

Teacher Quality Standard I

Teachers demonstrate mastery of and pedagogical expertise in the content they teach. The elementary teacher is an expert in literacy and mathematics and is knowledgeable in all other content that he or she teaches (e.g., science, social studies, arts, physical education, or world languages). The secondary teacher has knowledge of literacy and mathematics and is an expert in his or her content endorsement area(s).

The key to distinguishing the knowledge base of teaching rests at the intersection of content and pedagogy.

—L. S. Shulman

To teach all students according to today's standards, teachers need to understand subject matter deeply and flexibly so they can help students create useful cognitive maps, relate one idea to another, and address misconceptions. Teachers need to see how ideas connect across fields and to everyday life. This kind of understanding provides a foundation for pedagogical content knowledge that enables teachers to make ideas accessible to others. (Shulman, 1987)

Although Shulman's work dates back to the late 1980s, the importance of teacher content knowledge and pedagogical expertise has never been more important than it is now as teachers ensure students are college and career ready for the demands of the 21st century.

Element C: Math Teachers

Teachers demonstrate knowledge of mathematics and understand how to promote student development in numbers and operations, algebra, geometry and measurement, and data analysis and probability.

This section describes professional practices that should be demonstrated by Teachers responsible for teaching math.

The great book of nature can be read only by those who know the language in which it was written. . . and that language is mathematics.

—Galileo

Professional practices appearing under each element of the Rubric for Evaluating Colorado Teachers are cumulative. Therefore, for teachers of math to be proficient in demonstrating knowledge of mathematics and how to promote student development of mathematical concepts and skills, they must provide instruction that is a balance of conceptual understanding and procedural skills and is sequenced and appropriate for the age and grade of their students. Teachers also establish an environment where students are actively engaged in doing math that challenges their thinking, stimulates their curiosity, and encourages them to investigate further.



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PARTIALLY PROFICIENT RATING LEVEL

PROFESSIONAL PRACTICES: THE TEACHER:

Presents concepts:

- ***In a sequence.***

When concepts are presented in a sequence, they are ordered in a logical way so students can build on their prior knowledge and experiences. Sequencing within a lesson can relate to teaching objectives or to releasing responsibility to students. Concepts should be taught or reviewed in an appropriate sequence for the grade level and ability of the students. Teachers should make teaching decisions based on the needs of their students, the complexity of the objective, and the content.

As support in presenting concepts in a sequence, the teacher should reference the district's curriculum and ask the following questions:

- What do my students already know about this concept or skill?
- What are the prerequisite skills students need to master in order to meet the learning objective?
- How should the skills or steps for this concept be sequenced?
- How will I provide for a sequence that includes procedural learning and conceptual learning?
- How will I support students in building on their thinking and advancing their understanding?

- ***In a manner appropriate to students' age and grade.***

As support in presenting concepts in a manner appropriate to students' age and grade, the teacher should first refer to the Colorado Academic Standards and the district's curriculum. The teacher must also consider the cognitive level of the students, their attention span, communication skills, and previous learning from prior grades and units of study.

Mathematical concepts do not exist in isolation. Mathematics is a set of systems. Arithmetic of whole numbers is a self-contained, logical system until division is introduced. Division produces rational numbers that are not whole numbers, a new kind of number. The system has to be upgraded to encompass all rational numbers. Learning a concept in mathematics is almost always an upgrade of prior mathematics knowledge. Comprehending explanations in mathematics requires a strategic perspective of repairing and upgrading prior knowledge. (Daro, Mosher, & Corcoran, 2011)

Refer to these external resources for additional information:

- Document: The Standards for Mathematical Practice, annotated for the K–5 classroom
<http://commoncoretools.me/wp-content/uploads/2014/02/Elaborations.pdf>



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Document provides explanations of the Standards for Mathematical Practice that are appropriate for grades K–5.

- Website:
<http://omsd.omsd.k12.ca.us/departments/lss/academics/commoncore/Documents/SMP-Posters/Posters-K-1.pdf>
Website provides visuals appropriate for teaching the Standards for Mathematical Practice to early childhood and elementary students.

 - Website: Illustrative Mathematics
<http://www.illustrativemathematics.org/>
Website provides sample lesson plans for all grades aligned to Common Core Standards for Mathematics.

 - Website: Instructional Resources – Mathematics maintained by the Colorado Department of Education
<http://www.cde.state.co.us/comath/resources#Differentiation>
Website provides links to resources for differentiating math instruction based on students' academic needs and language.
- ***Helps students understand mathematics as a discipline.***

The following explanation regarding the understanding of mathematics as a discipline is taken from the Colorado Department of Education site: <http://www.cde.state.co.us/CoMath>

...these important competencies are interwoven throughout the standards: *inquiry questions; relevance and application; and the nature of each discipline*. These competencies should not be thought of as stand-alone concepts, but should be integrated throughout the curriculum in all grade levels. Just as it is impossible to teach thinking skills to students without the content to think about, it is equally impossible for students to understand the content of a discipline without grappling with complex questions and the investigation of topics.

- *Inquiry Questions*: Inquiry is a multifaceted process requiring students to think and pursue understanding. Inquiry demands that students (a) engage in an active observation and questioning process, (b) investigate to gather evidence, (c) formulate explanations based on evidence, (d) communicate and justify explanations, and (e) reflect and refine ideas. Inquiry is more than hands-on activities; it requires students to cognitively wrestle with core concepts as they make sense of new ideas.
- *Relevance and Application*: The hallmark of learning a discipline is the ability to apply the knowledge, skills, and concepts in real-world, relevant contexts. Components of this include solving problems, developing, adapting, and refining solutions for the betterment of society. The application of a discipline, including how technology assists or accelerates the work, enables students to more fully appreciate how the mastery of the grade level expectation matters after formal schooling is complete.
- *Nature of Discipline*: The unique advantage of a discipline is the perspective it gives the mind to



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see the world and situations differently. The characteristics and viewpoint one keeps as a result of mastering the grade level expectation is the nature of the discipline retained in the mind's eye.

The teacher should refer to the sections for each grade-level standard for concepts and skills students master on the Colorado Academic Standards for Mathematics for further guidance.

Refer to this internal resource for additional information:

- Discipline of Mathematics as a 21st Century Skill
Document provides explanations of mathematics as a discipline in relationship to Colorado's 21st Century Skills.

- ***Provides a balance of teaching for conceptual understanding and teaching for procedural fluency.***

One of the instructional shifts required by the Colorado Academic Standards is an equal intensity on conceptual understanding, procedural skills, and fluency and application.

Once we have a focused set of standards, teachers and students have the time and space to develop solid conceptual understanding. There is less pressure to quickly teach students how to get the answer, which often means relying on tricks or mnemonics instead of understanding the reason an answer is correct or why a particular trick works. (Alberti, 2013, para. 24)

For example, it is not sufficient for students to know they can find equivalent fractions by multiplying the numerator and denominator by the same number. Students also need to know why this procedure works and what the different equivalent forms mean. Attention to conceptual understanding helps students build on prior knowledge and create new knowledge to carry into future grades. It is difficult to build further math proficiency on a set of mnemonics or meaningless procedures. (Alberti, 2013, para. 25)

Refer to this external resource for additional information:

- Video: Don't Leave Out the Math with Phil Daro
<http://www.youtube.com/watch?v=uyeebGEDtio>
Video is Phil Daro, a lead writer of the Common Core State Standards for Math, discussing the difference between teaching for conceptual understanding and "answer getting."



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