

Using standards-based curricula in the middle grades: What can go wrong?

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Textbooks have been at the center of heated debate in mathematics education in the United States. Teachers play a critical role as ultimate decision makers regarding how is their curriculum enacted in the classroom. Their role is examined here through the lens of the curriculum materials they use to provide opportunities for learning for their students.

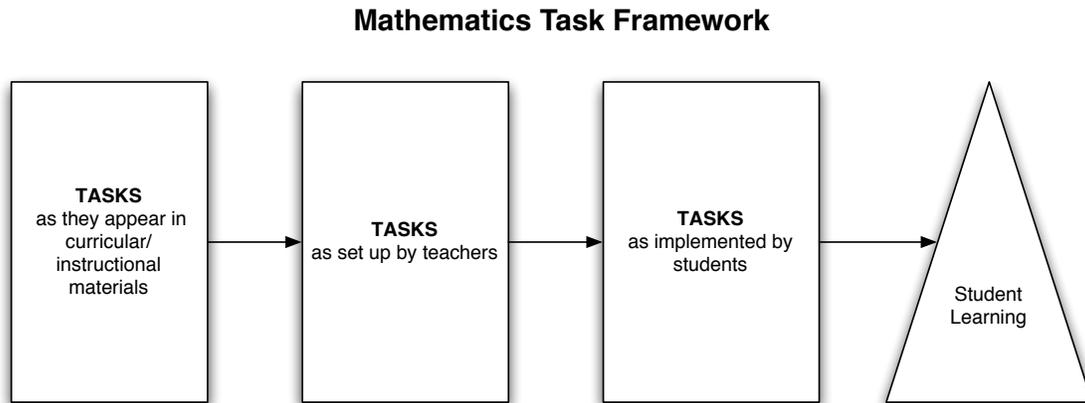
It is not uncommon to hear complaints from parents who claim that they would rather see their children using textbooks that look more like those they used when they were students. Critics of reform in mathematics education accuse reform oriented educators of watering down the mathematics curriculum. A frequent allegation is that basic skills are being sacrificed for the sake of “fuzzy math.” Nevertheless, when teachers struggle in the classroom with a textbook that might be somewhat unfamiliar, it is only natural that they ask themselves: are these critics right?

It is a fact that the vision set forth by the NCTM *Standards*, built upon the notions of deep knowledge of mathematics, substantive conversation about mathematics, and inquiry-based thinking, poses no trivial difficulties for teachers. The textbooks developed to reflect this vision provide rich curriculum materials but also expect challenging roles for teachers.

A useful approach to examine lessons was developed for the QUASAR project (Quantitative Understanding: Amplifying Student Achievement and Reasoning). These approach is based on the analysis of mathematical tasks and how the cognitive demand of these tasks changes as tasks are adapted from the instructional materials to the tasks as implemented by students.

Cognitive demand refers to the kind of thinking processes entailed in solving the task as announced by the teacher (during the setup phase) and the thinking processes in which students engage (during the implementation phase). These thinking processes can range from memorization to the use of procedures and algorithms (with or without attention to concepts, understanding, or meaning) to complex thinking and reasoning strategies that would be typical of “doing mathematics” (e.g., conjecturing, justifying, or interpreting). (Henningsen & Stein, 1997, p. 529)

The Mathematics Tasks Framework (Stein & Smith, 1998) describes the phases through which tasks pass. The nature of the tasks may change as tasks pass from one phase to the next:



Stein & Smith (1998)

These categories of cognitive demand into which mathematical tasks can be classified are:

- Memorization
- Procedures without connections to concepts or meaning
- Procedures with connections to concepts and meaning
- Doing mathematics

Most of the investigations in standards-based curricula, such as *Connected Mathematics Project*, *Mathematics in Context*, *Math Themes*, and *MathScape*, are characterized by tasks of high-level cognitive demand. Part of the criticism made to these curricula is in fact based on the visible effects of decline in the level of cognitive demand of the tasks presented to students.

According to their research (Henningsen & Stein, 1997; Smith & Stein, 1998; Stein & Smith, 1998), the factors that are associated with the maintenance of high-level cognitive demands are:

1. Scaffolding of student thinking and reasoning is provided.
2. Students are given the means to monitor their own progress.
3. Teacher or capable students model high-level performance.
4. Teacher presses for justifications, explanations, and meaning through questioning, comments, and feedback.

5. Tasks build on students' prior knowledge.
6. Teacher draws frequent conceptual connections.
7. Sufficient time is allowed for exploration—not too little, not too much.

On the other hand, the level of cognitive demand may decline for several reasons. Among the factors associated with the decline of high-level cognitive demands are:

1. Problematic aspects of the task become routinized.
2. The teacher shifts the emphasis from meaning, concepts, or understanding to the correctness or completeness of the answer.
3. Not enough time is provided to wrestle with the demanding aspects of the task, or too much time is allowed and students drift into off-task behavior.
4. Classroom-management problems prevent sustained engagement in high-level cognitive activities.
5. Task is inappropriate for a given group of students.
6. Students are not held accountable for high-level products or processes.

Further, they found that *unsystematic exploration* is a frequently observed manner of implementing “doing mathematics” tasks, when students explored around the edges of significant mathematical ideas but failed to make systematic and sustained progress in developing mathematical strategies or understandings.

Stigler and Hiebert (1999) observed that in many American classrooms that show the effects of current reform efforts, the *form* rather than the substance of the activities is what has changed, and that the mathematics is simple compared with other countries.

All these empirical observations support what Sfard (2003) has said from a theoretical perspective.

At the bottom of what can be observed as a declining level of cognitive demand in the tasks posed by the teacher it could lie a misconception of what learning with understanding implies.

Let me now address an important but elusive issue of what may happen if the Standards call for learning with understanding is interpreted in an inappropriate way. Just because of the educational importance and beauty of the new way of picturing developing minds implicit in the Standards, this call can easily be taken to a dangerous extreme. If not explained, this principle may be misinterpreted as implying the total exclusion of instruction which is not immediately rewarding in terms of understanding. The implementers of the Standards may wrongly conclude that they are expected to shield the student from the vexing experience of insufficient understanding at any cost. Such an extreme interpretation would soon become counter-productive. The effortlessly meaningful mathematics can only be trivial and

uninspiring, and the curriculum built around this principle is doomed to become watered down (Jackson, 1997, p. 695). Above all, however, teachers and students fear of lapses in understanding may engender defeatist attitudes which are harmful to both teaching and learning. (Sfard, 2003, p. 358)

On the other hand, unfocused mathematical activity, as described by Stigler and Hiebert and Henningsen and Stein can be the result of an overemphasis on certain aspects of standards-based teaching practices, a concern for form over content.

Impatient to put the good ideas to work, the interpreters [of the Standards] may forget that there is always more than one way to translate general curricular principles into concrete classroom strategies. Zealous to bring a real change, they often start believing that the old and the new are mutually exclusive. This is how the profound constructivist idea of a learner as a builder of her own knowledge may be trivialized into a total banishment of teaching by telling, and this is how the call to foster mathematical communication may turn into an imperative to make cooperative learning mandatory for all. This is also the mechanism through which the exhortation to teach mathematics through problem solving would bring a complete de-legitimatization of instruction which is not problem based, and this is how the request to make mathematics relevant to the student would result in a rejection of mathematics which does not come in a real-life wrapping. In spite of the high quality of the ingredients, the meal we cook in this unbalanced way must, sooner or later, prove harmful rather than healthy. (Sfard, 2003, p. 385)

While standards-based textbooks provide for different ways “to translate general curricular principles into concrete classroom strategies,” it still remains a challenge for the teacher to make decisions that will translate into meaningful mathematical experiences for his or her students.

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