Chapter VII

Question Driven Instruction: Teaching Science (Well) with an Audience Response System

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Abstract

Audience response systems (ARS) are a tool, not a magic bullet. How they are used, and how well they are integrated into a coherent pedagogical approach, determines how effective they are. Question Driven Instruction (QDI) is a radical approach in which an ARS-mediated “question cycle” organizes classroom instruction, replacing the “transmit and test” paradigm with an iterative process of question posing, deliberation, commitment to an answer, and discussion. It is an implementation of “real-time formative assessment.” In QDI, an ARS is used to facilitate and direct discussion, to engage students in active knowledge-building, and to support “agile teaching” by providing the instructor with constant feedback about students’ evolving understanding.
and difficulties. Class time is used primarily for interactively developing understanding, rather than for presenting content: in QDI, an instructor is more an engineer of learning experiences than a dispenser of knowledge. This requires new teaching skills, such as moderating discussion and managing the classroom dynamic, interpreting students’ statements and modeling their learning, making real-time teaching decisions, and designing ARS questions that teach rather than test and that target process as well as content. Above all, it requires understanding and communicating that ARS use is diagnostic and instructional, rather than evaluative.

Introduction

Educational use of audience response systems, also known as “classroom response systems,” is exploding in high schools and universities. One vendor claims over a million of their system’s keypads have been used, in all 50 U.S. states and 10 countries worldwide, in thousands of K-12 schools, and hundreds of universities (eInstruction, 2005). Several universities are beginning centralized programs to introduce and coordinate response system use across campus. A fringe technology 10 years ago, ARS are entering the mainstream.

ARS have the potential to radically alter the instructional dynamic of our classrooms, and impact student learning. However, for an instructor to realize this potential requires much more than merely learning to operate the technology. Response systems are a tool, not a solution. Their benefits are not conferred automatically: how they are used matters tremendously. To be fully effective, their use must be integrated into a larger, coherent pedagogic approach.

As part of the UMass Physics Education Research Group (UMPERG), we have worked with response systems for over a decade. In 1993, we began using Classtalk, a groundbreaking “classroom communication system” by Better Education Inc. In 1994, we received a U.S. National Science Foundation grant (DUE-9453881) to deploy, develop pedagogy for, and study the impact of Classtalk (Dufresne, Gerace, Leonard, Mestre, & Wenk, 1996). In 1998, we began Assessing-to-Learn, an NSF-funded project (ESI-9730438) to seed response systems in secondary school physics classrooms and help teachers develop suitable pedagogic skills and perspectives (Beatty, 2000; Feldman & Capobianco, 2003). In 1999, we brought EduCue PRS (since purchased by GTCO CalComp and renamed InterWrite PRS) to UMass, and began its dissemination across campus. As a sequel to Assessing-to-Learn, we are beginning a 5-year NSF-funded project (ESI-0456124) to research secondary school science teachers’ learning of response system pedagogy. Based on 12 years of experience with ARS — teaching, researching, and mentoring — we have developed a comprehensive perspective on the effective use of such systems for the teaching of science at both the secondary school and university levels.

In this chapter, we will introduce that perspective. We will not attempt to describe how response systems work, report our personal experiences using them, or discuss detailed logistical issues. Other chapters in this volume address those topics, and we have
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