Shifts in K–12 Mathematics: Moving to College and Career Readiness

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What is college and career readiness in mathematics?

This decade in education in the United States is marked by the shift to more rigorous standards in mathematics, with the K–12 system-wide goal of college and career readiness for each student. This has created resulting seismic shifts in the K–12 mathematics curriculum for school districts. Even if a state has abandoned or never adopted the Common Core State Standards (CCSS), it may be, as many states are doing, revising or rewriting its standards to be as or even more rigorous than those presented in the CCSS. These new, 21st-century standards are typically larger in grain size; each standard is more complex and must be unpacked to determine the knowledge, skills, and scaffolding required for students to show mastery at and across grade levels, thus creating huge implications for instruction. Educators are seeing the shifting of content across grade levels and the grouping of concepts in critical areas. However, the shifts are not only centered on the content and skills in each standard; the standards for mathematical practice require that students apply the content and skills in different and deeper ways. This may be the most significant shift in mathematics curriculum and instruction with the additional caveat that those practices are measured at all levels of assessment administration. This includes assessments ranging from the most informal such as classroom observations and classroom assessments, to more formal, district assessments and the accountability tests administered by each state. Teaching for understanding and students learning for understanding require a different approach to curriculum and instruction. How do students demonstrate this mastery of knowledge, skills, and application of concepts? They do so by justifying their conclusions and constructing viable arguments to make the case for a solution. One teacher recently shared that she has posters around her room that say, “Explain, explain, and when in doubt, explain some more!” By teaching students to write explanations using math vocabulary and sentence elaboration, teachers are noticing logic flaws much earlier in teaching the concept, helping teachers to correct misunderstandings before they become concrete for the student. This type of instruction also reinforces what students are learning in English Language Arts, where the standards require that students construct arguments, justify conclusions and explain ambiguities in thinking. Many schools are cross-teaming for this type of instruction, to help build the skills in mathematics and strengthen the instructional approaches in both content areas.

How will we measure college and career readiness?

Educators working collaboratively to unpack and prioritize standards to create local curriculum is only the initial work in implementing more rigorous standards. Considering how educators measure the learning from complex standards leads to multiple questions that represent a real change in assessment design. These questions include:

- How will we measure student learning based on more rigorous standards?
- How will we elicit the evidence we need to determine if students are learning for understanding more complex content and skills?
- How will instruction have to change to support student learning so that students work deeper and understand more?
- How can formal and informal formative assessments work together to provide the information teachers need regarding student learning based on more rigorous standards?
- How will accountability systems change as a result of the deeper learning required of students to show mastery of the standards?
- How will the results be explained to parents?

These questions are at the center of the shifts occurring in standards-based instruction across the country as educators implement new curriculum plans in mathematics. As educators analyzed the standards, it was soon clear that the efficiency of multiple choice items alone would not provide the evidence that educators need to diagnose student learning. These questions also form the basis of action to create the next generation of assessments—those that would more effectively measure learning based on rigorous standards in mathematics.

The next generation assessments have several elements that differentiate the new assessments from those used previously in accountability systems and in formative assessment programs. The development of the new assessments required the development of new and different item types to build assessments that include these characteristics:

- assessment grounded in real-world, authentic tasks and experiences;
- students performing at a higher depth of knowledge and performance to provide evidence that shows their level of proficiency;
- assessments that require the use of technology;
- assessments that require diverse item types to provide opportunities for students to write, explain, demonstrate understanding, and produce work;
- assessments that measure growth and progress to show evidence of at least a year's growth for a year's work;

- assessment plans and blueprints that give equal emphasis to formative and summative assessments; and
- assessments that provide information to teachers and parents about students' depth of understanding, including partial understanding, of targeted skills and concepts.

What are the new item types and tools often found on next generation math assessments?

Several item types are used on the next generation math assessments that may be new or less familiar to teachers. Each of these items types is listed below, along with implications for instruction to assist teachers with planning instruction aligned with the complexity of the college and career readiness standards. The item types are:

- **Multiple select items:** These items present with more than four options and more than one correct response. The purpose of this item type is to present students with a more thorough set of solutions for multiple ways to demonstrate evidence of learning. To be successful with this item type, students must analyze and/or evaluate each answer choice and choose the responses that satisfy given solutions and problem conditions. Implications for instruction include providing students with independent and collaborative opportunities for problem solving where multiple procedures and solutions are considered and requiring students to provide rationales as the evidence of the analysis of each procedure and solution.
- **Drag and drop:** These items allow interaction with a wide range of ideas or examples within one concept on a device screen. The purpose of this item type is to require students to analyze ideas to clarify, order, and/or categorize them within a concept. The implications for instruction include providing students with multiple opportunities to manipulate content in parts of a concept, requiring that students compare and contrast, organize, and explain their manipulation of the content on the screen.
- **Matching table:** These items present as a grid and allow analysis of multiple ideas within one concept by checking boxes or moving symbols or graphics to the correct position on the matching table. The purpose of this item type is to require that students analyze ideas to compare and contrast how they fit into a concept and then determine the relationship among the ideas to be matched. The implications for instruction include providing students with many opportunities to organize content, to define relationships between pieces of content, and to use tables or charts when doing so.
- **Graphing items:** These items require students to demonstrate graphing skills by placing points and/or lines on the graph. Graphing items require that students create, analyze and compare graphs. For this item type, students provide evidence of skills in graphing and create visual representations of the numbers, equations, and problem situations on a graph. The implications for instruction include teaching for understanding to include graphic representations of the number concepts so that students can explain verbally, pictorially, and in writing why the graph is important to understanding the concept.

- **Online calculator:** These items require students to use an on-screen calculator to present evidence of their understanding of the use of the calculator as well as the math content and practices measured by the item. Additionally, this item type measures the math practice regarding the use of mathematical tools. The implications for instruction include providing students with opportunities to make decisions about when tools should or should not be used to solve problems and which mathematical tool is most appropriate for the problem situations. In the case of the online calculator, students should receive explicit instruction regarding the use of an online calculator as aligned to the standards at the grade level.
- **Equation/numeric/gridded items:** These items allow for a greater range of responses and/or solution choices. The purpose of this item is to require that students apply their

The shifts are happening in K–12 mathematics!

Now that assessment practices are aligned with the college and career readiness standards, teachers are working in instructional systems that provide the information and tools to diagnose student learning in math like never before. However, the transition is still happening, where teachers need more information regarding the shifts in standards-based instruction in the new assessment era of Evidence Centered Design. Great ways to help educators implement more effectively and efficiently is to design collaborative professional learning regarding

- standards based alignment of the instructional system,
- the roles and purposes of assessments and the expectations of the use of the data from those assessments,
- the new item types and how those items gather evidence regarding student learning of complex standards, and
- the implications for data driven instruction to ensure students are learning at the levels expected by the standards.

The shifts are happening in K–12 mathematics and education is moving toward the ultimate goal of college and career readiness for each student.