Guidelines for the Evaluation of Instructional Materials in Science

Executive Summary

BSCS

Colorado Springs, CO

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Background

Following the release of *A Framework for K-12 Science Education* (National Research Council, 2012) and anticipating the release of the *Next Generation Science Standards* (NGSS; NGSS Lead States, 2013), the National Research Council [NRC] released a report entitled *Monitoring Progress Toward Successful K-12 STEM Education* (NRC, 2013). This *Monitoring Progress* report contained recommendations to the National Science Foundation on how to evaluate the status of science, technology, engineering, and math (STEM) education in the US. The report recommended 14 indicators that could be used to drive and track improvement in STEM education across the nation.

Recognizing the need to assess the status of STEM education, the National Science Foundation invited proposals for research projects focused on the indicators recommended by the *Monitoring Progress* report. This report is a product of one of the resulting projects. In this project, BSCS set out to address Indicator 4 from *Monitoring Progress*, which called for analyzing the degree to which the most widely used science and mathematics materials in US schools promote the vision of education described in the Common Core standards for math and the *NRC Framework* (NRC, 2013, p. 19). We interpreted the task of analyzing instructional materials as consisting of two components: (1) assessing the degree of alignment of instructional materials with the vision and goals of the *NRC Framework* and NGSS and (2) assessing the likelihood of the materials supporting teachers and students in bringing the vision and goals to life.

In approaching this task, we built on considerable work done over the last two decades on defining and measuring the quality of instructional materials (e.g., BSCS, 2007; Davis & Krajcik, 2005; Duschl, Schweingruber, & Shouse, 2007; Edelson, 2001; Kesidou & Roseman, 2002; Roseman, Stern, & Koppal, 2010). However, the vision of science teaching and learning presented by the *NRC Framework* and the NGSS has new elements that have not been part of previous assessments of instructional materials, for example, the explicit inclusion of science and engineering practices (SEPs), crosscutting concepts (CCCs), and disciplinary core ideas (DCIs). Therefore, an important part of the work on this project has been to identify and explain these new components to support assessment of them in instructional materials.

Overall, the *Guidelines for Evaluating Science Instructional Materials (*hereafter*,* the *Guidelines)* provide answers to the following questions:

- What criteria should be used to evaluate the extent to which instructional materials that support the vision of science education described in the *NRC Framework* and NGSS?
- What tools and processes should be used to evaluate instructional materials based on these criteria?

About the *Guidelines*

To conduct the review of instructional materials called for by the *Monitoring Progress* report will ultimately require the development of a fully specified set of tools and processes for evaluating instructional materials. Developing this complete set of tools and processes was beyond the scope of this project. The project's objective was to create guidelines for creating those tools and processes. Specifically, the *Guidelines* identify criteria for use in evaluating instructional materials as well as characteristics of tools and processes for applying those criteria. These guidelines are designed to provide a blueprint for the work of creating tools and a process that can be used to conduct valid and reliable assessments of instructional materials.

Having developed these guidelines for the goal of evaluating the most widely used materials across the country as recommended by the NRC *Monitoring Progress* report, we are also mindful of the fact that there are many other reasons that people conduct reviews and evaluations of instructional materials—such as textbook adoption decisions, teacher professional development, and revisions to materials to enhance their quality and alignment with the NGSS. We anticipate that these guidelines will have some value for the design of tools and processes for these purposes, as well.

The *Guidelines* report was developed over two years through a process that involved 10 BSCS researchers and 18 leaders in science education from across the country. The team brought to the project expertise in (1) the *NRC Framework* and the NGSS, (2) the development and use of tools and processes to evaluate the quality of science instructional materials, (3) curriculum development, and (4) policy making. The multistage development process included a synthesis of relevant literature; a convening of science education leaders to set the basic parameters for the *Guidelines*; the drafting of the evaluative criteria and guidelines for tools and processes; and multiple rounds of review, feedback, and revision.

The evaluative criteria for materials are summarized in Table 1. They include criteria for evaluating both student and teacher materials across four categories: learning goals, coherence, learning experiences, and monitoring learning. The guidelines for tools and processes are summarized in Table 2.

Table 1. Criteria for evaluation of instructional materials in science.

When evaluating student materials, consider the extent to which …	*When evaluating teacher materials, consider the extent to which …*
NGSS-Driven Learning Goals	
1S Materials are based on learning goals. Those goals call for learning of • disciplinary core ideas, science and engineering practices, crosscutting concepts from NGSS integrated as three-dimensional learning; • the nature of science, engineering, technology, and applications of science from NGSS; and • Common Core State Standards for English language arts and mathematics.	1T Materials explain the learning goals; the rationale for selecting them; and • how they promote three-dimensional learning; • how they promote learning of the nature of science, engineering, technology, and applications of science; and • how they promote learning of the Common Core standards for English language arts and mathematics.
2S Materials use phenomena or problems to focus students on learning goals.	2T Materials explain how the phenomena or problems are used to focus students on learning goals.
3S Materials are based on scientifically accurate and grade-level-appropriate learning goals.	3T Materials situate learning goals within the progression of K-12 learning laid out by the NGSS.
Coherence Across Three Dimensions	
4S Materials are designed with carefully sequenced learning goals and well-matched experiences.	4T Materials communicate the design principles and sequencing underpinning the storyline.
5S Materials provide students with opportunities to make links across the three dimensions to build coherent conceptual understanding and abilities to use the practices.	5T Materials promote teacher knowledge-building related to the storyline.
Learning Experiences Across Three Dimensions	
6S Materials provide multiple opportunities for students to share and negotiate their ideas, prior knowledge, and experiences.	6T Materials support teachers in anticipating common student ideas and include guidance to elicit and challenge student thinking.
7S Materials use motivating contexts to engage students in real-world phenomena and authentic design problems.	7T Materials provide guidance to teachers for using effective teaching strategies that engage students in real-world phenomena and authentic design problems.
8S Materials are accessible to a wide range of students.	8T Materials provide suggestions for how to address a range of students' skills, needs, and interests.
Monitoring Learning Across Three Dimensions	
9S Materials include accessible and unbiased formative and summative assessments of students' three-dimensional learning.	9T Materials highlight formative and summative assessments and provide tools and guidance for interpreting evidence of three-dimensional learning and using assessment results to plan for future instruction.
10S Materials include multiple opportunities for self-assessment and reflection to promote sensemaking among students.	10T Materials provide guidance for teachers to use data from assessments to provide feedback to students and promote student self-assessment and reflection.

Table 2. Guidelines for Assessing the Quality of Instructional Materials

The evaluation system
1. includes both tools and processes.
2. includes a guide for evaluators.
3. specifies a summary report that justifies the evaluation results and offers suggestions for modifying instructional materials to enhance their quality.

The evaluation system should be supported by **Tools** that	The evaluation system should include **Processes** that
4. specify what to look for as evidence for each Evaluative Criterion.	7. identify appropriate units of analysis.
5. have clearly defined scoring guidelines for capturing evidence from materials.	8. involve dialogue and consensus-building among a team of evaluators.
6. include forms for documenting specific evidence of the Evaluative Criteria and suggestions for improvement.	9. assure consistency across evaluators.