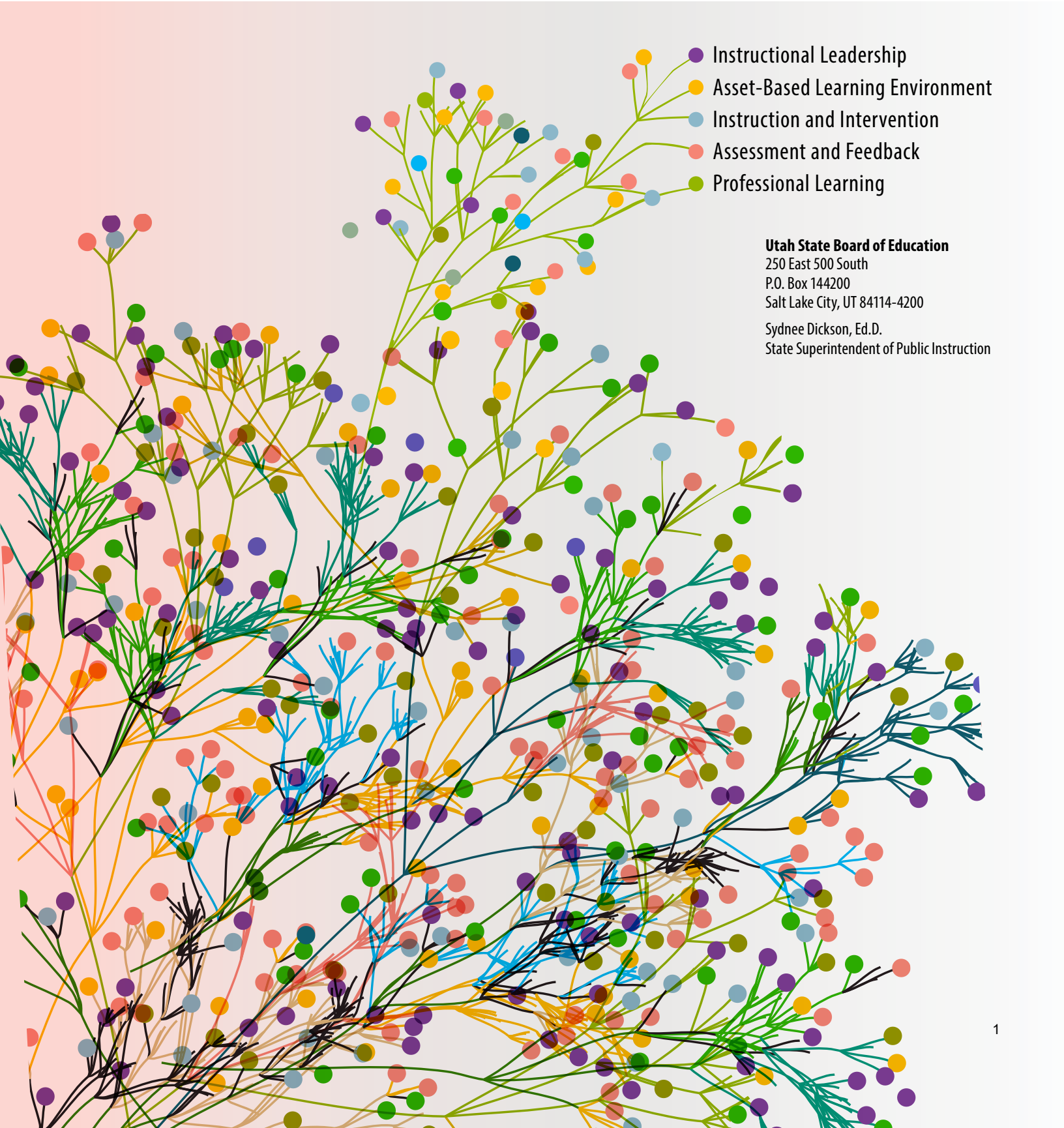
ADA Compliant October 2022

Utah's PK–12
MATHEMATICS FRAMEWORK



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UTAH'S PK–12 MATHEMATICS FRAMEWORK

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March 23, 2022

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Utah's PK–12 MATHEMATICS FRAMEWORK

Utah's critical components of mathematical practice include:

Conceptual Understanding	Procedural Fluency	Strategic and Adaptive Mathematical Thinking	Productive Disposition
The comprehension and connection of concepts, operations, and relations.	The meaningful, flexible, accurate, and efficient use of procedures to solve problems	The ability to formulate, represent, and solve mathematical problems with the capacity to justify the logic used to arrive at the solution.	The ability to see mathematics as useful and worthwhile while exercising a steady effort to learn mathematics. (R277-406)

INTRODUCTION

Utah's PK–12 Mathematics Framework

Mathematics is essential to navigating our data-filled and technologically-driven society. Every Utah learner is entitled to the acquisition of competent mathematics knowledge for skills, and dispositions and the inherent empowerment associated with such achievement. Currently, 50% of Utah's third grade students are mathematically proficient and that percentage decreases to 43% by eighth grade (USBE, 2019). Therefore, *Utah's PK–12 Mathematics Framework* is designed to serve as an evidence-based guide for educators to initiate productive growth and change in mathematical opportunities, achievement and outcomes for students in line with Utah's Portrait of a Graduate.

Over 30 years of research exists indicating how children learn to develop mathematical knowledge for skills, and dispositions, why some children struggle mathematically, and what components and instructional practices are essential to provide effective instruction in mathematics. This research has resulted in the following evidence-based **Teaching Practices**:

1. Establish mathematics goals to focus learning
2. Implement tasks that promote reasoning and problem solving
3. Use and connect mathematical representations
4. Facilitate meaningful mathematical discourse
5. Pose purposeful questions
6. Build procedural fluency from conceptual understanding
7. Support productive struggle in learning mathematics
8. Elicit and use evidence of student thinking

(NCTM, 2014)

The above Effective Teaching Practices are then coupled with the essential Standards for Mathematical Practice:

1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
3. Construct viable arguments and critique the reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for make use of structure
8. Look for and express regularity in repeated reasoning

(USBE, 2016)

When the Teaching Practices and the Standards for Mathematical Practice are integrated with the Equity Based Practices students are able to build positive mathematical identities and apply their mathematical knowledge to their everyday lives—thereby making mathematics relevant, applicable, and engaging.

Equity-Based Practices:

- Going deep with mathematics
- Leveraging multiple mathematical competencies
- Affirming mathematics learners' identities
- Challenging spaces of marginality
- Drawing on multiple resources of knowledge

(Aguirre et. al., 2013)

Utah's PK–12 Mathematics Framework synthesizes these research findings into a framework that provides opportunities for educators to evaluate their knowledge, tools and resources for meeting the instructional needs of all students in mathematics and should be used in conjunction with Utah's High Quality Instructional Cycle and Utah's Personalized, Competency Based Learning Framework. This will support districts, charters, and schools in evaluating, refining and monitoring the essential systems, structures, and mathematics practices necessary to achieve greater outcomes in the area of mathematics for students in grades PK–12.

Utah's PK–12 Mathematics Framework integrates five key elements that support mathematical outcomes:

Element 1: Instructional Leadership
Element 2: Asset-Based Learning Environment
Element 3: Instruction and Intervention
Element 4: Assessment and Feedback
Element 5: Professional Learning

Objectives

Utah's PK–12 Mathematics Framework intends to provide stakeholders with:

- An evidence-based framework and self-assessment tool to identify strengths and areas of growth, and
- Evidence-based practices that will yield positive mathematical outcomes for students.

How To Use Utah's PK–12 Mathematics Framework

Step 1: Read the Introduction to Utah's PK-12 Mathematics Framework to gain a sense of its intent and purpose.

Step 2: Read elements 1–5 to develop an overview of the essential evidence-based practices.

Step 3: Review the definitions for Assessment Scales to prepare for conducting a self- or systems-assessment.

Step 4: Establish a site/district-level mathematics team to complete the Self-Assessment Tool for each element.

Step 5: Refer to the Lines of Evidence to identify the site's/district's current level of implementation for the five elements.

Step 6: Create an action plan using the Mathematics Framework Planning Tool for Continuous Improvement for each of the five elements.

Step 7: Develop a process for monitoring efforts and evaluating progress towards your site's/district's goals. Continue to use the Mathematics Framework Planning Tool for Continuous Improvement process to refine and monitor progress.

ELEMENT 1

Self-Assessment Scale

ELEMENT 1: **Instructional Leadership** uses a four-point categorical scale based on a continuum of professional leadership for evaluation: not yet evident, emerging, effective, and highly effective as defined in Utah's Educational Leadership Standards (UELS) (2018).

4-POINT CATEGORICAL SCALE FOR ELEMENT 1

1 **Level 1:** **NOT YET EVIDENT**	2 **Level 2:** **EMERGING**	3 **Level 3:** **EFFECTIVE**	4 **Level 4:** **HIGHLY EFFECTIVE**
Leaders performing at the not yet evident level have not yet begun to implement the concepts underlying the Utah Educational Leadership Standards (UELS). Their practice, therefore, is below the minimum standards acceptable for instructional leaders.	Leaders performing at the emerging level understand the concepts underlying the UELS and attempt to implement them. Their performance may be inconsistent or exhibit gaps in understanding or implementation.	Leaders performing at the effective level clearly understand the concepts underlying the UELS. They lead students, faculty, staff, and community through consistent implementation of the UELS. Their schools are dedicated to equitable teaching and learning for all and are well managed and safe.	Leaders performing at the highly effective level completely understand the concepts behind the UELS and implement them thoroughly. They contribute significantly to the field both in and out of the school setting. The schools they lead consist of a community of learners who are highly engaged in teaching and learning at high cognitive levels and who take responsibility for their own learning and progress.

ELEMENT 1:

INSTRUCTIONAL LEADERSHIP

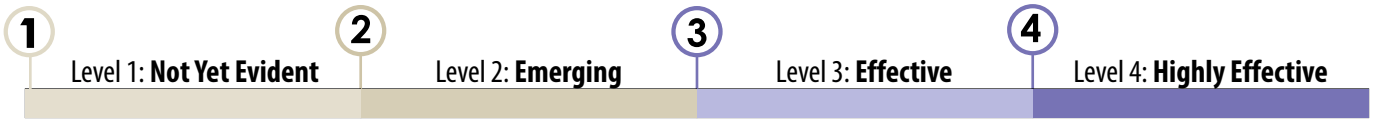
OVERVIEW

- Instructional Leadership is evident when educators unite to:
- organize resources around a shared, evidence-based vision of student mathematical competency,
- engage in collaborative goal setting, and
- implement and monitor strategies that support local mathematics goals, resulting in student and teacher growth.

Click here for resources

SELF-ASSESSMENT TOOL

INSTRUCTIONAL LEADERSHIP



▼CRITICAL INDICATORS	1	2	3	4
A. Educational leaders create and sustain a school environment in which each student is known, accepted, valued, trusted, and respected.	1	2	3	4
B. Educational leaders guide and support teachers in collecting and appropriately using varied sources of information and data to evaluate student learning, effective teaching, and program quality.	1	2	3	4
C. Educational leaders seek, acquire, and manage fiscal, physical, and other resources to support the school's vision, mission, and values.	1	2	3	4
D. Educational leaders implement coherent systems of curriculum, instruction, and assessment that promote the mission, vision, and values of the school, embody high expectations for all students, and promote student sense-making and reasoning.	1	2	3	4
E. Educational leaders build a professional culture of trust and collaboration, and professional learning (including: engaging teachers in sharing information, analyzing outcomes, and planning improvement).	1	2	3	4
F. Educational leaders intentionally develop staff member's professional mathematics knowledge, skills, and dispositions through a variety of opportunities for learning and growth, guided by an understanding of adult learning and current research-based mathematical pedagogy.	1	2	3	4

▼CRITICAL INDICATORS	1	2	3	4
G. Educational leaders ensure each student has equitable access to effective teachers, learning opportunities, academic and social support, and other resources necessary for success.	1	2	3	4
H. Educational leaders demonstrate a commitment to Professional Learning Communities (PLCs) by providing time, space and resources for mathematics teachers to engage in coaching opportunities, collaborative teaming, and professional learning.	1	2	3	4

For resources to support improvement in Element 1: Instructional Leadership, click here.

ELEMENTS 2–5

Self-Assessment Scale

6-POINT CATEGORICAL SCALE FOR ELEMENTS 2–5

1 Level 1: NOT YET STARTED	2 Level 2: EXPLORATION	3 Level 3: PLANNING	4 Level 4: INITIAL IMPLEMENTATION	5 Level 5: FULL IMPLEMENTATION	6 Level 6: INNOVATION AND SUSTAINABILITY
The LEA or school has not yet started investigating the evidence-based practice.	The LEA or school is investigating evidence-based practices that would lead to the targeted outcome and matching those with resources to make decisions as to how to proceed.	The LEA or school is developing strategic and tactical plans for successful implementation of the strategies they will use to achieve the outcomes.	The LEA or school is beginning to implement. The organization is building capacity of staff, students, and the system to implement the plans successfully (for example, skill building, organizational changes, cultural shifts, infrastructure, resource allocation)	The LEA or school is implementing the planned strategies and interventions. The focus is on sustainability and continuous improvement of the implemented strategies, interventions, or models.	The LEA or school is reviewing results and using those data to improve their programming to reach and exceed the targeted outcome and educators are given the opportunity to innovate on an already effective system.

ELEMENT 2:

ASSET-BASED LEARNING ENVIRONMENT

OVERVIEW

An asset-based learning environment reflects conditions that:

meets the needs of each student,

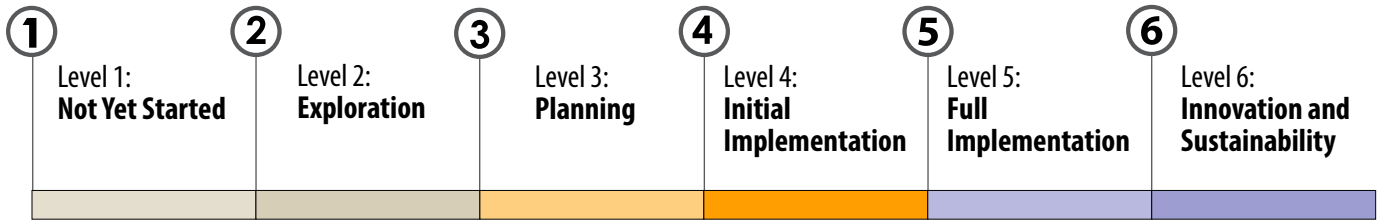
creates a mathematics-rich learning environment for student learning where staff are confident in their roles and relationships,

promotes a community culture that values trust, respect, and high expectations.

Click here for resources

SELF-ASSESSMENT TOOL

ASSET-BASED LEARNING ENVIRONMENT



CRITICAL INDICATORS	1	2	3	4	5	6
A. Students, teachers, leaders, and community partners demonstrate their belief that all students can achieve mathematically at high levels—no excuses, no exceptions—by setting high learning expectations and using rigorous, asset-based instructional methods to meet each student's needs.	1	2	3	4	5	6
B. Schools have a healthy mathematics culture that is psychologically safe and allows for students to authentically engage in the Standards for Mathematical Practices: ▮ Make sense of problems and persevere in solving them, ▮ Reason abstractly and quantitatively, ▮ Construct viable arguments and critique the reasoning of others, ▮ Model with mathematics, ▮ Use appropriate tools strategically, ▮ Attend to precision, ▮ Look for and make use of structure, and ▮ Look for and express regularity in repeated reasoning	1	2	3	4	5	6

▼CRITICAL INDICATORS	1	2	3	4	5	6
C. Leaders and educators build positive student mathematical identities through regular implementation of the Teaching Practices ▮ Establish mathematics goals to focus learning, ▮ Implement tasks that promote reasoning and problem solving, ▮ Use and connect mathematical representations, ▮ Facilitate meaningful mathematical discourse, ▮ Pose purposeful questions, ▮ Build procedural fluency from conceptual understanding, ▮ Support productive struggle in learning mathematics, and ▮ Elicit and use evidence of student thinking. (NCTM, 2014)	1	2	3	4	5	6
D. Leaders and educators build positive student mathematical experiences through regular implementation of the Equity-Based Practices: ▮ Going deep with mathematics, ▮ Leveraging multiple mathematical competencies, ▮ Affirming mathematics learners' identities, ▮ Challenging spaces of marginality, and ▮ Drawing on multiple resources of knowledge. (Aguirre et. al., 2013)	1	2	3	4	5	6
E. Leaders and educators support evidence-based practices over time to create lasting impact.	1	2	3	4	5	6
F. Educators foster high morale and collective efficacy by valuing and showing support for the entire student body. (Hattie, et. al., 2017)	1	2	3	4	5	6
G. Leaders and educators create productive school environments by: ▮ Having high student expectations, ▮ Respecting students' agency, and ▮ Engaging students in authentic mathematics learning experiences	1	2	3	4	5	6
H. Faculty and students exhibit a growth mindset that supports the development of mathematical thinkers and doers.	1	2	3	4	5	6
I. Educators routinely engage with families to celebrate their student's mathematical growth and set goals for future learning.	1	2	3	4	5	6
J. Schools gather stakeholder input on school climate and perceptions. Successes are celebrated and concerns are addressed.	1	2	3	4	5	6

▼CRITICAL INDICATORS	1	2	3	4	5	6
K. The school community acknowledges and promotes student development of the qualities outlined in the Portrait of a Graduate: ▮ Academic Mastery, ▮ Wellness, ▮ Civic, Financial and Economic Literacy, ▮ Digital Literacy, ▮ Communication, ▮ Critical Thinking and Problem Solving, ▮ Creativity and Innovation, ▮ Collaboration and Teamwork, ▮ Honesty, Integrity and Responsibility, ▮ Hard Work and Resilience, ▮ Lifelong Learning and Personal Growth, ▮ Service, and ▮ Respect.	1	2	3	4	5	6

For resources to support improvement in Element 2: Asset-Based Learning Environments, click here

ELEMENT 3:

INSTRUCTION AND INTERVENTION

OVERVIEW

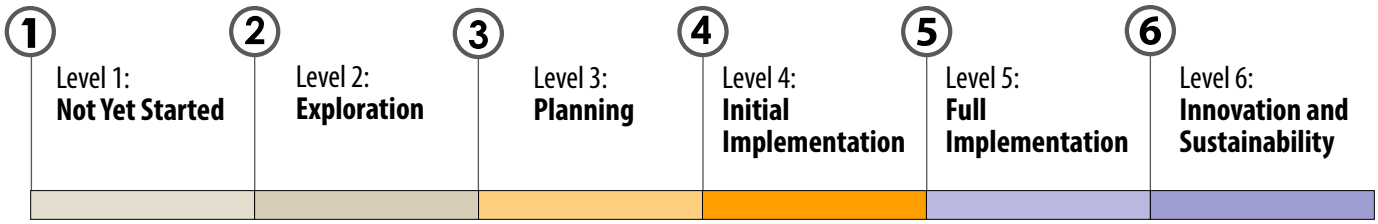
Effective instructional practice aimed at improving student-learning outcomes includes:

- strong standards-based instruction,
- data-informed planning,
- differentiation and individualization,
- evidence-based pedagogical approaches, and effective classroom management.

Click here for resources

SELF-ASSESSMENT TOOL

INSTRUCTION AND INTERVENTION



CRITICAL INDICATORS	1	2	3	4	5	6
A. Research-based curriculum and mathematics instruction includes evidence of the following Teaching Practices: ▮ Establish mathematics goals to focus learning, ▮ Implement tasks that promote reasoning and problem solving, ▮ Use and connect mathematical representations, ▮ Facilitate meaningful mathematical discourse, ▮ Pose purposeful questions, ▮ Build procedural fluency from conceptual understanding, ▮ Support productive struggle in learning mathematics, and ▮ Elicit and use evidence of student thinking. (NCTM, 2014)	1	2	3	4	5	6

▼CRITICAL INDICATORS	1	2	3	4	5	6
B. Educators include the Standards for Mathematical Practices throughout all tiers of the mathematics learning experience and incorporate opportunities for students to: ▮ Make sense of problems and persevere in solving them, ▮ Reason abstractly and quantitatively, ▮ Construct viable arguments and critique the reasoning of others, ▮ Model with mathematics, ▮ Use appropriate tools strategically, ▮ Attend to precision, ▮ Look for and make use of structure, and ▮ Look for and express regularity in repeated reasoning.	1	2	3	4	5	6
C. Educators provide opportunities for students to actively engage in meaningful interactions with mathematics in comprehensible ways that build positive student mathematical identities ("...dispositions and deeply held beliefs that students develop about their ability to participate and perform effectively in mathematical contexts…" (Aguirre, et. al, 2013) through the Equity Practices: ▮ Going deep with mathematics, ▮ Leveraging multiple mathematical competencies, ▮ Affirming mathematics learners' identities, ▮ Challenging spaces of marginality, and ▮ Drawing on multiple resources of knowledge (Aguirre et. al., 2013).	1	2	3	4	5	6
D. Educators establish learning intentions and success criteria based on the Utah Core Standards and communicate them to students for each mathematics learning experience.	1	2	3	4	5	6
E. Educators implement instruction, interventions, and extensions to align with learning intentions and success criteria (as outlined in Utah's PCBL Framework) to meet the needs of each student based on data as defined in their collaborative professional groups with attention to appropriate cognitive depth (Kanold et. al., 2018, p. 111).	1	2	3	4	5	6
F. Educators use research-based instructional materials and supports (manipulatives, calculators, numbers lines, etc.) that are: ▮ Coherent and aligned with the learning intentions and grade level content area standards, ▮ Task-based, ▮ Appropriately challenging and supportive for all students, ▮ Culturally and academically relevant, and ▮ Readily accessible to all students.	1	2	3	4	5	6

▼CRITICAL INDICATORS	1	2	3	4	5	6
G. Educators provide students with instructional routines that include opportunities for engagement in heterogeneous groups where all funds of knowledge are valued, celebrated, and used to personalize the mathematics learning experience. **Grade band recommendations:** ▮ **K–2**: 60 minutes (protected time)—45 minutes for Tier 1 across the school day. Approximately 5–8 minutes (11–18%) of daily class time is dedicated to direct instruction where teacher-talk dominates. ▮ **3–6**: 90 minutes (protected time)—60 minutes for Tier 1 across the school day. Approximately 8–12 minutes (13–20%) of daily class time is dedicated to direct instruction where teacher-talk dominates. ▮ **6–12**: Educators have an average of 60 minutes per school day of uninterrupted Tier 1 instructional time. No more than 12–15 minutes (20–25%) of daily class time is dedicated to direct instruction where teacher-talk dominates. (Leinwand & Milou, 2021).	**1**	**2**	**3**	**4**	**5**	**6**
H. All tiers of mathematics instruction and intervention allow students to engage in: ▮ Opportunities for risk-free mistake making–such as number talk warm-ups (Humphries & Parker, 2015), reasoning exercises, working in pairs, and collaborative mathematical sense-making (Leinwand & Milou, 2021), ▮ Opportunities for mathematical reasoning and sense-making through task-based learning opportunities coupled with engaging and relevant contexts, and ▮ Opportunities for student-led mathematical discourse (Smith & Stein, 2011).	**1**	**2**	**3**	**4**	**5**	**6**
I. In addition to Tier 1 instruction, educators intentionally deliver cognitively demanding, flexible, individually responsive, targeted Tier 2 and intensive Tier 3 mathematics instruction using strategies that are: ▮ Research-based, ▮ Driven by formative student data points, ▮ Personalized to student needs, ▮ Of varying levels of cognitive demand (Kanold et. al., 2018, p. 111) ▮ Routinely monitored, and ▮ Of sufficient intensity and duration to ensure student growth,	**1**	**2**	**3**	**4**	**5**	**6**
J. Educators provide balanced opportunities for appropriate student use of technology to facilitate mathematical reasoning and sense-making (i.e. educators provide a student-led discourse-rich and task-based classroom experience daily and use technology only when it will support and enhance these experiences).	**1**	**2**	**3**	**4**	**5**	**6**

▼CRITICAL INDICATORS	1	2	3	4	5	6
K. Educators provide opportunities for students to engage with mathematics through the Personalized, Competency Based Learning Framework (PCBL), where educators provide a learning experience that consists of: ▮ Opportunities for student agency through analyzing work, setting goals and students monitoring their own progress, ▮ A variety of learning pathways to demonstrate competency, ▮ Opportunities for student agency in performance-based competency demonstration, and ▮ The use of digital mathematics programs only when it enhances student-led, discourse-rich and task-based instruction.	1	2	3	4	5	6

For resources to support improvement in Element 3: Instruction and Intervention, click here.

ELEMENT 4:

ASSESSMENT AND FEEDBACK

OVERVIEW

Leaders provide direction and time during the school day for educators to:

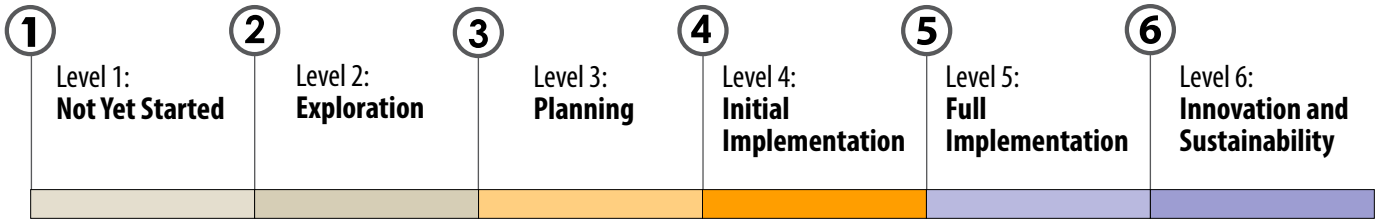
- Monitor students' progress to promote student learning and involve students in monitoring their own progress,
- Make evidence-based instructional decisions to modify instruction to facilitate student learning,
- Evaluate students' achievement to summarize and report students' demonstrated understanding at a particular moment in time, and
- Evaluate resources and programs to make decisions about instruction.

(NCTM, 2014, p. 89)

Click here for resources.

SELF-ASSESSMENT TOOL

ASSESSMENT AND FEEDBACK



▼CRITICAL INDICATORS	1	2	3	4	5	6
A. Educators follow a comprehensive, strength-based assessment plan by: ▮ Administering both formative and summative assessments, ▮ Providing students with the agency to show evidence of their understanding, and ▮ Providing opportunities for students to use multiple strategies and representations to capture their thinking and provide evidence of their understanding.	1	2	3	4	5	6
B. Educators meet in collaborative professional groups to align assessment to learning intentions, success criteria, and grade level core standards.	1	2	3	4	5	6

▼CRITICAL INDICATORS	1	2	3	4	5	6
C. Educators use assessments (formative and summative) to guide delivery of content and provide intentional opportunities for students to bridge their understanding of grade level content standards with attention to the Personalized, Competency Based Learning framework (PCBL). ▮ Trained personnel administer assessments, ▮ Educators have access to meaningful data interpretation experiences in a timely manner to inform instruction and intervention.	1	2	3	4	5	6
D. Educators collaborate frequently to: ▮ Plan and revise common standards-aligned assessments with attention to a balance of: ▯ Cognitive depth, ▯ Skills, ▯ Concepts, and ▯ Applications. ▮ Analyze assessment data to guide customized supports: ▯ Planning, ▯ Preparation, ▯ Lesson delivery, and ▯ Intervention/extension. (Kanold et. al., 2018, p. 111)	1	2	3	4	5	6
E. Educators or trained personnel regularly progress-monitor students through both formative and summative assessment measures to: ▮ Celebrate student funds of knowledge (student assets) and identity, and ▮ provide targeted, constructive, and consistent feedback to students on their current level of growth and proficiency.	1	2	3	4	5	6
F. Educators meet regularly in grade-band or subject area Professional Learning Communities (PLCs) to: ▮ Identify essential standards for each unit with the following understandings: ▮ A traditional or performance-based formative assessment (mid-unit) should contain between 1–2 essential standards, and ▮ A traditional or performance-based summative assessment (unit exam) should contain between 3–6 essential standards. ▮ Define appropriate and clear scoring rubrics, and ▮ Define the evidence of understanding requirements for each test item (includes traditional and performance-based assessments). (Kanold et. al., 2018).	1	2	3	4	5	6

▼CRITICAL INDICATORS	1	2	3	4	5	6
G. Educators regularly use formative assessment opportunities to: ▮ Facilitate personalized learning, ▮ Provide meaningful feedback that articulates what students currently understand and provide suggestions for how students can work towards deeper understanding, ▮ Adjust teaching methods and, ▮ Adjust pacing based on student needs. (Hattie, et. al., 2017)	1	2	3	4	5	6
H. Educators regularly implement performance assessment tasks (summative and formative) to assess grade level content knowledge as well as student engagement with the Standards for Mathematical Practice (which are an integral part of the Utah Core Standards): ▮ Make sense of problems and persevere in solving them, ▮ Reason abstractly and quantitatively, ▮ Construct viable arguments and critique the reasoning of others, ▮ Model with mathematics, ▮ Use appropriate tools strategically, ▮ Attend to precision, ▮ Look for and make use of structure, and ▮ Look for and express regularity in repeated reasoning.	1	2	3	4	5	6
I. Students can articulate the learning intention(s) and success criteria that are the focus of the mathematics learning experience. Students engage in: ▮ Goal setting, ▮ Monitoring, and ▮ Assessing their own learning.	1	2	3	4	5	6

For resources to support improvement in Element 4: Assessment and Feedback, click here.

ELEMENT 5:

PROFESSIONAL LEARNING

OVERVIEW

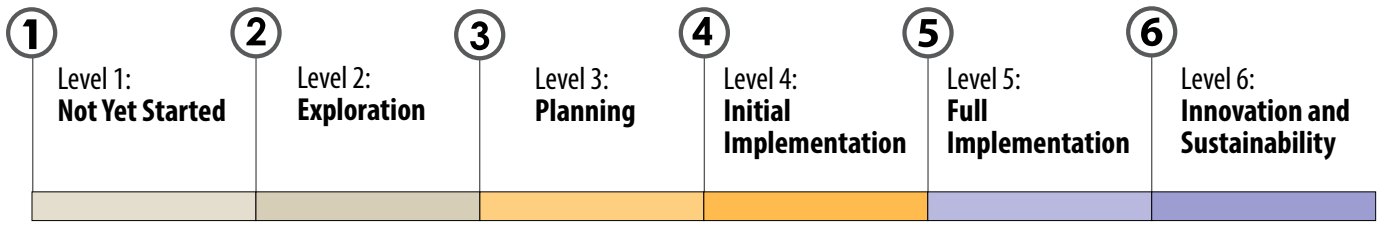
Professional learning is ongoing, high quality, and job-embedded. Learning opportunities are responsive to the site, team, and individual learner needs and are designed to build staff capacity for improvement through:

- coaching,
- mentoring,
- observation (including peer observations), and
- leveraging the effectiveness of high-performing teachers, coaches, and leaders by using them as models and peer coaches.

Click here for resources

SELF-ASSESSMENT TOOL

PROFESSIONAL LEARNING



▼CRITICAL INDICATORS	1	2	3	4	5	6
A. Professional Learning Communities (PLCs) are established, and educators collaborate in teams to: ▮ Set goals, ▮ Analyze impact and, ▮ Make adjustments for continuous improvement .	1	2	3	4	5	6
B. Professional learning aligns with The Professional Learning Standards for teachers and school administrators: **1.** Learning Communities **2.** Skillful Leaders, **3.** Resources, **4.** Data, **5.** Learning Design, **6.** Implementation, **7.** Outcomes, and **8.** Technology as described in legislative code 53G-11-303.	1	2	3	4	5	6

▼CRITICAL INDICATORS	1	2	3	4	5	6
C. Professional learning is designed, developed, implemented, and evaluated using evidence-based research and data from a variety of sources (e.g. student, educator, and/or system level).	1	2	3	4	5	6
D. Professional learning focuses on the implementation of the Utah Core Mathematics Standards and the Effective Mathematics Teaching Practices: ▮ Establish mathematics goals to focus learning ▮ Implement tasks that promote reasoning and problem solving ▮ Use and connect mathematical representations ▮ Facilitate meaningful mathematical discourse ▮ Pose purposeful questions ▮ Build procedural fluency from conceptual understanding ▮ Support productive struggle in learning mathematics, and ▮ Elicit and use evidence of student thinking.	1	2	3	4	5	6
E. Professional learning builds teacher capacity for developing students' mathematical proficiency: ▮ Adaptive Reasoning, ▮ Strategic Competence, ▮ Conceptual Understanding, ▮ Productive Disposition, and ▮ Procedural fluency. (Kilpatrick, et. al, 2001)	1	2	3	4	5	6
F. Leaders provide educators and paraprofessionals with: ▮ Training and support in implementing evidence-based curriculum programs and assessments, ▮ Opportunities to engage in professional organizations, conferences, and publications, and ▮ Opportunities to engage in collaborative/PLC teams to ensure the curriculum and instruction is horizontally and vertically aligned across grade levels.	1	2	3	4	5	6
G. Individuals and collaborative teams engage in targeted opportunities to participate in professional learning through: ▮ Observation, ▮ Instructional coaching, ▮ Peer mentoring, ▮ Professional conferences//memberships, ▮ Interactions with teacher leaders, and ▮ Educators recognize that the time spent in professional learning is key to their growth and development.	1	2	3	4	5	6
H. Professional learning opportunities include time for educators to: ▮ Reflect, ▮ Discuss, and ▮ Implement new processes and information.	1	2	3	4	5	6

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APPENDICES

Appendix A:

The Task Analysis Guide

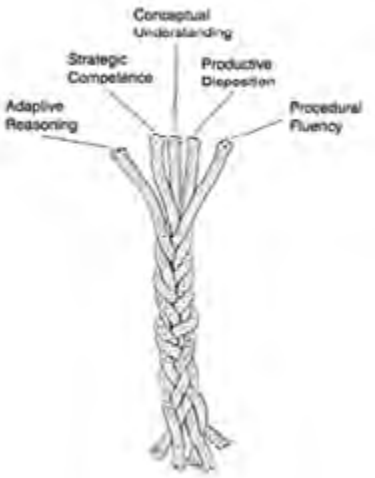
LOWER-LEVEL DEMANDS	HIGHER-LEVEL DEMANDS
MEMORIZATION ▮ involves either reproducing previously learned facts, rules, formulae or definitions OR committing facts, rules, formulae or definitions to memory. ▮ cannot be solved using procedures because a procedure does not exist or because the time frame in which the task is being completed is too short to use a procedure. ▮ is not ambiguous. Such tasks involve exact reproduction of previously-seen material, and what is to be reproduced is clearly and directly stated. ▮ has no connection to the concepts or meaning that underlie the facts, rules, formulae or definitions being learned or reproduced.	**PROCEDURES WITH CONNECTION** ▮ focus students' attention on the use of procedures for the purpose of developing deeper levels of understanding of mathematical concepts and ideas. ▮ suggest pathways to follow (explicitly or implicitly) that are broad general procedures that have close connections to underlying conceptual ideas as opposed to narrow algorithms that arc opaque with respect to underlying concepts. ▮ usually are represented in multiple ways (e.g., visual diagrams, manipulatives, symbols, problem situations). Making connections among multiple representations helps to develop meaning. ▮ require some degree of cognitive effort. Although general procedures may be followed, they cannot be followed mindlessly. Students need to engage with the conceptual ideas that underlie the procedures in order to successfully complete the task and develop understanding.
PROCEDURES WITHOUT CONNECTIONS ▮ are algorithmic. Use of the procedure is either specifically called for or its use is evident based on prior instruction, experience, or· placement of the task. ▮ require limited cognitive demand for successful completion. There is little ambiguity about what needs to be done and how to do it. ▮ have no connection to the concepts or meaning that underlie the procedure being used. ▮ are focused on producing correct answers rather than developing mathematical understanding. ▮ require no explanations or explanations that focus solely on describing the procedure that was used.	**DOING MATHEMATICS** ▮ requires complex and non-algorithmic thinking (i.e., there is not a predictable, well-rehearsed approach or pathway explicitly suggested by the task, task instructions, or a worked-out example). ▮ requires students to explore and understand the nature of mathematical concepts, processes, or relationships. ▮ demands self-monitoring or self-regulation of one's own cognitive processes. ▮ requires students to access relevant knowledge and experiences and make appropriate use of them in working through the task. ▮ requires studenis to analyze the task and actively examine task constraints that may limit possible solution strategies and solutions. ▮ requires considerable cognitive effort and may involve some level of anxiety for the student due to the unpredictable nature of the solution process required.

(Smith, M.S., & Stein, M.K., 1998)

Appendix B:

Components of Mathematical Proficiency

Mathematical proficiency is not just fact, fluency, and recall; it includes five interwoven components as illustrated below:



(Kilpatrick, et. al, 2001)

Adaptive Reasoning

Mathematics is more than a set of rules and procedures. Mathematical proficiency includes the ability to justify and think logically about problems. Students who demonstrate the capacity to solve problems flexibly and think through their solutions and outcomes have the adaptive reasoning necessary to be proficient in mathematics. "In mathematics, adaptive reasoning is the glue that holds everything together, the lodestar that guides learning." (Kirlpatrick, et. al., 2001)

Strategic Competence

Students who are able to formulate, make sense of, and solve mathematical problems demonstrate strategic competence in mathematics. Students who demonstrate *strategic competence* are adept at thinking logically to derive multiple solution pathways for a variety of cognitively deep mathematical problems. Students understand there is not only one method only for solving mathematical problems and work to find and understand the multiple methods and models for arriving at a solution.

Conceptual Understanding

Conceptual understanding is necessary in order for students to develop a mathematical foundation and is essential for developing procedural fluency. Conceptual understanding is defined as the "comprehension and connection of concepts, operations, and relations" (NCTM, 2014, p. 7) i.e. the ability to apply mathematical procedures in multiple contexts.

Productive Disposition

A student's attitude towards mathematics is a major contributor to their educational success or failure. Students with a *productive disposition* around mathematics see math as sensible, useful, and most importantly, see themselves as learners and doers of mathematics through the Standards for Mathematical Practice:

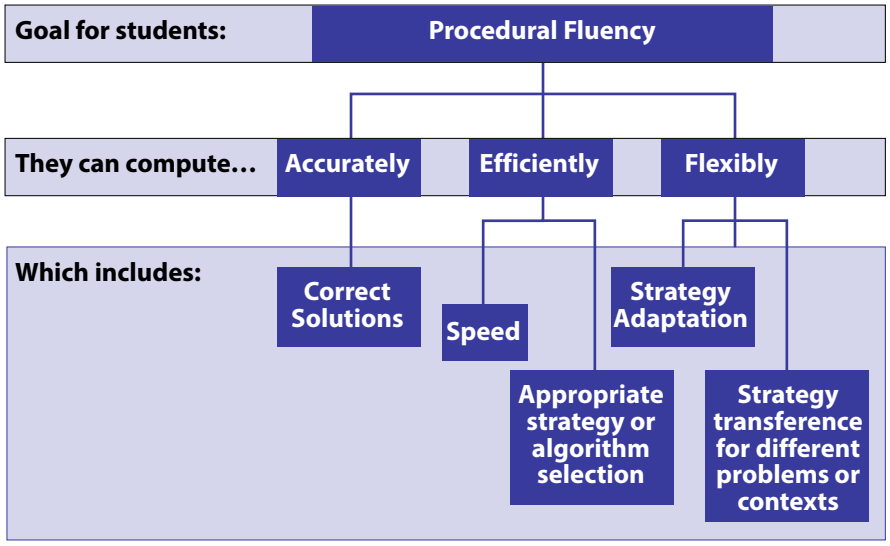
- Standard 1: Make sense of problems and persevere in solving them
- Standard 2: Reason abstractly and quantitatively
- Standard 3: Construct viable arguments and critique the reasoning of others
- Standard 4: Model with mathematics
- Standard 5: Use appropriate tools strategically
- Standard 6: Attend to precision

- Standard 7: Look for and make sure of structure
- Standard 8: Look for and express regularity in repeated reasoning

A productive disposition means a willingness to engage in productive struggle with mathematical problems and to seek out and learn from challenging situations. (Kilpatrick, et. al, 2001)

Procedural Fluency

Procedural fluency refers to knowledge of procedures, knowledge of when and how to use procedures appropriately, and skill in performing procedures flexibly, accurately, and efficiently (Kilpatrick, et. al., 2001). Developing procedural fluency goes beyond memorization of facts or a list of procedures that are not connected to an understanding of "why it works". (Baroody 2006; Griffin 2005). Additionally, "procedural fluency...is fragile and meaningless without a sound conceptual understanding of the mathematics" (NCTM, 2017, p. 55) as summarized in the diagram below:



(Spangler & Wanko, 2017, p. 63)

Conceptual understanding and procedural fluency work together to help students develop strategic competence (i.e., the ability to formulate, represent, and solve mathematical problems) and adaptive reasoning (i.e., the capacity to think logically and to justify one's thinking). These competencies are both necessary for students when solving mathematics problems that they may encounter in real life, as well as within mathematics and other disciplines. (NCTM, 2014, p. 7).

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