mastery education

WHITE PAPER

Measuring Up

The Benefits of Technology-Enhanced Items

in Digitally-Delivered Assessments

The Benefits of Technology-Enhanced Items in Digitally-Delivered Assessments

INTRODUCTION

The newest generation of digitally delivered assessments developed for the Common Core State Standards reflects an effort to capitalize on the expanded flexibility of digital delivery and an effort to assess students more accurately and thoroughly. The newest types of items on these latest digitally delivered assessments reduce the likelihood of accurate random guessing and increase high-level student interaction with the test material. There are two categories of item types developed specifically for these assessments that students will encounter more frequently on digitally delivered assessments and on digitally delivered test-preparation material: Technology-enabled Items and Technology-enhanced Items (TEIs). The latter is the focus of this white paper.

In this white paper, we will explore the following questions:

- How are Technology-enhanced Items defined?
- What are the general benefits of TEIs?
- How do TEIs eliminate random guessing and require higher-order cognitive skills?
- What are some specific examples of TEI types?

HOW ARE TECHNOLOGY-ENHANCED ITEMS DEFINED?

Technology-enhanced Items are computer-delivered items that cannot be easily translated to paper-and-pencil tests (Parshall, Davey, and Pashley, 2000). A broader definition of TEIs encompasses any computer-delivered item that requires some kind of performance or specialized interaction in the "response" that is used for collecting data (Smarter Balanced Technology-enhanced Items Guidelines, 2012). Interaction with the stimuli or answer choices can involve highlighting or selecting text, reordering text, dragging and dropping an object or text, or completing a sentence or equation using a drop-down menu or a fill-in constructed response.

Specialized interaction is an important distinction to make in the definition of a TEI since traditional selected response items (selecting one multiple-choice answer) can be used in computer-delivered tests but are, in fact, no different than those provided by paper-and-pencil tests. Items referred to as Technology-enabled include video or audio media that must be viewed/heard before or during response to the item stimuli. Technology-enabled items do not necessarily require specialized interactions; the item stimuli may still require a traditional selected response (Smarter Balanced Technology-enhanced Items Guidelines, 2012).

WHAT ARE THE GENERAL BENEFITS OF TEIs?

Recent research has shown that Technology-enhanced Items are an improvement over traditional selected response items because they are more engaging; allow for students to use higher-level cognitive skills, process skills, and complex problem-solving skills (Huff and Sireci, 2001); and can be more genuinely aligned to curriculum objectives and experiences. In particular, if the specialized interaction simulates a real-world experience (working with graphic organizers, graphing, using a simulated form of technology like lab equipment, or interacting with primary source documents), then the measureable data becomes more indicative of the responder's skill (Bennett, 1999). Such "cognitively rich contexts that mirror the real world" support the demonstration of higher-order cognitive skills and problem-solving skills (Gorin, 2006).

Another significant benefit of TEIs is that they reduce successful random guessing allowed by items that ask students to select a single response from a limited list of pre-generated choices. TEIs, unlike traditional selected response items, require students to produce information from prior understandings, show relationships, and reproduce skillful actions. Any time students are asked to show comprehension through authentic assessment, especially when producing information rather than selecting it, the data is more informative and valuable (Archibald & Newmann, 1988; Smarter Balanced Technology-enhanced Items Guidelines, 2012). TEIs reduce random guessing by often allowing students

to select more than one response from a broader combination of response choices enabled by a scoring algorithm (Huff & Sireci, 2001). Thus, the data provided is more predictive of educational performance and provides more information to support diagnosis for further improvement (Birenbaum & Tatsuoka, 1987; Birenbaum, Tatsuoka & Gutvirtz, 1992; Frederickson & Ward, 1978).

Furthermore, by using interactive, visual stimuli, less reading, and less cognitive demand on working memory are required. Students can demonstrate skills (reasoning, synthesis, and evaluation) and knowledge without having to attend to "content irrelevant test-taking skills" because the test is not "imposing construct irrelevant high cognitive demands" (Clark & Mayer, 2011). As a result, TEIs can improve the measurability and effectiveness of the test item (Huff & Sireci, 2001). The visual nature of a TEI interaction space supports how students make meaning of the presented content (Kumar, White & Helgeson, 1993). Though research is limited in this area, there are significant implications for ELL students and special education students, in particular, who might otherwise be burdened by lengthy written instructions in the stimuli (Abedi, Lord, Hofstetter & Baker, 2000).

Finally, if the technology involves interactive environments and real-world simulation, students have been shown to find the items more engaging (Dolan, Goodman, Strain-Seymour, Adams & Sethuraman, 2011). If students are engaged and less distracted and anxious about the test items, they are more likely to perform well and demonstrate their skill and knowledge fully.

HOW DO TEIS ELIMINATE RANDOM GUESSING AND REQUIRE HIGHER-ORDER COGNITIVE SKILLS?

TEIs give students the ability to interact with content in a variety of ways. For example, students responding to TEIs can:

- Choose more than one selected response answer
- Generate or complete sentences or equations
- Generate or extend a pattern
- Order and reorder objects or text
- Complete graphic organizers
- Categorize and classify
- Show the relationship between hierarchies or content relationships

Each of these interactions has advantages with regard to showing student comprehension and to eliminating random guessing with success. When a stimulus prompts students to choose more than one selected response answer, the possibility of a successful random guess decreases. Ordering or reordering objects and text further decreases the chance of a successful random guess because of the number of possible sequences a student might choose. Finally, when a stimulus asks students to generate or complete sentences or equations, particularly when the response must be constructed without computer-generated choices, the potential for successful random guessing is almost entirely removed.

Many TEI interactions are advantageous because they require students to demonstrate higher-order cognitive skills. Most traditional selected response items engage students in recalling information by describing, naming, or finding an answer—all more basic cognitive functions (Anderson & Krathwohl, 2001). Whereas, TEIs have the increased potential to engage students in demonstrating understanding and applying concepts through more complex interactions, such as summarizing, connecting ideas, classifying, showing relationships, and applying rules functions (Anderson & Krathwohl, 2001). TEIs that engage students in higher-order cognitive skills are more in line with current recommendations for quality assessments (Darling-Hammond et al., 2013).

WHAT ARE SOME SPECIFIC EXAMPLES OF TEI TYPES?

In an effort to improve the quality of computer-delivered assessments so that students can demonstrate more fully their comprehension of concepts and skills in the Common Core State Standards, PARCC and Smarter Balanced include the following TEIs in their assessments:

PARCC TEIs

- Click and Drag
- Multi-Select
- Pick from Drop-Down Menu
- Drag and Sequence
- Move Tiles
- Fill-In
- Prose Constructed Response*
  (can be a technology-enabled item)

SMARTER BALANCED TEIs

- Drag and Drop
- Multi-Select
- Select Objects
- Drop-Downs
- Re-Order Text/Select and Order
- Tiling
- Enter a Text String
- Prose Constructed Response*
  (can be a technology-enabled item)

After coursework, the next most significant impact on test scores is the use of quality test-preparation materials that familiarize students with the test and the knowledge base they need to answer the questions (Briggs, 2001). *Measuring Up Insight*®provides similar TEIs to PARCC and Smarter Balanced so that students gain familiarity with question types, as well as with the content, that they will experience on these assessments. *Measuring Up Insight* includes the following TEIs:

MEASURING UP INSIGHT TEIs

- Drag and Drop
- Multi-Select
- Select Objects
- Drop-Downs
- Re-Order
- Tiling
- Fill-In Constructed Response
- Prose Constructed Response*
  (can be a technology-enabled item)

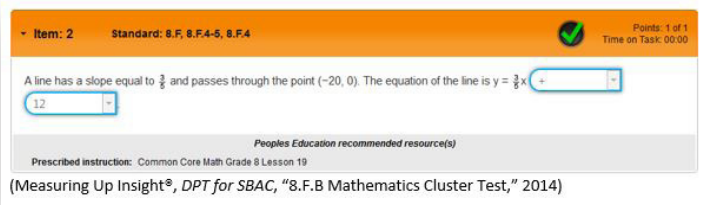
The following semantic map illustrates the benefits of each type of TEI provided by *Measuring Up Insight.*

Benefits of TEIs Higher-Order Cognitive skills						
TEI Type ↓	Choose more than one selected response answer	Generate or complete sentences or equations	Order and reorder objects or text	Complete graphic organizers	Categorize and classify	Show the relationship between hierarchies or content relationships*
Drop-Down and Multi-Select/Drop-Down		X		X	X	X
Tiling/Drag and Drop		X	X	X	X	X
Tiling/Reorder			X	X	X	X
Select Objects and Select Objects/Multi-Select	X	X		X	X	X
Multi-Select	X	X		X	X	X
Fill-in-the-Blank		X		X	X	X
Constructed Response		X		X	X	X

*(Jodoin, 2001)

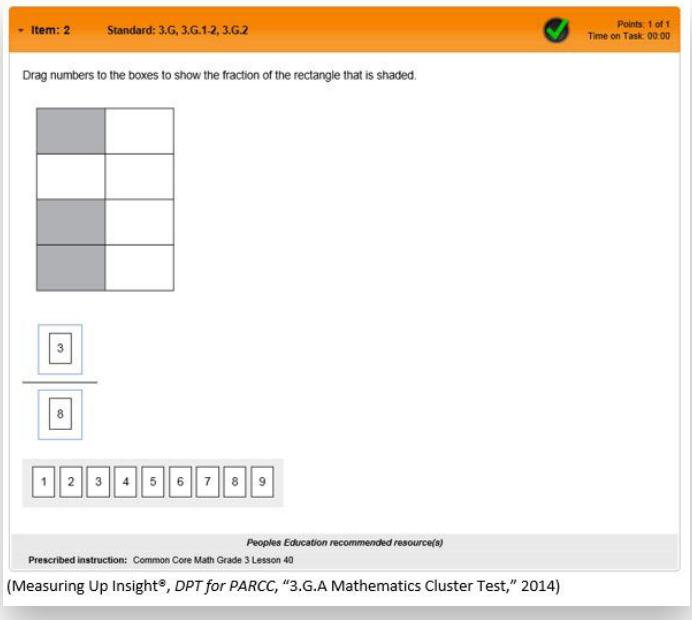
The following are examples of specific types of TEI from *Measuring Up Insight* and an explanation of how they reduce the potential for successful random guessing and support higher-order cognitive engagement:

- **Multi-Select/Drop-Down**—In the following TEI, students must select one correct answer for each of the two drop-down menus; each drop-down menu includes several possible answers. There is one correct equation with many possible answer combinations, and successful random guessing is highly unlikely. Students must understand functions and how to model a linear relationship between two quantities in order to solve the problem.



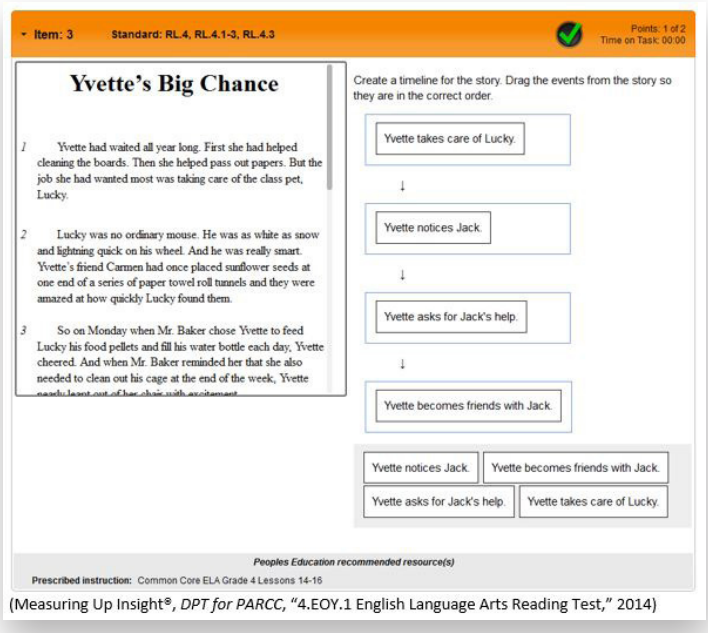
(Measuring Up Insight®, *DPT for SBAC*, "8.F.B Mathematics Cluster Test," 2014)

- **Tiling/Drag and Drop**—In the TEI below, students create a fraction by selecting the appropriate number tile and by dragging and dropping the tile into the numerator or the denominator. Students must understand the concept of fractions and the hierarchical relationship between the numerator and the denominator. While there is only one correct answer, there are many possible fractions students can create using the tiles. Thus, correct random guessing is significantly reduced.



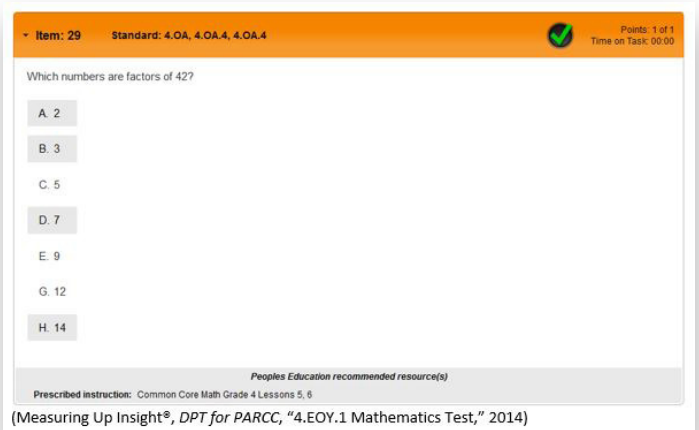
(Measuring Up Insight®, *DPT for PARCC*, "3.G.A Mathematics Cluster Test," 2014)

- **Tiling/Reorder**—In the example below, students must rearrange the events from the story by placing the tiles in the correct sequence. There are 7 tiles and 4 possible timeline openings, allowing for 28 possible sequences and 1 correct sequence. The skills involved in this interaction include more basic cognitive functions (recalling details) and higher cognitive functions (ordering and showing content relationships).



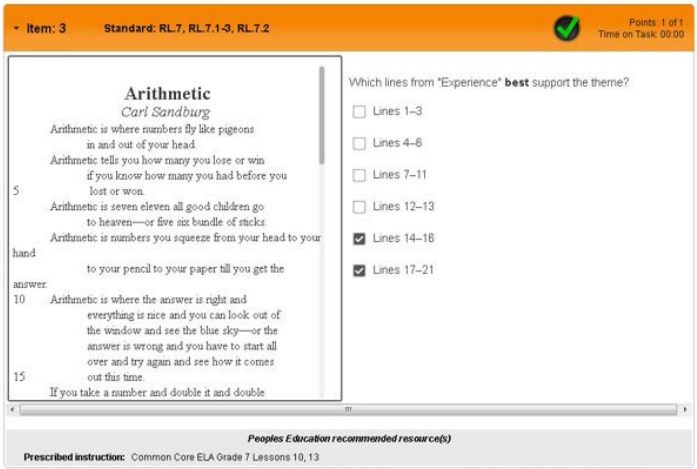
(Measuring Up Insight®, *DPT for PARCC*, "4.EOY.1 English Language Arts Reading Test," 2014)

- **Select Objects/Multi-Select**—In the following example from *Measuring Up Insight*, students must select all possible factors of the number 42. Students must understand the concept of factors and can choose any combination of up to 7 answer choices. However, students must select all correct answers in order to receive full credit. The possibility of successful random guessing is significantly reduced because more than one answer choice can be selected. Furthermore, higher-order cognitive skills of categorization are required.



(Measuring Up Insight®, *DPT for PARCC*, "4.EOY.1 Mathematics Test," 2014)

- **Multi-Select**—The TEI below asks that students consider the theme of the poem, use evidence to support their response, and choose any combination of up to 6 possible answers. As with the Select-Object/Multi-Select example above, students must select both correct answers in order to receive full credit.

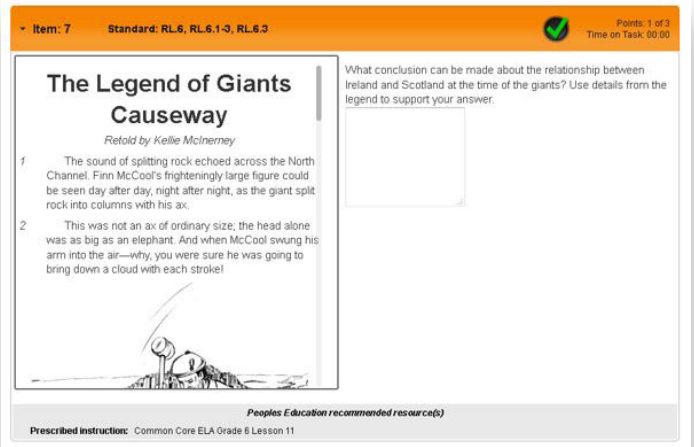


(Measuring Up Insight®, *DPT for SBAC*, "7.EOY.1 English Language Arts Reading Test," 2014)

- **Fill-in-the-Blank**—The TEI below requires that students understand place value, round a number appropriately, and produce a response without any possible answer choices from which to choose. In the case of most fill-in-in-the-blank TEIs, there is little chance of a successful random guess. Students must rely entirely upon their own mathematical skills.

(Measuring Up Insight®, *DPT for SBAC*, "5.NBT.A Mathematics Cluster Test," 2014)

- **Constructed Response**—As with the fill-in-the-blank TEI above, a constructed response requires that students produce their response independently based on their understanding of the story with the use of supporting details. There is little opportunity for a random guess here.



(Measuring Up Insight®, *DPT for SBAC*, "6.RL.1 English Language Arts Domain Test," 2014)

CONCLUSION

20% of all items in *Measuring Up Insight* are now Technology-enhanced in order to simulate the same experience students will have when taking a PARCC or Smarter Balanced assessment. *Measuring Up Insight* helps foster familiarity with the item types that students need in order to perform well on these assessments. Furthermore, with the increased use of TEIs, students will encounter more interactive questions that are engaging and that assess their skills and knowledge more accurately. Students will be challenged to demonstrate higher-order cognitive skills, and at the same time their working memories will not be as taxed by text-heavy question items. Finally, TEIs enable educators to take away more detailed information from the data on these assessments about our students in order to inform future instruction.

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