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Technology- Enhanced Items in Assessment

Chandler Gifford
A Pass Educational Group

APass Educational Group, LLC

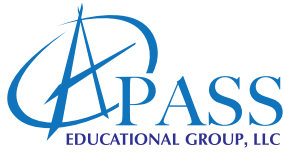
32985 Hamilton Court, Suite 135 • Farmington Hills, Michigan 48334
248.742.5124 • www.apasseducation.com



The demand for new technologies in assessments continues to grow throughout the United States and across the globe. Educators and content developers are intrigued by the possibilities technology presents for creating engaging and effective environments and interfaces designed to assess students’ knowledge and skills. Innovations and ongoing research in assessment technology give educators increasing flexibility in the ways they can present information and assess a student’s interaction with that information. Technology-enhanced items, or TEIs, represent a relatively new branch of assessment items that broadly refers to any kind of computer-based item or test question that incorporates technology beyond simple option selection as the student’s method of response. Technology-enhanced assessment items include interactive matching activities and classification activities in which students drag and drop “tiles” into the appropriate area within a table. Other examples include items in which the student highlights or clicks on certain text in a passage to respond to a question, items that make use of dropdown menus, and items with embedded video or audio content as the stimuli for the items.

Technology-enhanced items have received plenty of attention recently, in no small part due to the emergence of the assessment consortia, Smarter Balanced Assessment Consortium and Partnership for Assessment of Readiness for College and Careers (PARCC, 2013). These consortia both aim to establish highly effective and comprehensive computer-based assessment systems aligned to the Common Core State Standards (PARCC, 2013). These two groups, each made up of several member states, have been endorsed and funded by the U.S. Department of Education as part of the federal Race to the Top assessment grant program. To help prepare students for these computer-based assessments, teachers need access to digital learning content and assessments that include the same kinds of technology used in the assessment items developed by Smarter Balanced and PARCC. As a result, many educational publishers are working to create technology-enhanced items for use in both formative and summative assessments.

So, just as many teachers across the country continue to adapt to the Common Core State Standards and to the technological advances driven by the assessment



consortia, educational publishers continue to grapple with the changing needs of the American educational system. The educational system's current focus and emphasis on assessment means educators at all levels and in every field are faced with the challenge of finding effective ways to test and measure their students' learning and critical thinking skills. Those of us involved in the development of educational content are working to ensure the effective implementation of the ongoing shifts that are necessary to meet the needs of the student population in the 21st century. An important part of this effort involves technology-enhanced items.

This paper briefly explores the benefits of technology-enhanced items, discusses some possible drawbacks of these items, and takes a look at what is necessary for the development of effective TEIs.

Benefits of TEIs

TEIs are attractive for a number of reasons. Research suggests that TEIs are more likely than traditional multiple-choice items to motivate students in assessment scenarios (Barton & Schultz, 2012). Understanding the deep integration of technology in the daily lives of many American students, educators and content developers strive to appeal to the sensibilities of students growing up in the Information Age. Young people today interact with many kinds of content through a number of devices and technologies. Technology-enhanced items allow for the creation of assessment environments that can resemble real-world scenarios in which students might interact with information using technology. This quality makes TEIs inherently more authentic and engaging for students.

Another significant benefit of this kind of assessment item is that the interactive elements of TEIs often provide opportunities for educators to get more information about how students are thinking through a problem or formulating a response to a

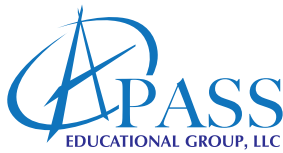
prompt. TEIs are designed to “better measure students' critical-thinking and problem-solving skills and their ability to communicate clearly” than traditional testing and assessment tools. (PARCC, 2013).

TEIs also have the advantage of being computer-scorable, which makes the process of gathering scoring data for these kinds of items simple and efficient. Furthermore, the technology used for many TEIs has great potential for assessment because it enables teachers to capture student responses at different stages of interaction with the items.

Interactivity and Authenticity

The incorporation of technology into educational materials, including assessment items, has proven in studies to be more engaging for students than traditional curricula and testing materials (Strain-Seymour, Way, & Dolan, 2009; Dolan, Goodman, Strain-Seymour, Adams, & Sethuraman, 2011). The ever-expanding range of interactive features available with TEIs are by nature more likely to get someone interested than an old-fashioned pencil-and-paper test consisting of multiple choice items and short essay responses. It is human nature to want to touch and interact with our environment. Especially for students today, many of whom frequently use touchscreen smartphones, tablets, and computers in their daily lives, the use of technological enhancements for assessment items has a substantial and important appeal. A number of educational researchers have also found that this increased level of student engagement usually has a positive effect on the motivation of the student to successfully complete the task at hand (Coley, Cradler, & Engel, 1997).

Another significant advantage of TEIs is that they often provide opportunities for educational content developers to create more authentic learning contexts within the assessments. The variety of technological enhancements available gives developers a range



of realistic scenarios as options with which to work. Many students will be familiar with the interactive features used in these items from prior experience using computer software and the internet. For example, drop-down menus are common features of websites, and highlighting text is a useful skill for word processing applications. Students can easily relate to situations in which those kinds of interfaces would be used. This true-to-life “feel” of TEIs improves the authenticity of the assessment items and opens the door to a wider landscape of possibilities for assessments and other educational materials.

Improved Measurement of High-Level Comprehension

The use of technology in educational materials has been shown to have a positive impact on high-level thinking and problem-solving ability. Unlike selected response (SR) items, which have traditionally been the most widely used kind of assessment item, technology-enhanced items allow students to engage more directly with the concepts on which they are being assessed. The interactive elements of TEIs not only increase student engagement, they also help students develop and use advanced thinking skills. “Research and evaluation shows that technology tools for constructing artifacts and electronic information and communication resources support the development of higher-order thinking skills” (Cradler, McNabb, Freeman, & Burchett 2002). This idea of “constructing artifacts” is key. TEIs often require students to formulate their responses, which is more challenging than choosing from a list of options. Like constructed response items, TEIs require students to produce information and not simply to select information as a response to a question (Bennett, 1999; Gorin, 2006; Huff & Sireci, 2001; Jodoin, 2003; Sireci & Zenisky, 2006; Zenisky & Sireci, 2002). These qualities of TEIs give teachers a clearer picture of their students’ high-level comprehension and their ability to correctly respond to rigorous questions and other assessment activities than do traditional test items.

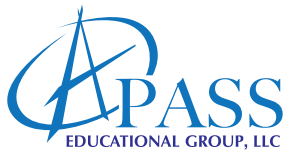
Another positive effect of TEIs with regard to the assessment of high-level thinking skills is that they can improve students’ attitudes about themselves and their feelings of independence. “By encouraging experimentation and exploration of new frontiers of knowledge on their own through the use of technology, students gain a greater sense of responsibility for their work — producing higher-quality assignments that reflect the increased depth and breadth of their knowledge and talent” (Coley, Cradler, & Engel, 1997).

TEIs Are Computer Scorable

Technology-enhanced items offer a number of advantages over multiple choice questions. However, part of the beauty of TEIs is that, like traditional selected response items, they still support automated scoring. Being technology-based, these items are fully integrated with the computer systems used to deliver the assessment content. As such, they lend themselves to convenient automated scoring processes.

Publishers and educational developers are working toward more sophisticated scoring methodologies wherein measurements are assigned to the different actions the student takes when working with technology-enhanced content. This way the computer systems can automatically record the student’s interactions with different steps of a TEI and generate scoring data based on these interactions. As Barton and Schultz point out:

Even with static and less interactive items, multiple data points can be captured, such as response time, response changes, tool usage, search logs, item navigations and items skipped. For more interactive items, various item-specific interaction data, such as frequency of drags and drops, size or length of text selected for dragging into more open response areas, number of variations



for grouping or sequencing, and extent of graphing response variations can be made available for additional analyses. (2012)

The availability of these kinds of measurement tools means TEIs can help educators better understand student thinking and problem-solving abilities by painting a clearer picture of how their students formulate and reason through their responses.

How TEIs Compare to Traditional Assessment Item Types

Traditional assessments have consisted of selected response (or multiple choice) questions and short essays, also known as constructed response items. Selected response and constructed response items each have their advantages and disadvantages for assessment. Selected response items are desirable because they can be automatically scored by computers, but they provide limited assessment of high-level thinking skills. Constructed response items allow teachers to evaluate student's high-level comprehension and their ability to express ideas, but they have to be read and scored by a human being. One driving factor for the development of technology-enhanced items is the demand for assessment items that strike a balance between these two traditional types of test questions. TEIs may not be the perfect solution to the problems presented by multiple choice and short essay questions, but they already represent major progress in education and assessment, and they hold the promise of greater things to come.

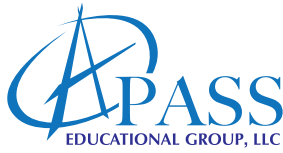
Advantages over Selected Response Items

Multiple choice questions come with the benefit of being easily scored using automated computer processes. However, basic selected response items come with a number of limitations. Many educators and researchers agree that simply selecting a response from a list of options is less challenging than responding by writing an answer or by performing

an interactive task, and also less likely to provide useful measurement of comprehension (Archbald & Newmann, 1988). TEIs give assessment developers the ability to use a wide variety of item constructs to test students' knowledge and skills in ways that multiple choice items simply cannot achieve. For example, an item that presents students with several paragraphs of text and asks them to highlight the content that supports a certain idea or conclusion is much more challenging than an item that provides four phrases or sentences from this same set of paragraphs and asks students to choose between those four options.

A second important shortcoming of selected response items is that they are conducive to student guessing. A student who is reluctant to engage with a test question or to make a genuine attempt at determining the correct answer is likely to guess when presented with several options. Technology-enhanced items reduce the effect of this random guessing (Huff & Sireci, 2001). They do so by requiring students to interact with the content of the items in order to respond.

Another factor that can skew the results of multiple-choice based assessments is that some students have better test-taking skills than others, even if their content knowledge and critical thinking ability is similar. Certainly, test-taking skills are important, but if the goal of the assessment is to determine whether the students have specific skills in language arts or mathematics (i.e., those outlined by the Common Core State Standards), assessment developers should aim to avoid any external influences upon the measurement of those skills. Of course, TEIs require their own set of specialized skills related to test-taking, but they also expand the range of alternatives for approaches to assessment. This allows for improved diversity of test questions, thereby increasing the rigor and variety of assessment scenarios.



Advantages over Constructed Response Items

Constructed response (CR) items, which ask students to write short responses to prompts, provide a more effective way to assess the students' ability to express their ideas and interpretations of texts than do traditional selected response items. CR items require students to produce a written response. By nature, writing a short essay is more demanding than choosing from several possible responses. Putting together a short essay requires students to demonstrate a number of skills. As a result, including CR items in an assessment is an effective way of counter the shortcomings of multiple choice questions. The main disadvantage of constructed response items is that they have to be "hand-scored." That is, a human being must read the response and assess the student's work (often using a rubric that accompanies the item). Scoring CR items can be time-consuming and expensive, as opposed to the relatively quick and inexpensive systems of automated scoring used for selected response items. Like SR items, TEIs can be scored by computer systems, but they are also similar to constructed responses in that they provide opportunities for more rigorous assessment than multiple choice questions. "CR items have always reduced the impact of test-taking skills and guessing, but TE items allow these benefits to be leveraged on items administered via computer and automatically scored" (Measured Progress/ETS Collaborative, 2012).

Limitations of Technology-Enhanced Items

TEIs have a number of significant benefits, and there is no shortage of potential for the increased utility of these items. As with other kinds of assessment items, however, there are drawbacks associated with TEIs that must be taken into consideration.

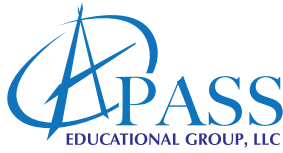
For some students, TEIs will present new obstacles in testing situations. Many schools do not have extensive technological resources to offer their stu-

dents, and many students do not have access to smartphones or computers at home. As discussed previously, TEIs can provide opportunities for interaction with technology, and in this way they are beneficial to students. However, students with less experience or "computer savvy" are likely to face some barriers that might prevent them from being able to grasp and respond to the given tasks. On the other hand, TEIs can be instructive by simulating real-world kinds of computer-related tasks for students who may not have had as many opportunities to interact with technology as others.

Another challenge presented by technology-enhanced items is the costs that can arise with their development. "Unfortunately, TEIs have been expensive to develop and score. They have commonly been "one-off" productions requiring custom programming, and thus were created only for large-scale assessment, where the high stakes justified the expense." (Measured Progress, 2014). Then again, as mentioned earlier, TEIs are still often less expensive and time-consuming to score than constructed response items.

The Key to Effective Technology-Enhanced Items

It is clear that technology offers many profound benefits for the development of assessments and other educational materials. However, many of these are only potential benefits unless those who create the materials take great care to ensure the lessons and tests they produce reflect best instructional practices. The Common Core State Standards put a premium on the use of evidence as the basis for instruction and assessment. Likewise, effective TEIs must have a foundation in valid evidence. Only well-constructed, evidence-based TEIs will truly be of use to help teachers determine whether their students can make connections between ideas or solve a series of problems.



The expanding range of interesting and engaging options for assessment items through the use of technology brings exciting possibilities, but with this growth comes the danger of getting swept up by the current and losing sight of what is most important for the effective assessment of the students' skills and knowledge. "Items should be designed and documented with the most valid and innovative thinking in mind, regardless of feature availability" (Barton & Schultz, 2012). In other words, the people creating technology-enhanced items cannot approach TEIs any differently than they would any other kind of assessment item. TEIs must be held to the same high standards for rigor, alignment, and quality of content as other kinds of educational materials. As publishers and educational developers create TEIs, they may find themselves trying to force an idea or certain kinds of content to work within certain technology-enhanced frameworks. If there is not a good fit between the content of the item and the technology-enhancements, though, these items are likely to be of dubious quality. As suggested by Scalise and Gifford (no relation to the present author), it is crucial that developers avoid becoming so taken by the attractiveness of the technological features and interactive elements of these items that they inadvertently shift the focus of the assessments away from the content or evidence (2006). In other words, it is essential to avoid letting technology drive assessment item development. "If the technology is considered first and in terms of what technology is available, the assessment can become severely limited by the kinds of evidence and how much evidence can be captured. If that is the case, the technology is not really an enhancement and the validity of the evidence is diminished" (Barton & Schultz, 2012).

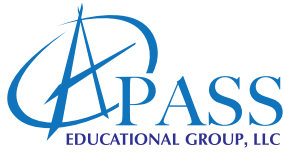
So, while there are many specific components (depending on the format of the TEI) and a number of considerations that go into creating an effective technology-enhanced assessment item, research has suggested that what makes a TEI truly effective

is the combination of engaging interactive features and well-crafted, pedagogically sound textual content that challenges students to clearly demonstrate that they understand the importance of supporting their responses with evidence and that they have acquired the knowledge and skills described by the Common Core State Standards.

The Impact of Technology-Enhanced Items

Although TEIs are not perfect by any stretch, they are already changing the landscape of education and assessment. The computer-based testing developed by Smarter Balanced and PARCC is designed to more accurately assess the high-level thinking skills specified by the Common Core State Standards. Technology-enhanced items are a natural and integral part of these assessments. TEIs give test-makers many more options than have been traditionally available for developing assessment items. And while multiple choice and short essay questions will likely remain fixtures in assessments for the foreseeable future, by adding technology-enhanced items to the mix of item types, educational publishers and content developers can mitigate the undesirable traits of both selected response and constructed response assessment items.

During this era of rapid technological innovation, the list of types and variations of TEIs continues to grow by leaps and bounds. The technological enhancements featured in these items provide vastly more engaging ways for students to interact with content. They also provide new, potent tools with which teachers can measure their students' learning. It stands to reason that the quality and effectiveness of TEIs will improve over time, along with advancements in computer programming. As long as technology does not drive the development of assessment items, TEIs can be highly effective for assessing student knowledge and learning. Educational publishers and content developers must



strive to create technology-enhanced assessment items that are engaging and interactive, but they must also ensure that these items have all the attributes of well-crafted test questions and a clear and valid alignment to the skills and standards they are designed to assess.

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