Chapter 17
Technology–Assisted Formative Assessment

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ABSTRACT

Reliable just-in-time assessments are the foundation of informed teaching and learning. Modern electronic technologies assist in the formative assessment process by supporting classroom environments that allow students and teachers to assess learning and providing mechanisms to present information about student learning during instructional sequences. To implement formative assessment practices, students and teachers benefit from rich educational tasks that invite students to share information about their understanding of the lesson while the lesson is occurring in order to nurture productive learning by both teacher and student. Formative feedback is facilitated by technologies such as connected classrooms, videography, online formative quizzes, and manuscript multi-draft editing. Technology-assisted formative assessment represents a powerful option to promote improved classroom communications that support formative assessment practices for teachers in twenty-first century classrooms.

INTRODUCTION

Reliable just-in-time assessments are the foundation of informed teaching and learning. With the focus on high-stakes testing and accountability, teachers are challenged to balance assessment *for* learning with assessment *of* learning (Black, Harrison, Lee, Marshall, & Wiliam, 2003). In recent years, resource allocation and policy attention have been driven primarily by summative assessments intended to measure student learning and used subsequently to rank teachers, schools, and districts. The desire to improve student achievement, especially in science, is driven largely by the performance of US students on international assessments such as the Trends in International Mathematics and Science Study (Martin, Mullis, Foy, & Stanco, 2012).

Some have argued that summative high-stakes tests can be used for program improvement and thus represent an example of formative assessment. For the purposes of this article, formative assessment will be defined as "a planned process in which assessment-elicited evidence of students' status is used

by teachers to adjust their ongoing instructional [practices] or by students to adjust their current learning tactics" (Popham, 2008, p. 6). Formative assessment defined in terms of student and teacher action is classroom based and does not include program adjustments that might result from analysis of high-stakes tests. Four unique elements of formative assessment include (a) task selection and implementation, (b) questioning to probe student understanding, (c) teacher/student awareness of student progress, and (d) follow-up feedback informed by teacher/student knowledge of student learning (Shirley & Irving, 2014).

The first step of the formative assessment process involves the selection of rich instructional tasks (Torrance & Pryor, 1998) that provide opportunities for high levels of student engagement and productive classroom discourse (Bell & Cowie, 2001; Cowie & Bell, 1999 Ruiz-Primo & Furtak, 2006, 2007; Torrance & Pryor, 1998). Collection of data that measures student learning, aggregation of those data, followed by meaning making from the data lead to knowledge about the state of student understanding during an instructional sequence. Change in teaching and/or learning strategies for either individual students or for the whole class completes the formative assessment cycle (Black & Wiliam, 1998; Cowie & Bell, 1999; Wiliam, 2006). When the teacher commands a sufficient toolbox of instructional strategies to act on this knowledge, or the student acknowledges the need for a change in learning strategy and acts to improve his/her learning success, the subsequent adjustment in strategies completes one iteration of the formative assessment cycle.

This chapter explores technology-assisted formative assessment – the use of electronic resources to support the implementation of formative assessment practices in science classrooms. Two primary aspects of the formative assessment cycle lend themselves particularly well to assistance from modern electronic technologies – (1) task selection and implementation, and (2) formative feedback processes. After a description of formative assessment, the article highlights how electronic technologies support the design and implementation of rich tasks in science classrooms using simulations and online data sets as key examples. Next, the article describes the role of electronic technologies in nurturing communication patterns unique to twenty-first century electronic classrooms. In particular, the role of feedback as a tool in the formative assessment process is examined through video analysis, connected classrooms, editorial feedback on written work, and the use of classroom management systems to provide students feedback before summative assessments. The chapter concludes with recommendations for technology-assisted formative assessment practices and suggestions for future research directions.

BACKGROUND

Formative Assessment

In the traditional *transmission* paradigm of learning, the teacher tells and the students listen. Little opportunity exists in this paradigm for information flow from student to teacher regarding student learning. Teacher-centered activities such as lecturing maximize the presentation of material and have proven efficient in covering large amounts of content, but provide little opportunity for teachers to learn about student thinking or for students to explore their understanding or develop self-regulated learning behaviors (Black, Harrison, Lee, Marshall, & Wiliam, 2003). In the *constructivist* paradigm of learning, students actively engage in the learning process and build understanding based on their prior knowledge. By selecting an instructional task that requires students to analyze, to discuss, to write, to synthesize,

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