Instructional Assessments: Lever for Systemic Change in Science Education Classrooms

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The Educational Testing Service/University of Delaware Science Education project has addressed the challenge of promoting systemic change in science education through the use of instructional assessments. Instructional assessments integrate performance-based assessments with curriculum and instruction at the classroom level. Instructional assessment provides a promising lever for promoting professional development and improving middle school science curriculum, instruction, and assessment.

Key words: Assessment; instructional assessment; science; science curriculum.

By the year 2000, U. S. students will be first in the world in science...achievement. —America 2000, p. 63

SYSTEMIC CHANGE: "I KNOW AN OLD WOMAN WHO SWALLOWED A FLY . . ."

A children's song begins,

I know an old woman who swallowed a fly.  
I don't know why she swallowed a fly.  
Perhaps she'll die.  
I know an old woman who swallowed a spider  
that wriggled and wiggled and tickled inside her.  
She swallowed the spider to catch the fly,  
but I don't know why she swallowed the fly.

The subsequent verses expand on this food chain as the woman, to the singer's delight, ingests larger and larger and more and more preposterous animals to help her solve her problem.

The United States has great needs and lofty goals for citizens of all ages to be more literate in science and technology. A central challenge to achieving these goals is to improve the science education that takes place in the schools, but many historians of science education and current advocates of reform agree that improving American science education embodies a systemic challenge approaching proportions like those faced by the troubled but energetic woman in the song. Working on one part inevitably raises a need to work on another part in an interconnected educational system. Science education well illustrates this point: to meet the governors' and president's resolution that American children will be number one in the world in science, the science curriculum must be refocused to connect education with the real world. However, to implement such curricula, teachers must be trained both in increased subject matter understanding and new pedagogical approaches. Instructional practices must be radically transformed from the "teach by mentioning" and "read about science; don't do science" approaches predominant today. Teacher preservice institutions must rethink the relation between "education" and the science discipline areas. Teacher in-service must reach millions of teachers with more than a half-day workshop in science per year. Teachers must work with parents to foster sustained interest in science among students in greater numbers.

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and greater diversity, and, to support competent science teachers and students to practice in the schools, assessments, expectations, funding, and organizational structures must be revised.

As studies concur that piecemeal solutions have constrained impact and little staying power, the need for systemic reform is rapidly becoming accepted: curricular revision must include attention to teacher training or be doomed from the beginning; organizational restructuring of schools must be accompanied by provision for adequate resources; changes in assessment must support desired changes in practice (NSF, 1990). A key task is to identify where to start in the system: Where can we focus our efforts that will lead to systemic improvements, where efforts in one area will support and magnify contributions in other areas?

ASSESSMENT AND SCIENCE EDUCATION

Assessment may provide a strategic leverage point for systemic reform, many people in education, research, politics, and business agree. In the press to improve the American educational system, assessment has been cast in the role of “driving instruction and curriculum” increasingly frequently (cf. Department of Education, 1991; Resnick, 1991; Shepard, 1991; Frederiksen and Collins, 1989). It has been true for science education reform as well. In the past decade, dozens of reports by various commissions and boards have called for reform of science education (e.g., AAAS, 1989). Many of these reports have noted that improved assessment will play a crucial role in supporting the needed changes. However, in most of these discussions, assessment appears as a precursor or adjunct to classroom learning. Rather than being assigned an active, ongoing role, assessment is relegated to providing a statement of goals, motivation, or general information for accountability rewards and sanctions.

Although there is wide agreement that assessment is a necessary component of systemic reform in science education, there is less agreement about what form assessment should have and what role it should play. Much debate and action have revolved around reforming assessment instruments. The current debate over multiple-choice response formats and “authentic assessments” is perhaps the most evident and intense part of this focus on instruments (e.g., Archbald and Newmann, 1988). However, the question of the role for assessment, especially in relation to other parts of the educational system, precedes the technical questions of format (e.g., multiple choice versus non-multiple choice), medium (e.g., pencil-and-paper versus performance), and administration mode (e.g., standardized versus work sample). The more essential issues have to do with what purposes the different types of assessment are being used to achieve, how the assessment is related to the other components of the educational system, and how the information is used to improve learning and teaching.

Perhaps because of the focus on national and state-level reform, there has been less discussion of how assessment might be incorporated by teachers and students in the classroom to enhance learning. Discussion of the role of assessment in supporting educational change must be extended to envision teachers and learners more actively assessing and improving their own goals and performances. A challenge for educational reformers is to envision classrooms that are self-improving systems and to conceive of classroom-based assessments that are powerful in the hands of learners and teachers, coherent in relation to the best of curriculum and instruction, and practical in the contexts of classrooms today.

Promoting Systemic Change in the Classroom through Instructional Assessment

For the past several years we have focused on instructional assessment as a leverage point for promoting systemic change at the classroom level. Instructional assessment can powerfully improve science education by providing mechanisms that make a system more adaptive, self-monitoring, and self-improving: Instructional assessments help provide useful information to teachers and students, engage teachers and learners in active assessment to improve classroom teaching and learning, motivate purposeful learning, and adapt instruction to the progress of learners. Instructional assessments can merge performance assessments into the on-going instructional decisions of the classroom.

Our underlying model of assessment holds that assessment should be informative and empowering: it should inform intelligent action, and the information should support those educational agents who need to act and make decisions, notably teachers and students. At the same time, instructional assess-