The Common Core, the DQP, and K-16 Mathematics

Dev P. Sinha
Department of Mathematics
University of Oregon

Plan

- A primer on the Common Core State Standards in Mathematics (CCSSM).
- Opportunities for improving interfaces and transitions in K-14 mathematics.
- Differences and similarities between Common Core and DQP efforts.
- Lessons and challenges.

Common Core State Standards in Mathematics

The CCSSM was initiated by the National Governor's Association (along with state superintendents, etc), funded in large part by the Gates Foundation, and emphasized in the Race to the Top initiative. They have been adopted by 43 states, including Oregon, with an aim locally for implementation in 2014.

Its primary aim is to increase mathematical proficiency, aiming at college-readiness, based on best practices from around the world and widely-accepted research. Our own Dave Conley chaired the validation committee.

The effort has brought together mathematics educators, mathematicians, teachers, administrators and people from allied fields for the first time.

Common Core State Standards in Mathematics

The CCSSM comes in two parts - Content Standards and Standards for Mathematical Practice.

The Content Standards are modeled on those of high-performing countries, but also incorporate established research findings. They aim to narrow focus, with a goal of intellectual depth. The Standards for Mathematical Practice are an elaboration of what that intellectual depth should entail.

Their integration and implementation will change the way mathematics is approached in the classroom at the K-12 level.

Common Core State Standards in Mathematics

Two related standards:

2.NBT.5 : Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.

2.NBT.9 : Explain why addition and subtraction strategies work, using place value and the properties of operations. (Explanations may be supported by drawings or objects.)

Common Core State Standards in Mathematics

Traditional curricula would focus on the fluency with addition and subtraction, with plenty of practice with pencil-and-paper calculation.

Recent (last twenty years) reform curricula would focus on understanding of why addition and subtraction strategies work, for example using base-ten blocks.

In a CCSSM-aligned curriculum, both of these kinds of activities are likely to be needed, with proficiency ultimately indicated by tasks which fully integrate these proficiencies such as the following (more formative) task.

Common Core State Standards in Mathematics

Consider the numbers from 1 to 100, listed in rows of ten. Take any number not on an edge and add the numbers to its left and right. Then add the numbers above and below it. What do you notice? Do the same with other numbers, and try to explain what you see.

$$\begin{array}{ccc} \ldots 26 & 27 & 28 \ldots \\ \ldots 36 & 37 & 38 \ldots \\ \ldots 46 & 47 & 48 \ldots \end{array}$$

Such a task not only engages the two cited Content Standards but a number of Standards for Mathematical Practice.

Common Core State Standards in Mathematics

Current events:

- The Illustrative Mathematics Project, led by one of the CCSSM lead writers, is producing such tasks to help guide assessment writers, textbook writers, etc. A first batch is to be made available in December. I am working for this project.
- Two large assessment consortia have been formed, and are looking to produce tools which will be used both formatively (day-to-day) and summatively, engage parents, etc.
- Teacher training will be a large challenge, probably the greatest which the school systems face in this effort (curricula have been changing a lot; none of our teachers have learned in such a system).

Opportunities for improving interfaces and transitions in K-14 mathematics.

- Knowing what has been completed and assessed in the CCSSM could allow for greatly clarity in needs for remediation and for a narrowing of focus in prerequisites and beginning coursework.
- Knowledge of the assessment consortia's work could inform both content-focused short-answer assessments, such as currently being developed by the UO Mathematics Department, and in practice-focused project-based assessments, such as being developed by EPIC.
- One could conceive of continuing CCSSM-style work through calculus, as a way to align efforts (standard HS calculus, AP, dual-enrollment, 2-yr, 4-yr), though it would be expensive to do well and would run into significant new challenges, similar to those discussed below.

Differences and similarities between CCSSM and DQP

There are some very large differences between the CCSSM and DQP efforts.

CCSSM	DQP
Defines content	Explicitly does not define content.
K-12	Post-secondary
Some details given centrally	Framework given centrally
Subject-specific	Universal

Also, the CCSSM addresses a system (K-12 mathematics) universally found lacking, as evidenced by international benchmarks, while the DQP addresses a system (post-secondary) which can be improved but is strong by many measures.

Differences and similarities between CCSSM and DQP

But there are some important similarities between the CCSSM and DQP efforts:

- A focus on demonstrable student outcomes.
- Analogous roles played by Standards for Mathematical Practice and DQP's illustrative outcomes, as given in the DQP matrix.
- Emphasis on applied/ contextualized learning.
- Having outcomes drive assessment (not the other way around).

Lessons and challenges

Prescriptive student outcomes, such as those given in the Standards for Mathematical Practice or the DQP's illustrative outcomes, need to be tied to content through examples in order to be meaningful. (This is what the Illustrative Mathematics Project is about. Compare with Adelman's "sample of assessments.") But such a framework would have the potential to interfere with choices made by instructors based on their own content knowledge and expertise, which is at the heart of the current post-secondary education model.

Much good work on student outcomes has been already done at the departmental and institutional level, and the leverage and resources needed to incorporate, coordinate, and change as needed will be significant.

Lessons and challenges

The CCSSM is field-specific, and focussed within that field. It will be a challenge, if possible at all, to describe outcomes across fields without reverting to vacuous language such as "critical thinking."

For all of its trappings, the CCSSM is primarily about raising the level of academic rigor in K-12 mathematics. Level of rigor is meant to be the focus in our current post-secondary system, especially in liberal education. When paid attention to, it is one of our greatest strengths. We cannot sacrifice its primacy in any reform efforts.