Measuring Technology and Engineering Literacy (TEL) on the Nation's Report Card

William Ward
National Center for Education Statistics

Abstract

In the spring of 2016, the National Assessment of Educational Progress (NAEP) (also known as The Nation's Report Card) released results of the first Technology and Engineering Literacy (TEL) assessment, which was administered to a national sample of grade eight students in 2014. In this session, the TEL content specialist from the National Center for Education Statistics (NCES) will share: 1) the key elements of the framework, and how the framework was developed; 2) how the 8th-grade assessment was developed and delivered, including sample items; and 3) the results of the 2014 assessment at grade eight, including scale scores, achievement levels, and comparison of student groups.

Keywords

NAEP, Nation's Report Card, Technology and Engineering Literacy

Session Papers Summary

In 2014, about 21,500 eighth-grade students across the nation were administered the Technology and Engineering Literacy (TEL) assessment. TEL is completely computer-based and presents interactive real-world scenario-based tasks involving technology and engineering challenges. Students were asked to respond to questions aimed at assessing their knowledge and skill in understanding technological principles, solving technology and engineering-related problems, and using technology to communicate and collaborate. Students were also surveyed on their opportunities to learn about technology and engineering in and out of school.

Through the TEL assessment the National Assessment of Educational Progress (NAEP) is pioneering at least three areas of innovation: (1) what TEL measures; (2) how NAEP assesses TEL content; and (3) what NAEP can report about TEL. TEL addresses content never before measured by a large-scale national testing program, assesses students using scenario-based tasks, and innovatively reports the results. This session will introduce these three areas of innovation underway in NAEP, relating to what NAEP measures, how NAEP assesses, and what NAEP can report.

What TEL Measures

Since Science, Technology, Engineering, and Mathematics (STEM) learning have become more salient in national education policy conversations, TEL is a landmark in the study of STEM

achievement by providing data about how America's students use and evaluate principles of technology and engineering to solve authentic, real-world problems with a broad definition of technology, as anything humans make to address needs and desires. Prior to 2014, assessments have focused only on mathematics or science, the well-publicized M and S in STEM. As a content area, the TEL assessment addresses this gap by measuring students' knowledge and skills in the T and E through items on technology and society, design and systems, and information and communication technology, with cross-cutting practices and within a variety of everyday contexts. Helping America take full advantage of technology's benefits in all areas of our society NAEP added TEL to its portfolio of assessments to respond to the growing importance of technology and engineering in the educational landscape. The first paper will present the TEL assessment framework which broadly defines technological and engineering literacy as: "the capacity to use, understand, and evaluate technology as well as to understand technological principles and strategies needed to develop solutions and achieve goals." TEL measures three interconnected areas of technology and engineering literacy content: (1) technology and society; (2) design and systems, that is, the nature of technology and principles for approaching technological problems; and (3) information and communication technology. Students also were asked to demonstrate three kinds of practices: (1) understanding technological principles; (2) developing solutions and achieving goals, referring to students' systematic use of technological knowledge, tools, and skills to solve problems in realistic contexts; and (3) communicating and collaborating.

How NAEP Assesses TEL Content

In the TEL assessment, eighth-grade students were tested using computer simulations of technology and engineering problem-solving tasks (also called scenario-based tasks or SBTs) set in a variety of real-world contexts to solve problems across its three content areas. Some tasks measured student performance in one content area and practice while other tasks measured more than one content area or practice. The assessment included long SBTs (about 30 minutes) and short SBTs (about 10 to 20 minutes). These SBTs were designed to be accessible to all students so they could progress through each task to completion and demonstrate their TEL knowledge and skills.

Following the overview of how NAEP TEL fits in the larger context of student assessment, the second paper will engage the audience in a demonstration and discussion about two SBTs and how NAEP measured the TEL content. After explaining the nature and scope of the NAEP TEL assessment, this paper then presents a subset of specific content objectives covered in the TEL assessment. The session will conclude with a demonstration of how these objectives are reflected in sample tasks from the TEL field test and operational assessment. In the digital-based and interactive NAEP TEL assessment, scenario-based tasks can engage students with questions like: To what extent can young people analyze the pros and cons of a proposal to develop a new source of energy? Construct and test a model or prototype? Use the Internet to find and summarize data and information in order to solve a problem or achieve a goal? Though this paper's focus is on TEL, the lessons which may be drawn and applied from this paper stretch broadly to encompass assessment generally. TEL was administered only via computer, an approach to which the other NAEP assessments are transitioning, a landmark in NAEP history.

Beyond its computer-based administration, TEL comprises sets of questions involving discrete items as well as long and short scenarios. The innovative interactive scenario-based tasks ask students to perform a variety of actions using a diverse set of tools to solve problems and meet goals. The scenarios depict realistic situations and feature video, audio, and interactive simulations to prompt either multiple choice or constructed response answers. For example, one already-released TEL task asks students to play the role of an engineer who is brought to a remote village to determine why the local water well has stopped working. The NAEP Science assessment has included similar items since 2009, and on TEL, the marriage of content to item construction results in exciting new paths forward in assessment development. Not only should such a complex and realistic situation challenge the problem-solving skills of students but the interactive nature of the tasks should also immerse the students in the problem and deeply engage them with the assessment. These scenario-based tasks do not represent the typical problem set students encounter during school or on traditional tests, but instead stretch the capacity of students to apply their knowledge and skills. The tasks also help assessment specialists by monitoring and collecting data about student actions as the students interact with the tasks.

What NAEP Can Report About TEL

The results of the 2014 TEL assessment at grade eight, including scale scores, achievement levels, and comparison of student groups were released as a Nation's Report Card in May, 2016. The third paper in this session will present TEL results with an emphasis on the survey questionnaires and student response patterns allowing for NCES and others to better understand student achievement, taking full advantage of NAEP's new digital platforms. This paper will highlight reporting features for NAEP Report Cards, based on these important data sources. For example, a TEL reporting feature is to better summarize student and school contextual information. The NAEP survey questionnaires administered with each assessment now include clusters of questions, which will help NAEP aggregate responses across multiple questions into an index. Different topics will have different reportable indices. The relative unfamiliarity of TEL raises the importance of understanding the in-school and out-of-school learning opportunities for these skills and knowledge. The questionnaires include items on demographics as well as TEL-specific questions about student experiences with technology, e.g., whether they studied technology or engineering topics in school and in what technology and engineering-related activities they participate inside and outside of school. The contextual variables captured by TEL also include questions on students' interest in various technologies, their values about—and enjoyment of—technology, and who taught them what they know about engineering and technology. Principal questionnaires inquire about what opportunities exist through the school to support the building of such knowledge and skills.

The session will end with an opportunity for audience questions and discussion.

Conclusion

This innovative NAEP assessment emerged after years of thoughtful, careful work in creating the assessment framework, guided by technology and engineering experts, classroom teachers,

researchers, and business representatives, in designing and developing the test and its subscales, item types, and mode of delivery, and in piloting the items and the test itself. All of this investment pioneered the cutting edge of assessment today and thus provide critical lessons for those interested in assessment development and those interested in pushing America's students to leverage their native understanding of technology and engineering to a more engaged and thoughtful level.

An open exploration of the TEL assessment data provides rich, never-before-seen insights into how America's students apply technology and engineering skills to real-life situations. Moreover, NAEP's innovations in digital-based assessment and reporting will help us learn as much as possible from the TEL results, as well as the results of other NAEP assessments in the coming years.

William Ward

William Ward is a statistician at the U.S. Department of Education's National Center for Education Statistics (NCES). At NCES he is the project leader for National Assessment of Educational Progress (NAEP) Sampling and Data Collection and the Technology and Engineering Literacy assessment. Prior work experience includes developing teacher certification tests and program evaluation for the Corporation for National and Community Service. He holds a Ph.D. in Experimental Psychology from the University of Tennessee and a B.A. in Psychology from Southern Methodist University.

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