Standards INSTITUTE

Rigor in the Standards-Application

Handout, High School

Rigor in the Standards

The *High School Publishers' Criteria* gives a high level description of rigor for grades 9 through 12, and while it is not exhaustive, it is meant to frame your thinking around rigor for this grade band. This "Rigor in the Standards" handout, and the examples contained within, should be used to discuss the meaning, intent, and themes of the major work for this grade band. Use this document as a resource during planning or professional learning opportunities to frame conversations around rigor within this grade band and to reflect on the instructional practices necessary to appropriately attend to rigor in content standards.

"To help students meet the expectations of the Standards, educators will need to pursue, with equal intensity, three aspects of rigor: (1) conceptual understanding, (2) procedural skill and fluency, and (3) applications. The word "rigor" isn't a code word for just one of these three; rather, it means equal
intensity in all three. The word "understand" is used in the Standards to set explicit expectations for conceptual understanding, and the phrase "real-world problems" and the star symbol (★) are used to set expectations and flag opportunities for applications and modeling. (Modeling is a Standard for Mathematical Practice as well as a content category in High School.) The High School content standards do not set explicit expectations for fluency, but fluency is important in high school mathematics." ***—High School Publishers' Criteria for the Common Core State Standards for Mathematics***

At UnboundEd, we've studied the state standards, spent time in classrooms, and looked at work done by other organizations to form an understanding of these three aspects of rigor that we think is most useful for educators to understand the standards and shift their practice. So while the words *understand*, *fluently*, and *real-world problems* do indicate the three aspects of rigor, they are not comprehensive. We've come to associate conceptual understanding with higher order thinking skills, working with multiple representations, and teaching more than just computational procedures. Procedural skills are about students accurately performing core functions required for grade-level mathematics; fluency is explicitly called for in certain standards and implies efficiency. Application can be thought of generally as problem solving, in real-world or mathematical contexts. For example, the words *recognize* or *compar*e can be used to indicate conceptual understanding, *count* can indicate procedural skill and fluency, and *solve addition and subtraction word problems* can be used to indicate application. Nevertheless, the example standards here that indicate an aspect of rigor should be used as examples and are not meant to be a checklist or keyword indicators.

Additional Aspects of the Rigor and Balance Criterion from the *High School Publishers' Criteria*::

(1) The three aspects of rigor are not always separate in materials. (Conceptual understanding needs to underpin fluency work; fluency can be practiced in the context of applications; and applications can build conceptual understanding.)
(2) Nor are the three aspects of rigor always together in materials. (Fluency requires dedicated practice to that end. Rich applications cannot always be shoehorned into the mathematical topic of the day. And conceptual understanding will not come along for free but must be explicitly taught.)

Application

"Allowing teachers and students using the materials as designed to spend sufficient time working with engaging applications/modeling. Materials include an ample number of contextual problems that develop the mathematics of the course, afford opportunities for practice, and engage students in problem solving. Materials also include problems in which students must make their own assumptions or simplifications in order to model a situation mathematically. Applications take the form of problems to be worked on individually as well as classroom activities centered on application scenarios. Materials attend thoroughly to those places in the content standards where expectations for multi-step and real-world problems are explicit. Students learn to use the content knowledge and skills specified in the content standards in applications, with particular stress on applying widely applicable work. Problems and activities show a sensible tradeoff between the sophistication of the problem and the difficulty or newness of the content knowledge the student is expected to bring to bear. Note that modeling is a mathematical practice in every grade, but in high school it is also a content category (CCSSM, pp. 72, 73); therefore, modeling is prominent and enhanced in high school materials, with more elements of the modeling cycle present (CCSSM, p. 72). Finally, materials include an ample number of high-school-level problems that involve applying key takeaways from grades K–8; see Table 1. For example, a problem in which students use reference data to determine the energy cost of different fuels might draw on proportional relationships, unit conversion, and other skills that were first introduced in the middle grades, yet still be a high-school level problem because of the strategic competence required." —***High School Publishers' Criteria for the Common Core State Standards for Mathematics***

The *High School Publishers' Criteria* sets expectations for materials to reflect the appropriate aspect of rigor called for in the Standards. In order to ensure instruction reflects the appropriate aspect of rigor, first we must unpack what rigor looks like in the standards and how instruction might reflect this aspect of rigor. The table below identifies the main goal and effective instructional strategies for application.

Application	
Main goals:	**Effective instructional strategies:**
● Apply skills and understandings to: new situations, other subject areas, real-world and problem-solving situations.	o **Problem-solving opportunities:** Provide time for student to work on tasks independently, with a partner, or in small groups with consistent teacher feedback. o **Share multiple solution methods:** Facilitate classroom discussions where students share, explain, and justify a variety of problem solving strategies and/or solutions. o **Intentionally integrate content:** Provide learning opportunities for students to apply their knowledge of multiple standards, clusters, or domains.
Source: **Achievement Network** https://static1.squarespace.com/static/5321dc4ae4b0c72ad0ceedfe/t/59c4179537c5811bd8d9000c/1506023318140/Instructional+Approaches+for+Math+Rigor.pdf Retrieved Nov. 9, 2018	

The examples below are standards within high school grades that indicate application. Each example provided highlights language in the standard that indicates the aspect of rigor, rationale for why this standard indicates the aspect of rigor, other standards that similarly reflect the aspect of rigor, and additional information that helps to articulate the nuance of the Standards and helps to paint a more complete picture of rigor for this grade band. Language in the standard that reflects a different aspect of rigor than the one being highlighted has been grayed.

Language of the standards that indicates application:	
Apply/In applied G-SRT.C.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles **in applied** problems.*****	
Rationale:	Addresses application because students apply skills and understandings to real-world and problem-solving situations. In G-SRT.C.8, students apply their knowledge of trigonometric ratios and the Pythagorean Theorem to solve applied problems involving right triangles.
Standards:	G-MG.A.3
More to know:	G-MG.A.2 indicates application in multiple ways. Application is indicated in the standard by the language: ● G-MG.A.2: **Apply concepts** of density based on area and volume in **modeling situations** (e.g., persons per square mile, BTUs per cubic foot).* Geometric concepts are applied in modeling situations.

Language of the standards that indicates application:	
Model F-TF.B.5[+] Choose trigonometric functions to **model** periodic phenomena with specified amplitude, frequency, and midline.	
Rationale:	Addresses application because students apply skills and understandings to model real world situations involving periodic phenomena. While F-TF.B.5 could also be regarded as a conceptual understanding standard, it is an example of students modeling periodic phenomena using the key features of trigonometric functions.
More to know:	F-BF.A.2 indicates both procedural skill and fluency and application. Application is indicated in the standard with the language: ● F-BF.A.2: **Write** arithmetic and geometric sequences both recursively and with an explicit formula, use them to **model** situations, and translate between the two forms. Writing arithmetic and geometric sequences, as an isolated skill, can be thought of as procedural. It becomes associated with the application aspect when these sequences are used to model real-world situations.

[+] Identified with a (+) in the Standards: "Additional mathematics that students should learn in order to take advanced courses such as calculus, advanced statistics, or discrete mathematics"