SPACE: Online Tools for Supporting Formative Instruction

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Abstract: Modern pedagogies offer considerable promise for supporting improved student learning. Formative assessment can improve teaching and learning by using evidence of student understanding to adapt instruction. However, the current social and technical infrastructure of schooling often makes the teacher workload associated with such practices difficult to scale and sustain. We describe SPACE, an online tool for teachers and students to plan, do, formatively and summatively assess project-based Inquiry.

Introduction

Enabling every student to succeed requires fundamental changes to the longstanding organization of instruction in most schools, both inside and outside of the classroom, from teacher training, to in-service professional development, to the mechanisms through which individual teachers and whole schools are evaluated. In particular, schools must move from delivering identical instruction to classfulls of students to differentiated instruction which responds to the individual backgrounds and ongoing needs of students. Formative instruction, the practice of adapting instruction on a student-by-student basis using data about ongoing learning, has been recognized as a remarkably powerful method for improving outcomes for all students (Black and William, 1998). It is an especially critical pedagogical approach in learning environments where, rather than following homogeneous trajectories of pre-scripted activities, students' learning comes through hands-on participation in scientific or pseudo-scientific investigations of personally meaningful topics (i.e., Inquiry).

Yet, despite overwhelming evidence in favor of inquiry-based learning and formative instruction, American schools have struggled to implement and sustain them. From the perspective of an individual teacher, inquiry-based differentiated instruction usually requires far more effort than more traditional pedagogies; the demands of such reform instruction may be more than any single teacher, working alone, can sustain. Success requires heroic efforts that are rarely scalable and are only seldom sustainable, given the current state of development of the technology of schooling (we construe technology broadly to include both information technologies, but also the other material and social resources and routines that together constitute schooling as a technical system).

Organizationally and materially, the social structure of schools insufficiently supports teachers' classroom work as they lead Inquiry learning. The methods we use to assess students and train and assess teachers (and schools) are mismatched to the kinds of knowledge developed through engagement in Inquiry (Resnick, Lesgold, and Hall, 2005); standardized tests do not test (and their reports do not give credit to) most of these skills. Grade-as-average representations of learning are inappropriate accounts of constructivist activities where students build densely interconnected knowledge over long time-spans, rather than rote learning or sets of discrete skills (Stroup and Wilensky, 1999). Adopting formative instruction (or, recognizing that change in schools is a highly distributed practice, we might say *constructing* formative instruction) necessitates giving students credit not only for the quality of the final products they create, but also for the developmental trajectory that allows them to create them, including the many revisions along the way. The challenge of developing assessments consistent with reform pedagogy is both material and social, as the tools in place and the meanings of those tools, as constructed in practice (e.g., as varying kinds of assessments are differentially legitimated by leaders, policy makers, or parents) must change. Finally, the loosely coupled organizational structure of most schools, where teachers seldom see and rarely critique each others' work, especially across subject areas, does little to prepare teachers for and to lend them ongoing support on learning activities (like Inquiry) that integrate a wide range of disciplinary skills (e.g., the literacy, science, mathematics, and visual arts skills that are used on a science fair project).

The SPACE (for Supporting Projects through Authoring, Critique, and Exemplars) tool, described here, is a computational infrastructure for improving the range of instructional practices necessary for successful formative instruction of project-based Inquiry. The SPACE tool is not intended to be the sole driver of school change toward formative instruction; our design philosophy (Bryk et al., 2006) explicitly rejects such technological imperative models. Rather, we have designed SPACE as part of a larger effort of social practice design, including innovative professional development protocols.

Problems of Practice

The SPACE tools are intended to support the resolution of several critical problems of practice incumbent on teachers implementing formative instruction for Inquiry. Specifically:

- *Describing a trajectory of intermediate tasks whereby students work toward final project goals.* Doing this supports students' meta-cognition by helping them to monitor their progress as they complete a complex project.
- *Articulating robust and specific expectations for the quality of student work on every step of this trajectory, using a shared language that is comprehensible to students and other teachers.* Doing this supports students' meta-cognition by allowing them to self-assess their work. It also supports teachers' practice by offering clear dimensions with which to evaluate students' work. This is especially critical when teachers from different subject-areas collaborate, by making the expectations within teachers' different disciplines mutually visible.
- *Managing the many artifacts that are created in the course of project-based Inquiry, including both finished products and intermediate work product.:* A typical student project may have a dozen steps, each producing at least one artifact. Teachers and students (especially those working in groups) often struggle to keep track of these artifacts when doing projects.
- *Assessing student work and giving students low-latency feedback so that they can revise and re-submit.* Assessment lies at the core of formative instruction routines, providing information that can guide ongoing teacher reflection and instructional support.
- *Using assessment data to adapt ongoing instruction and plan future instruction.* A database of assessment data describing students' success on the individual steps of each project can reveal specific skills that need improvement. Cross-student or cross-class patterns in this data can reveal systemic skill strengths/weaknesses (e.g., difficulties using evidence to construct arguments in multiple subject areas).

Tool Description

SPACE is a web-based application with which teachers can do all of the above; it supports the entire lifecycle of project-based Inquiry, including project planning, execution, assessment, and reflection. To use SPACE, a teacher must break a project down into a set of tasks. For each task (e.g., pick a topic, state a hypothesis, describe materials, etc.), the teacher can specify instructions and must enter at least one assessment criterion (e.g., good spelling and grammar or relates the independent and dependent variables). Taken together, the set of entered criteria form a rubric for that step. When a student creates a new project in SPACE, or accesses an existing project, he or she sees a list of all of the tasks that make up the project. Each item in the list shows the number of times it has been critiqued, as well as an indication of whether a teacher has required that the work be revised. From that list, the student can click on any task to see instructions, the rubric, and enter his or her work. If the work has been critiqued, the student can also see past critique and commentary about the work. At any point, the student can also browse other students' work, in order to critique it or learn from it.

Because student work and assessments thereof reside in a persistent central database, teachers may freely browse student work in a number of interesting ways. They may, for example, look at all of a single student's work on a project or look at all students' work on the same task of a project. At any time that student work is viewed it may also be assessed using the rubric of the associated task template. SPACE also offers multiple aggregated representations of student work: Teachers may easily view a grid-based view of all students' status on a given project, with states that demand immediate attention highlighted. They may also access several summary reports of assessments, on a per-student, per-project, or per-cohort basis, describing students' performance on the range of assessment criteria (and associated standards/benchmarks) input during project planning. These reports offer a compelling alternative to the infrequently collected and disconnected-from-instruction standards-based data that are typically available to teachers.

Design and Implementation

SPACE was created through a participatory design process involving teachers and leaders at an urban charter middle school in a large Midwestern United States city. The implementation of SPACE in science, social studies, and literacy classrooms led teachers to dramatically increase their schoolwide press for common research skills expectations and instruction, as evidence of student weakness on such skills was made universally evident through the data visible in, and activity facilitated by, SPACE.

References

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