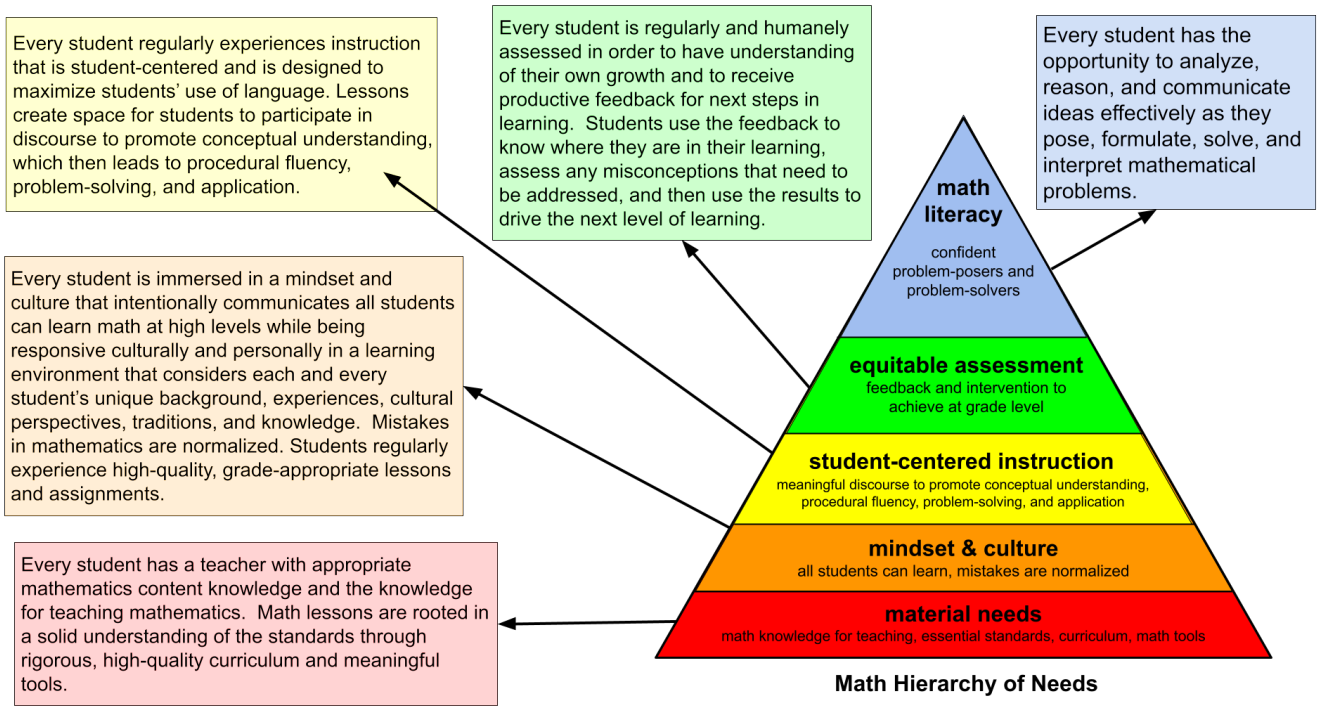
The hierarchy consists of five layers:

- material needs
- mindset and culture
- student-centered instruction
- equitable assessment
- mathematical literacy

Scan for more info about the Math Hierarchy of Needs

Each layer consists of a plethora of things a district can choose to focus on with respect to their goals, personnel, resources, and strengths. Lower layers are not intended to be prerequisites before beginning work higher up the pyramid, but the layers in their entirety do tell a coherent story of an ambitious mathematics system. Ambitious, high-quality instruction is achieved when students fully experience each of the layers in the hierarchy on a regular basis.

Let's unpack each of the five layers of the Math Hierarchy.



Math Hierarchy of Needs

Material Needs

> *Every student has a teacher with appropriate mathematics content knowledge and the knowledge for teaching mathematics. Math lessons are rooted in a solid understanding of grade-level standards through rigorous, high-quality curriculum and meaningful tools.*

In Maslow's hierarchy, the bottom layer addresses the physiological needs such as breathing, food, water, shelter, etc. Without fulfilling these needs a person will have little chance of thriving and advancing to the next level. In the Math Hierarchy of Needs, the bottom layer is called Material Needs.

Material Needs begins with the knowledge that for students to develop a deep understanding of mathematics they must experience a steady stream of effective math teaching practices. Building on Deborah Loewenberg Ball's 30-year study of effective math teaching practices, powerful instruction requires teachers to have a specialized type of knowledge called Mathematical Knowledge for Teaching (MKT). MKT includes abilities such as analyzing the student thinking that led to an incorrect answer, identifying the mathematical understanding a student does not yet have, and deciding how to best represent a mathematical idea so that it can be understood by students.

Teachers need to have strong mathematics content knowledge for the purpose of making mathematics accessible for students. More than arriving at the correct answer, however, teachers need to know how to use concrete manipulatives, pictorial representations, and numbers and symbols to illustrate WHY the answer is what it is...not just HOW to get the answer.

Teachers also need a deep understanding of how students learn mathematics. For a given math concept, which visual representation might provide the biggest bang for the buck? Is there a solution

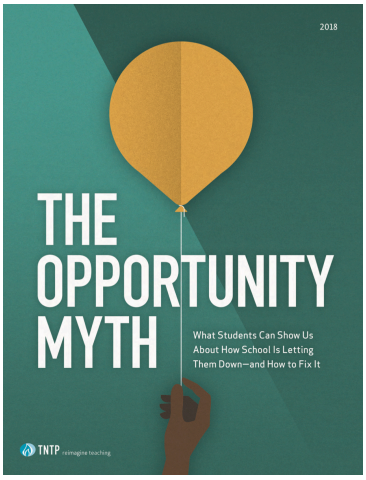
strategy that might support students beyond just the current math concept, but also scales up to subsequent topics.

Lastly, teachers must have at their disposal instructional strategies that promote thinking, reasoning, and making sense of mathematics. There are a variety of such strategies: Thinking Classrooms, 5 Practices, Teaching through problem-solving, and Three-Part Lessons are examples. (More on this in *Student-Centered Instruction*.)

Mindset and Culture

> *Every student is immersed in a mindset and culture that intentionally communicates that all students can learn math at high levels while being responsive culturally and personally in a learning environment that considers each and every student's unique background, experiences, cultural perspectives, traditions, and knowledge. Mistakes in mathematics are normalized. Students regularly experience high-quality, grade-appropriate lessons and assignments.*

Once the material needs of students have been satisfied, students need to be immersed in a mathematical culture that supports them in taking risks and productively struggling with rigorous mathematics. This is the purpose of the mindset and culture layer. Students are provided the safety and security that declares all students are capable of learning rigorous mathematics and that mistakes are normalized as a necessary components of mathematics achievement.



Instrumental in the mindset and culture layer is students' access to rigorous grade-level mathematics. *The Opportunity Myth* gives clear direction regarding the incredible growth in student achievement when students have access to grade-appropriate assignments, stronger instruction, deeper engagement, and higher expectations.[5] For example, students who started the year behind grade level and were provided access to stronger instruction and grade-appropriate assignments closed gaps in student achievement by more than seven months! Moreover, teacher expectations for students' success with grade-level content is one of the strongest predictors of student growth.

Providing students with unfettered access to grade-level content requires teachers to create a culture for transforming mathematics learning. From Boaler's *Unlocking Children's Math Potential*, five research-informed practices are provided that create an environment in which such a culture will flourish.[6]

[5] "The Opportunity Myth | TNTP." 25 Sep. 2018, https://tntp.org/publications/view/student-experiences/the-opportunity-myth. Accessed 29 Jun. 2020.
[6] "Unlocking Children's Math Potential - Parents League." 3 May. 2020, https://www.parentsleague.org/blog/unlocking-children's-math-potential. Accessed 25 Nov. 2021.

- All teachers demonstrate an unwavering belief that all students can learn mathematics at high levels.
- Support teachers and students in developing a growth mindset and ensure that the school system communicates a belief in growth mindset through its course pathways and student grouping practices
- Utilize "open" problem-solving opportunities that emphasize mathematics as a sense-making endeavor rather than merely an answer-getting endeavor.
- De-emphasize speed and establish mathematics as a subject that values depth of thought, insight, and creativity
- Teacher messaging and feedback to students that support a growth mindset rather than a fixed mindset

Student-Centered Instruction

> *Every student regularly experiences instruction that is student-centered and is designed to maximize students' use of language. Lessons create space for students to participate in discourse to promote conceptual understanding, which then leads to procedural fluency, problem-solving, and application.*

We subscribe to the commonly held belief amongst the education community that the person in the classroom who is doing the talking is probably the one who is doing the learning. In many typical classrooms, teachers are doing most of the talking, which means the students are learning far less than they otherwise could.[7] In response, classrooms need to be places where students are active participants in their own learning who regularly participate in academic discourse with their peers.

To provide the type of student-centered instruction necessary for students to become mathematically literate, the teacher will use instructional strategies that are unlike the typical classroom instruction of the past. We begin with the premise that students need to do most of the talking. In a typical classroom, teachers do 70% to 90% of the talking; and when students do speak it is generally limited to short one- or two-word answers. Student engagement is at its lowest when teachers are talking. On the flip side, however, student engagement and comprehension improve when they are the ones doing most of the talking.[8]

When student discourse is commonplace students are more likely to experience the three aspects of rigorous mathematics: conceptual understanding, procedural fluency, and application.

[7] "How Much Should Teachers Talk in the Classroom? Much Less ...." 10 Dec. 2019, https://www.edweek.org/leadership/how-much-should-teachers-talk-in-the-classroom-much-less-some-say/2019/12. Accessed 29 Nov. 2021.
[8] "How Much Should Teachers Talk in the Classroom? Much Less ...." 10 Dec. 2019, https://www.edweek.org/leadership/how-much-should-teachers-talk-in-the-classroom-much-less-some-say/2019/12. Accessed 30 Nov. 2021.

Conceptual understanding is the comprehension of mathematical concepts, operations and relations. Students with conceptual understanding know more than isolated facts and methods. Students see the connections among concepts and procedures and can give arguments to explain why some facts are consequences of others. This goes beyond memorizing procedures or individual facts to a focus on sense-making. Teaching conceptual understanding enables students to understand a concept from multiple perspectives and look for patterns that can help them understand future problems.[9] Developing conceptual understanding also leads directly to students more effectively learning standard algorithms.[10]

Standard algorithms are one component of procedural fluency. Procedural fluency refers to knowledge of procedures, knowledge of when and how to use them appropriately, and skill in performing them flexibly, accurately, and efficiently. Students also need to know reasonably efficient and accurate ways to add, subtract, multiply, and divide multi-digit numbers, both mentally and with pencil and paper. Students need to see that procedures can be developed that will solve entire classes of problems, not just individual problems.[11]

Student-centered classrooms also provide students with opportunities to apply their conceptual understanding and procedural fluency through problem-solving activities in which the solution method is not immediately obvious. The standards call for students to use math in situations that require mathematical knowledge. Correctly applying mathematical knowledge encourages students to develop a solid conceptual understanding and procedural fluency. To engage in application:

- Students need opportunities to apply mathematical knowledge and/or skills in a real-world context.
- Materials should promote activities that call for the use of mathematics flexibly in a variety of contexts in both routine and non-routine problems.
- Students are given opportunities to use math to make meaning of and access content.

Equitable Assessment

Every student is regularly and humanely assessed in order to have understanding of their own growth and to receive productive feedback for next steps in learning. Students use the feedback to know where they are in their learning, assess any misconceptions that need to be addressed, and then use the results to drive the next level of learning.

[9] "The Role of Rigor in the Mathematics Classroom - Yup Math." 21 Sep. 2021, https://yup.com/blog/rigor-in-math-classrooms/. Accessed 13 Mar. 2023.
[10] "From Student Invented Strategies to Standard Algorithms." 24 Oct. 2020, https://vctm.wildapricot.org/resources/Documents/From%20Student%20Invented%20Strategies%20to%20Standard%20Algorithms_%20What%E2%80%99s%20the%20Rush_.pdf. Accessed 29 Nov. 2021.
[11] "K-8 Aspects of Rigor Guidance Document." https://webnew.ped.state.nm.us/wp-content/uploads/2019/03/K-8-Aspects-of-Rigor-Guidance-Document_FINAL.pdf. Accessed 13 Mar. 2023.

Assessing students in mathematics is a crucial component of the education system, as it helps teachers and students identify areas where students are excelling or struggling. However, it is equally important to conduct assessments in a humane way that takes into account the individual differences and unique circumstances of each student. This means that teachers should avoid solely relying on standardized tests and instead adopt a variety of assessment methods that are tailored to meet the needs of each student.

One of the main benefits of assessing students in a humane way is that it can help boost their confidence and motivation. If students feel like they are being assessed in a fair and personalized way, they are more likely to engage with the material and feel a sense of ownership over their learning. Conversely, if students feel like they are being judged solely based on their test scores, they may become discouraged and lose interest in the subject.

Another important reason to assess students in a humane way is that it can help address issues of equity and accessibility in mathematics education. Standardized tests are often biased towards certain groups of students, such as those from more privileged backgrounds or those who are proficient in English. By adopting a more personalized approach to assessment, teachers can ensure that all students have an equal opportunity to succeed in mathematics and that their unique strengths and challenges are taken into account.

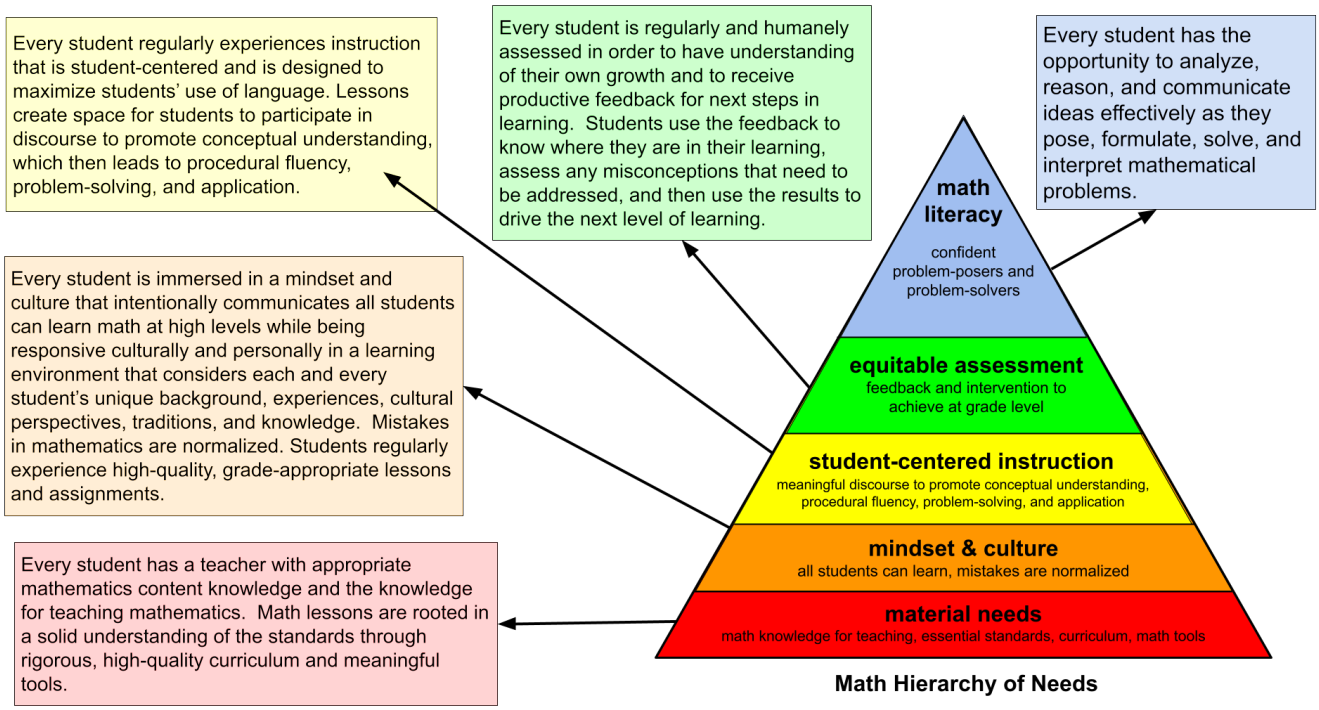
Mathematical Literacy

> *Every student has the opportunity to analyze, reason, and communicate ideas effectively as they pose, formulate, solve, and interpret mathematical problems.*

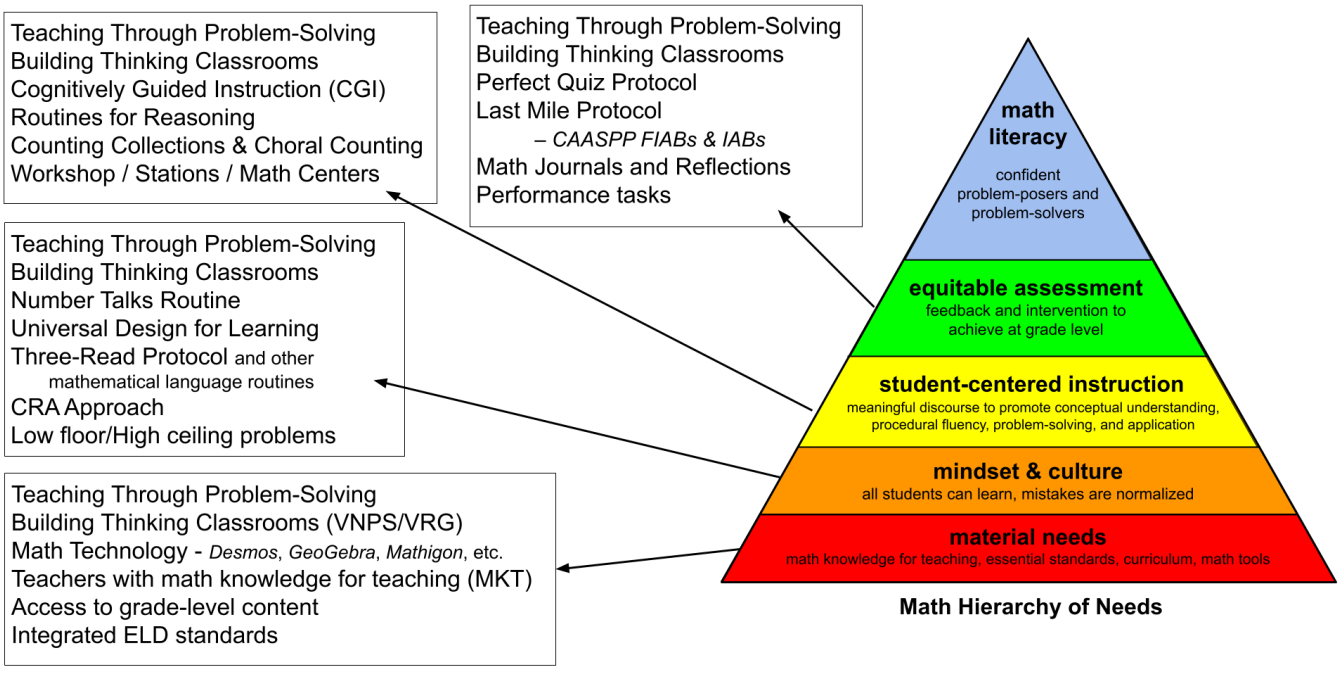
This is the goal for students: mathematical literacy. The entire purpose of the Mathematics Hierarchy of Needs is to provide the framework for teachers, schools, and districts to create math communities where students flourish as confident problem-posers and problem-solvers. The Organization for Economic Co-operation and Development (OECD) best describes mathematical literacy as

> "an individual's capacity to formulate, employ and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals to recognise the role that mathematics plays in the world and to make the well-founded judgements and decisions needed by constructive, engaged and reflective citizens." (OECD, 2018, p. 67)

Here we provide a simple bird's eye view of the hierarchy…



Let's take a look at the mathematics hierarchy of needs and some practical examples for each layer of the pyramid. When trying to create an ambitious mathematics program for a school site or an entire district, each of the layers must be fully addressed for students to become confident problem-posers and problem-solvers. In other words, students who are mathematically literate.



How a site or district satisfies the needs of any particular layer depends on the unique strengths and human resources available to them.

High-quality professional development designed to support implementation of each layer of the hierarchy.

We offer high-quality professional development designed to support every site and district to satisfy each layer.

Initial training would focus on the specified initiative. For most training, the session will include classroom, physical or virtual, demonstrations where students participate in the strategy being covered and teachers observe. Subsequent to the demonstration, teachers will have the opportunity to debrief, and in some cases, have the opportunity to utilize deliberate practice within the training ahead of introducing into their own teaching practice in the classroom.

Equitable Instruction

Despite our vision that every student is empowered by the opportunities mathematics affords, the evidence is compelling that traditional (typical) instructional practices result in fewer opportunities to learn in mathematically powerful spaces for children who are identified as Black, Latinx, Indigenous, multiple language learners, economically disadvantaged, with disabilities, along with other marginalized learners.[12]

The Math Hierarchy of Needs provides a framework for designing a mathematics instructional ecosystem in which learning opportunities are equitably distributed (Lampert & Graziani, 2009; NCTM, 2000)[13]. In other words, students who are multiple-language learners, in special education, and/or are members of historically underserved communities should have the same access as the general population to the empowering opportunities mathematics affords.

Some foundational components of the hierarchy for establishing ambitious math instruction with equitable results are:

- Student access to high-quality grade-level mathematics curriculum (Material Needs)
- Instruction that is engaging, affirming, and meaningful for students (Mindset & Culture)
- Mathematics lessons that regularly require students to interact with and employ the use of the eight standards of mathematical practice that strengthen student identity and agency. (Student-centered Instruction)
- Provide targeted intervention and support within the typical lesson rather than in a "pull-out" environment. (Equitable assessment)

[12] "Catalyzing Change in Early Childhood and Elementary Mathematics ...." https://eric.ed.gov/?id=ED605343. Accessed 3 Aug. 2023.
[13] "Equity and Quality in Education - OECD." https://www.oecd.org/education/school/50293148.pdf. Accessed 16 Oct. 2020.

The MCOE Math Team is keenly aware that instruction guided by the Math Hierarchy of Needs results in equitable instruction that positively predicts mathematics achievement on cognitively demanding assessments such as California Assessment of Student Performance and Progress (CAASPP).[14]

PD+Coaching Support

A critical component of ensuring that students are receiving strong, standards-aligned instruction with high-quality instructional materials (HQIM) aligned to those standards is to ensure all teachers receive professional development and in-class coaching grounded in effective instructional strategies and the district-adopted materials.[15]

A view of PD + Coaching in action.

We believe the best professional development is short (generally no longer than 2 hours) and adheres to the principles of andragogy – the method and practice of teaching adult learners. As such, when we provide teachers with professional development, teachers are only pulled away from their students for a minimal amount of time. And during that time, the professional development is relevant to the adults, honors their existing experience, and allows the teachers to actively craft the flow of the professional development.

The professional development we provide is paired with in-class demonstrations and coaching to ensure an implementation of the ambitious instruction envisioned by the school or district.

Job-embedded, in-class support to teachers extend their knowledge of content and of pedagogy.

It has long been recognized that mathematics-specific instructional coaching leads directly to improved math instruction in the classroom and to increased student achievement.[16,17] It is critical for teachers (in all stages of their career) to co-participate in teaching

[14] "Blazar, D. (2015). Effective teaching in elementary mathematics." http://www.sciepub.com/reference/290855. Accessed 3 Aug. 2023.
[15] "For maximum impact, align professional learning with high-quality ...." https://fordhaminstitute.org/national/commentary/maximum-impact-align-professional-learning-high-quality-instructional-materials. Accessed 28 Jul. 2023.
[16] "Impact of Mathematics Coaching on Teachers and Students ...." https://www.nctm.org/Research-and-Advocacy/Research-Brief-and-Clips/Impact-of-Mathematics-Coaching-on-Teachers-and-Students/. Accessed 16 Oct. 2020.
[17] "(PDF) The Impact of Elementary Mathematics Coaches on ...." 6 Oct. 2020, https://www.researchgate.net/publication/262765395_The_Impact_of_Elementary_Mathematics_Coaches_on_Student_Achievement. Accessed 16 Oct. 2020.

practices with instructional coaches[18] and enacting the coaching cycle: lesson planning, observing instruction, debriefing the lesson.[19]
Instructional coaching…

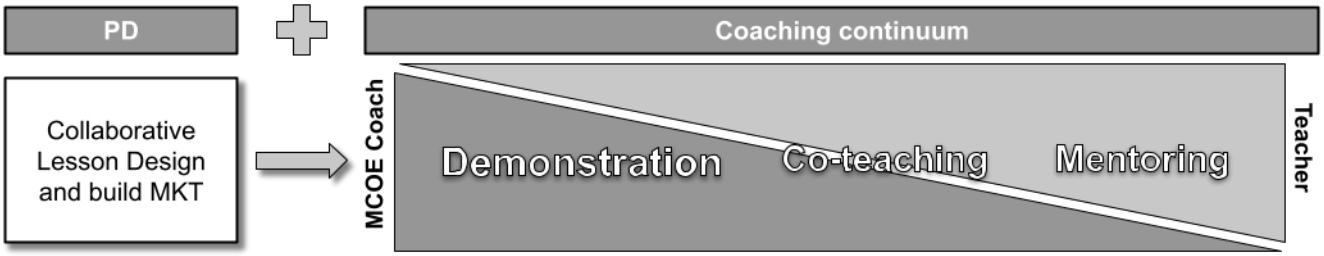
- Increases reflective practice of teachers[20]
- Promotes positive cultural change[21]
- Increases the use of data to inform practice[22]
- Promotes accountability for implementing new teaching practices[23]
- Fosters a collaborative culture for leading improvement efforts[24]

Acting as instructional coaches, we provide teachers with job-embedded, in-class support to help teachers grow in their knowledge of content and of pedagogy. Teachers extend their understanding of mathematical knowledge and of instructional strategies to assess student thinking and to develop effective lessons for all students in their classrooms.[25]

It is recommended that for every one session of professional development a teacher receives, the teacher also receives 2 - 3 sessions of instructional coaching. This additional coaching – which includes in-class demonstrations and co-teaching – increases the likelihood of the teacher incorporating the new instructional skills into their classroom repertoire.[26]

A typical sequence of this PD+Coaching cycle might look like this…

[18] "Benefits of Co-Teaching For Teachers - West Virginia ...." https://wvde.state.wv.us/titlei/documents/CoachingModelDefined.doc. Accessed 16 Oct. 2020.
[19] "Focused Coaching and Instructional Improvement." 13 Oct. 2017, https://www.cde.state.co.us/coloradoliteracy/focusedcoachingandinstructionalimprovementhunsaker. Accessed 16 Oct. 2020.
[20] "(PDF) The Heart of the Matter: The Coaching Model in ...." https://www.researchgate.net/publication/303970625_The_Heart_of_the_Matter_The_Coaching_Model_in_America's_Choice_Schools. Accessed 16 Oct. 2020.
[21] "Coaching: A Strategy for Developing Instructional Capacity ...." https://www.annenberginstitute.org/publications/coaching-strategy-developing-instructional-capacity. Accessed 16 Oct. 2020.
[22] "School Coaching in Context: A Case Study in Capacity Building.." https://eric.ed.gov/?id=ED480122. Accessed 16 Oct. 2020.
[23] "Mathematics Implementation Study: Final Report, June 2000." https://www.wested.org/resources/mathematics-implementation-study-final-report-june-2000/. Accessed 16 Oct. 2020.
[24] "The measurement of collaborative culture in secondary ... - ERIC." 28 Mar. 2017, https://files.eric.ed.gov/fulltext/EJ1143030.pdf. Accessed 16 Oct. 2020.
[25] "Pedagogical Content Coaching - Inside Mathematics." https://www.insidemathematics.org/sites/default/files/assets/tools-for-educators/tools-for-coaches/pedagogical-content-coaching.pdf. Accessed 16 Oct. 2020.
[26] "Instructional coaching holds promise as a method to improve ...." 25 Jan. 2019, https://www.brookings.edu/articles/instructional-coaching-holds-promise-as-a-method-to-improve-teachers-impact/. Accessed 3 Aug. 2023.



A benefit to the nature of a county office of education is that the employees are located within the communities that we serve as opposed to support providers that are often flown in from anywhere in the country. Because of our close proximity, we are able to maintain close relationships with the teachers we serve. Our coaching also includes making ourselves available to teachers through a booking service where teachers have the opportunity to schedule a virtual meeting or call for any available time in our schedule as needed. This is the type of coaching *no outside service* could ever consider offering.

PLC Support

A professional learning community, or PLC, is a group of educators that meets regularly, shares expertise, and works collaboratively to improve instruction and the academic performance of students. High-trust relationships are formed in PLCs allowing teachers to discuss, rehearse and adapt practices included in training sessions to support effective instruction, and to collect and analyze student achievement data.

> Coming together is a beginning;
> keeping together is progress;
> working together is success.
>
> Henry Ford

In contrast with many third-party PLC training available outside Merced County that largely focuses on collecting student assessment data and designing subsequent interventions, the MCOE Math Team adopts a much broader – and, frankly, more effective – view of professional learning communities.

In our view, the purpose of PLCs is for teachers to learn as much about THEMSELVES as it is to learn about the students.

PLCs form the environment in which teachers take ownership of their improvement journey in three essential ways:

1. Develop a collective understanding of the instructional initiative being implemented;
2. Determine data collection and analysis protocols to ensure teachers are implementing the instructional initiative with consistency and integrity;

Fake QR code to a video showing us working with a group of teachers

3. Employ equitable assessment techniques to determine whether the instructional changes result in increased academic performance of students.

Learn about teaching: Math Calibration

Math Calibration™ is the PLC process that enables teachers to develop a collective understanding of the instructional initiative being implemented. During *Math Calibration* teachers work to arrive at consensus around DuFour's four critical questions: 1) What do we want all teachers to know and implement? 2) How will we know if teachers are implementing it? 3) How will we respond when some teachers have not implemented it? 4) How will we extend the learning for teachers who are already implementing the initiative?

The answers to these four questions form the basis of how the PLC moves forward. The role of the MCOE Math Team is to facilitate the conversations as teachers run their PLC, helping them maintain their focus on the four questions, clarifying any confusion that may exist about the focus initiative, and providing additional training and instruction as needed. Principles of improvement science are interwoven in the process to work past speedbumps that will naturally occur during the initial implementation of the new initiative. For example, conducting several PDSAs to problem-solve why teachers are not finding the time to fit the number talk routine into their day. Or creating a driver diagram to narrow down a plethora of change ideas we might try.

Sustain healthy PLCs to ensure teacher growth and implementation of Math Hierarchy of Needs.

Ultimately, our goal is to support schools and districts to sustain healthy PLCs so they can play an instrumental part in their next identified area of need. Research in teacher professional development suggests that potentially productive PLC activities might include doing mathematics problems and comparing solution strategies, analyzing student work and classroom video-recordings, and rehearsing high- leverage instructional practices[27].

Our Math Calibration protocol begins with a teacher proposing a discrete math problem to discuss. This might be a problem such as 5 + (-7) or $1\frac{3}{4} \times 2\frac{1}{2}$. Then teachers solve the proposed problem using a variety of strategies and models. Teachers are also particularly encouraged to use those strategies and models to investigate non-standard methods (algorithms) for solving the problem. During this time teachers openly ask reflective questions such as "What concrete manipulative might best be used?" or "What is the benefit of using this strategy versus that strategy?" or "How does this strategy vertically align with next year's grade level?". By discussing these questions, teachers interrogate their own understanding of the math concept and

There comes a point where we need to stop just pulling people out of the river. We need to go upstream and find out why they're falling in.

Bishop Desmond Tutu

[27] "(PDF) New Directions for the Design and Study of ...." 6 Oct. 2020, https://www.researchgate.net/publication/249704816_New_Directions_for_the_al_Development. Accessed 27 Oct. 2020.

deepen their understanding of the standard algorithm that might be associated with that math concept.

Throughout Math Calibration, teachers learn to find joy in mathematics and increase their own comfort level in navigating uncertainty.

We incorporate the work of Dr. Michael Fullan to maximize teacher impact on student achievement and build the capacity of all team members. By building collaborative cultures teams will experience deeper insight into instructional practices that will then have the power to affect student learning. Below are the eight essentials of effective networks from Essential features of effective networks in education.[28]

1. Developing high-trust relationships
2. Focusing on ambitious student learning goals linked to measurable outcomes
3. Continuously improving instructional practice
4. Using deliberate leadership and skilled facilitation
5. Frequently interacting and learning inwards
6. Connecting outward to learn from others
7. Forming new partnerships among students, teachers and families
8. Securing adequate resources to sustain the work

It is during Math Calibration that teachers create the building blocks of effective core instruction.[29] In particular, Math Calibration creates the space for teachers to develop their mathematical knowledge for teaching (MKT) which has long been associated with increased student achievement.[30] As Bishop Desmond Tutu said, "There comes a point where we need to stop just pulling people out of the river. We need to go upstream and find out why they're falling in." Math Calibration is the act of teachers collectively going upstream to improve the core instruction to reduce the subsequent academic intervention of pulling students out of the river.

Collective feedback from demonstrations and side by side coaching are other avenues for teachers to align their instructional practices during PLC time.

Learn about students: Data discussions and intervention

As previously mentioned, a second focus of professional learning communities is to improve the academic performance of students. Using student data in PLCs to improve instruction assumes that teachers have the mathematical knowledge for teaching necessary to know what to do in response to the student data collected. Otherwise, teachers are left to merely gaze at the achievement gaps without any recourse for improving the situation.

Assuming teachers are regularly using their PLC time to engage in Math Calibration, using student data to improve instruction is the next logical step.

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[28] "(PDF) Essential Features of Effective Networks in Education." https://www.researchgate.net/publication/303873022_Essential_Features_of_Effective_Networks_in_Education. Accessed 21 Oct. 2020.
[29] "5 Key Building Blocks of Effective Core Instruction - Edutopia." 6 Oct. 2022, https://www.edutopia.org/article/5-key-building-blocks-effective-core-instruction/. Accessed 3 Aug. 2023.
[30] "Effects of Teachers' Mathematical Knowledge for Teaching on ...." https://lmt.soe.umich.edu/files/hillrowanball.pdf. Accessed 3 Aug. 2023.

Our MCOE Math Team utilizes a variety of data discussion protocols borrowed from the improvement science communities. These protocols empower teachers to make data-informed instructional decisions made possible by the teachers' mathematical knowledge for teaching (MKT) developed during Math Calibration.

Effective PLC data-informed discussions also use DuFour's four critical questions to examine and improve student achievement: 1) What do we want all students to know and be able to do? 2) How will we know if they learn it? 3) How will we respond when some students do not learn? 4) How will we extend the learning for students who are already proficient?

As teachers grow their MKT during Math Calibration, the intervention provided to students needing additional support is greatly enhanced.

Site and District Leadership Support

Historically, site leadership has focused on administration and management, but increasing accountability demands have caused site administration to also serve as instructional leaders in mathematics. Indeed, there is evidence that effective site leadership results in increased student achievement.[31] However, it is unrealistic to expect a site leader to be an expert in every academic area, so we see the value in a distributed leadership model in which the site/district math coaches and our team are responsible for supporting teacher growth, while the site leadership is responsible for ensuring the new instructional practices are being effectively implemented in the classroom as anticipated.[32] In fact, there is evidence that this shared responsibility improves the effectiveness of the coaching provided to the teachers.[33]

FAKE QR code to a video showing a Number Talk.

The MCOE Math Team supports site leaders:

- Understand the instructional improvements and what they might look like in the classroom
- Effectively and realistically support teachers to improve the quality of instruction
- Provide feedback to teachers that communicates expectations for ambitious instruction
- Clarify the roles of site coaches, teacher PLCs, and our team in supporting teachers' development

Support site and district leadership to monitor progress of instructional improvement and recognize needed adjustments.

[31] "How Leadership Affects Student Achievement - RAND ...." 13 May. 2014, https://www.rand.org/pubs/research_briefs/RB9786.html. Accessed 16 Oct. 2020.
[32] "International perspectives on School Leadership for ... - OECD." http://www.oecd.org/education/school/37133264.pdf. Accessed 16 Oct. 2020.
[33] "1 Gibbons, L. K. & Cobb, P. (in press). Identifying coaching ...." https://peabody.vanderbilt.edu/departments/tl/teaching_and_learning_research/mist/Gibbons_Cobb_ESJ_Coaching_Practices_toShare.pdf. Accessed 16 Oct. 2020.

- Analyze and align adopted curriculum and assessment tools to the frameworks and interim assessments (IABs and FIABs).
- Support both vertical and horizontal alignment in mathematics throughout the school and district

While there is very little literature describing the role of district leadership in supporting teachers to implement ambitious instruction, we believe that district leadership plays a critical role in creating goals for both ambitious instruction and student learning. In the process of working toward improving both teaching and learning, district leadership will necessarily need to distinguish how it orients itself between two frames of thinking: *instructional improvement* and *instructional management*.

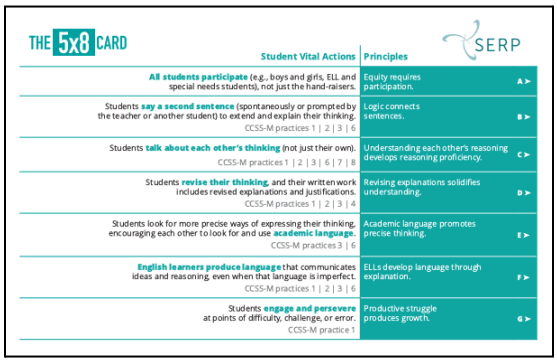
Instructional improvement focuses on the quality of classroom instruction by providing professional development and job-embedded coaching to support teachers' ability to get the greatest benefit from the district-adopted curriculum. An example of this would be district leadership that embraces the National Council of Teachers of Mathematics (NCTM) Eight Effective Teaching Strategies[34] and works to ensure that teachers are able to employ those strategies on a daily basis.

Instructional management focuses on student learning of major mathematics standards and provides students who have not met those particular standards with additional instruction or tutoring. This orientation attends to the process of redeploying resources and personnel to support student growth and does not attempt to improve the quality of those resources.

Instructional improvement and instructional management are both important to the success of a school district. We will support district leadership to coordinate both orientations ensuring that struggling students receive the necessary support, but instruction is also improved thereby reducing the number of students who might need that support in the future.

There are two powerful tools that support site and district leadership monitor progress in instructional improvement. Neither is designed for evaluative purposes. Rather they help shine a light on the instructional practices in the classroom in order to celebrate successful implementation and areas that need continued growth.

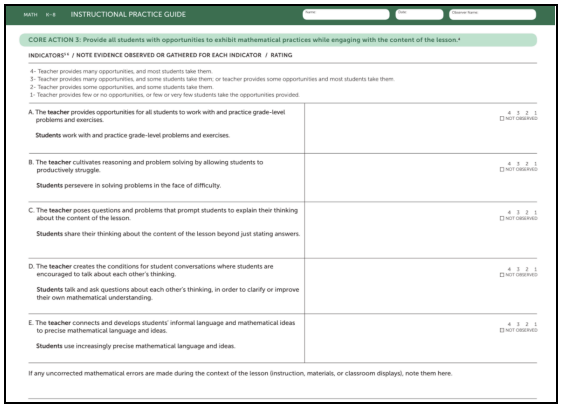
SERP 5x8 Card



The SERP 5x8 Card was developed with the standards of mathematical practice in mind to help principals understand the developmental progress of students against those standards. The 5x8 Card was not designed as a teacher evaluation tool. Rather, it is a math observation tool that focuses observers' attention on what students are saying and doing so that their work (their thinking) can be at the center of educators' discussions.[35]

[34] "Effective Mathematics Teaching Practices - National Council ...." https://www.nctm.org/Conferences-and-Professional-Development/Principles-to-Actions-Toolkit/Resources/7-EffectiveMathematicsTeachingPractices/. Accessed 21 Oct. 2020.
[35] "5x8 Card | SERP Institute." https://www.serpinstitute.org/5x8-card. Accessed 16 Oct. 2020.

Instructional Practice Guide (IPG)


MATH K–8 INSTRUCTIONAL PRACTICE GUIDE

CORE ACTION 3: Provide all students with opportunities to exhibit mathematical practices while engaging with the content of the lesson.*

INDICATORS** / NOTE EVIDENCE OBSERVED OR GATHERED FOR EACH INDICATOR / RATING

4- Teacher provides many opportunities, and most students take them.
3- Teacher provides many opportunities, and some students take them; or teacher provides some opportunities and most students take them.
2- Teacher provides some opportunities, and some students take them.
1- Teacher provides few or no opportunities, or few or very few students take the opportunities provided.

A. The **teacher** provides opportunities for all students to work with and practice grade-level problems and exercises.
Students work with and practice grade-level problems and exercises. 4 3 2 1 NOT OBSERVED

B. The **teacher** cultivates reasoning and problem solving by allowing students to productively struggle.
Students persevere in solving problems in the face of difficulty. 4 3 2 1 NOT OBSERVED

C. The **teacher** poses questions and problems that prompt students to explain their thinking about the content of the lesson.
Students share their thinking about the content of the lesson beyond just stating answers. 4 3 2 1 NOT OBSERVED

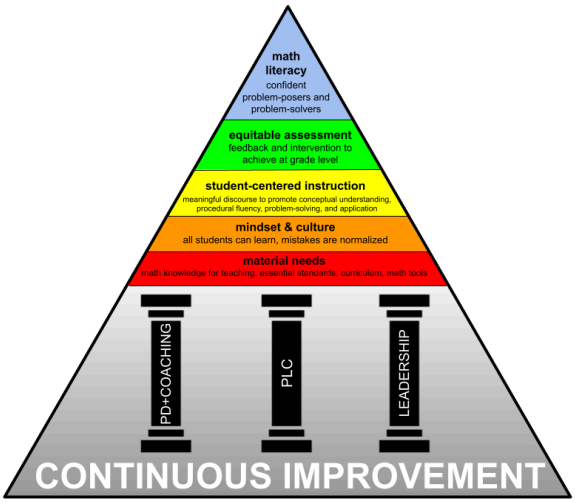
D. The **teacher** creates the conditions for student conversations where students are encouraged to talk about each other's thinking.
Students talk and ask questions about each other's thinking, in order to clarify or improve their own mathematical understanding. 4 3 2 1 NOT OBSERVED

E. The **teacher** connects and develops students' informal language and mathematical ideas to precise mathematical language and ideas.
Students use increasingly precise mathematical language and ideas. 4 3 2 1 NOT OBSERVED

If any uncorrected mathematical errors are made during the context of the lesson (instruction, materials, or classroom displays), note them here.

The purpose of the Instructional Practice suite of tools is to help teachers and those who support teachers to make the Shifts in instructional practice required by the Common Core and other college- and career-ready standards. The Instructional Practice suite includes resources for coaching, lesson planning, and training support that are all designed to work together.[36] The Instructional Practice Guide (IPG) is designed around Core Actions that encompass the Shifts in instructional practice required by the college- and career-ready standards, including the Common Core.[37]

Continuous Improvement



Continuous improvement as the fifth key component of the Comprehensive Improvement Plan. A district may engage with continuous improvement as it self-identifies areas of improvement that it would like to focus on. Additionally, we may also employ continuous improvement strategies as the safety net that ensures a site/district is getting the results that were anticipated in a work plan from the very beginning. If roadblocks to fulfilling the initiatives in a work plan become visible, improvement science protocols will be implemented to evaluate the system and develop intentional support to remove the roadblock.

Throughout the entire implementation of the Comprehensive Improvement Plan, the school, district, and MCOE Math Team evaluate the progress of the initiative implementation. When barriers to the implementation naturally arise, we use the guiding principles of Improvement Science to identify pinch-points and adjust accordingly.

To fully address utilizing Improvement Science for a system, we'll rely on The Six Core Principles of Improvement from *Learning to Improve: How America's Schools Can Get Better at Getting Better* from the Carnegie Foundation which are as follows:

[36] "Aligned Instructional Practice - Achievethecore.org." https://achievethecore.org/page/2730/aligned-instructional-practice. Accessed 16 Oct. 2020.
[37] "Instructional Practice Guide - Achievethecore.org." https://achievethecore.org/page/1119/instructional-practice-guide. Accessed 16 Oct. 2020.

1. Make the work problem-specific and user-centered.
   It starts with a single question: “What specifically is the problem we are trying to solve?” It enlivens a co-development orientation: engage key participants early and often.

2. Variation in performance is the core problem to address.
   The critical issue is not what works, but rather what works, for whom and under what set of conditions. Aim to advance efficacy reliably at scale.

3. See the system that produces the current outcomes.
   It is hard to improve what you do not fully understand. Go and see how local conditions shape work processes. Make your hypotheses for change public and clear.

4. We cannot improve at scale what we cannot measure.
   Embed measures of key outcomes and processes to track if change is an improvement. We intervene in complex organizations. Anticipate unintended consequences and measure these too.

5. Anchor practice improvement in disciplined inquiry.
   Engage rapid cycles of Plan, Do, Study, Act (PDSA) to learn fast, fail fast, and improve quickly. That failures may occur is not the problem; that we fail to learn from them is.

6. Accelerate improvements through networked communities.
   Embrace the wisdom of crowds. We can accomplish more together than even the best of us can accomplish alone.[38]

Add Theory of Improvement and Considering the System Frameworks to this section.

Improvement Journeys

Many of the districts are committed to improvement journeys for one reason or another. Some begin an improvement journey through networks they’ve joined. Some begin their improvement through requirements such as differentiated assistance and comprehensive support and improvement. Others begin as they seek out ways to improve outcomes in their systems. Improvement teams are organized to learn their way into improved outcomes. There are five major phases that sites/districts will work through on their journey.[39]

Those phases are:

1. Understand the current system
2. Focus collective efforts
3. Generate ideas for change
4. Learn in practice
5. Sustain and spread

[38] "The Six Core Principles of Improvement | Carnegie ...." https://www.carnegiefoundation.org/our-ideas/six-core-principles-improvement/. Accessed 16 Oct. 2020.
[39] "Improvement Science at Your Fingertips: A resource guide for ...." https://www.amazon.com/Improvement-Science-Your-Fingertips-improvement/dp/B0B9MWZWP9. Accessed 3 Aug. 2023.

While most will start with analyzing data to understand the system, many journeys are nonlinear and these phases don't necessarily happen sequentially and phases might be revisited over time. As we work with schools on their improvement journey, The Model for Improvement is what guides our work. Ultimately, we are looking to support districts and sites with these three questions:

1. What are we trying to accomplish?
2. What change can we make that will result in improvement?
3. How will we know that a change is an improvement?

It is through these three questions that we guide districts on their improvement journey with the heart of the work and learning being the Plan-Do-Study-Act (PDSA) cycle. Once a team has understood their system, identified a collective focus, they will start the PDSA process where the select change ideas, plan the implementation of the change idea, carry out the change idea while collecting data on its progress, study the data, and make a decision about how effective the change idea was and how to move forward with the collected information.

The PDSA process involves iterative cycles of testing out change ideas that are tweaked and tested until an improvement has been made. Once the improvement meets the expectation of the Aim or goal, additional PDSA cycles are used to scale the change idea out more broadly within and across the system. As districts consider the scope of their project, the team members that will form the improvement team will depend on the extent of the Aim. For this reason, the district team that we work with may include district administrators, site administrators, site leaders, teachers, and staff, although not all teams require representation from each of these groups for every goal. For example, an Aim that focuses around student engagement would require teachers to play an active role in the improvement team. Ultimately, the teachers would need to be part of the process to collect and analyze classroom data in order to understand and improve the identified problem. On the other hand, an Aim that focuses on teacher recruitment and retention may not have a teacher on the improvement team. While the teachers would be a focus of this goal, those responsible for carrying out the PDSA cycles would likely be at the administrative level.

	Guiding Questions	Purpose	Potential Tools
Understand the Current System	What are our current outcomes? What is the current design of our system? How is the design of our system producing our outcomes?	Develop a shared understanding of what is currently happening. See the system from multiple perspectives. Identify key levers for change.	Empathy Interviews Empathy Observations Process Map Force Field Analysis Cause and Effect/Fishbone Diagram

	Guiding Questions	Purpose	Potential Tools
Focus Collective Efforts	What specifically are we trying to accomplish?	Create a shared sense of purpose and direction for improvement work. Establish the boundaries and develop the scope of work.	Cause and Effect/Fishbone Diagram Aim Statements Theory of Practice Improvement: Driver Diagram
Generate Ideas for Change	What changes might we introduce?	Make your theory of change explicit. Develop specific, actionable ideas for change to test.	Empathy Interviews Empathy Observations Process Map Force Field Analysis Driver Diagram
Learn In Practice	How can we test our ideas in practice? How will we know if a change is an improvement?	Learn about the utility, functionality, and impact of change ideas.	Driver Diagram Plan-Do-Study-Act (PDSA) Cycles
Sustain and Spread	How do we get changes to work reliably across an increasingly diverse set of contexts?	Embed changes in the system to ensure sustained improvement. Consolidate “proven” changes worthy of spread. Create conditions for change ideas to spread.	Process Map PDSA Ramps

Common Improvement Science tools utilized by the MCOE Continuous Improvement Team

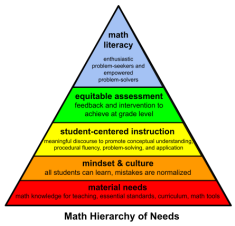
- Universal Data Protocol/Ladder of Inference
- Empathy Interviews/Observations
- Process Mapping
- Fishbone Diagram (Cause-and-effect Diagram)
- Force Field Analysis
- Driver Diagram (AIM, Drivers, Change Ideas, Change Concepts)
- Measurement Tree
- PDSA Cycles and Ramps
- Data Analysis Tools (Run charts, Pareto charts, Shewhart charts)

A CULTURE of MATH LEARNING

EVERY student is "enthused about mathematics, sees the value and beauty of mathematics, and is empowered by the opportunities mathematics affords."

(National Council of Teachers of Mathematics, 2016)

SITE/DISTRICT PLANNING PAGE (Sample)

		Year 1	Year 2
 Math Hierarchy of Needs ***Ambitious instruction*** in which all students, regardless of ethnicity, race, socio-economic status, and gender, develop a deep and profound understanding of grade-level content and are confident problem-posers and problem-solvers.		***Material Needs:*** ***Aligning and unpacking the major standards at each grade level*** • *Identify major standard clusters* • *Correlate to chapters/units/modules of district curriculum* • *Vertical alignment of visual representations* • *Identify relevant IABs and FIABs* ***Mindset & Culture:*** ***Number Talks*** • *Understanding the basic routine* • *Augmenting the basic routine with additional ELD strategies and ELD standards*	***Mindset & Culture:*** ***Using the CRA Approach to math instruction*** • *Introduction to CRA* • *Deliberate practice with grade level-specific content* • *Classroom demonstrations and team-teaching* ***Student-centered Instruction:*** ***Three-Read Protocol*** • *Understanding the basic routine* • *Augmenting the basic routine with additional integrated ELD strategies* • *Classroom demonstrations and team-teaching*
3 Pillars of Support	PD+COACHING Job-embedded ***PD & coaching*** that supports teachers to grow in their knowledge of content and of pedagogy.	• *1 demo per teacher* • *Multiple side-by-side coaching per teacher* • *Teachers use Calendly to book additional support via Zoom*	• *1 demo per teacher* • *Multiple side-by-side coaching per teacher* • *Teachers use Calendly to book additional support via Zoom*
	PLC Support ***Professional Learning Communities*** to identify barriers to implementation and improve ambitious instruction.	• *Half-day sessions scheduled to coincide with coaching days* • *Calibration of Number Talk routine* • *Data sharing*	• *Half-day sessions scheduled to coincide with coaching days* • *Calibration of Number Talk routine* • *Data sharing*
	LEADERSHIP ***Leadership support*** to coordinate instructional changes with student achievement and support.	• *One-on-one support sessions* • *Administrator walk-throughs* • *Data sharing*	• *One-on-one support sessions* • *Administrator walk-throughs* • *Data sharing*

Continuous Improvement
Continuous Improvement is the safety net that ensures the anticipated results though ongoing monitoring or progress.
		• *Utilize tools to understand the barriers to implementation, the system, and theory to improve them.*
		  ○ *Driver diagram*
		  ○ *Fishbone*
		  ○ *PDSA cycle*
			• *Utilize tools to understand the barriers to implementation, the system, and theory to improve them.*
			  ○ *Driver diagram*
			  ○ *Fishbone*
			  ○ *PDSA cycle*

Our goal is to have at least 80% of your teachers implementing each initiative with 100% integrity.

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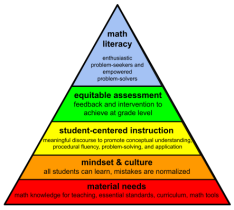 Math Hierarchy of Needs ***Ambitious instruction*** in which all students, regardless of ethnicity, race, socio-economic status, and gender, develop a deep and profound understanding of grade-level content and are confident problem-posers and problem-solvers.			
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The MCOE Math Team

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Melanie Martinez	Laura Delmas	