Conference Board of Mathematical Sciences

National Forum on the Content and Assessment of School Mathematics

Plenary Session Panel: What Are the Features of a Coherent Curriculum?

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Thank you, Jeremy, for framing this discussion for us – and I especially want to thank you for encouraging feedback on the current draft, which will help us a great deal.

Within the frame of this discussion I'd like to talk about coherence as it relates specifically to the CCSSO/NGA College and Career Readiness Standards. A set of standards is not a curriculum by any means, the College and Career Readiness Standards least of all, as they are not even organized into courses or progressions. But I know people are eager to hear more about that document, and I'll do my best to answer questions here and throughout the day. Other members of the work group are also here today.

Jeremy mentioned an interesting measure of coherence, which we're all doubtless turning over in our minds right now, which is the ratio of the number of outcomes that link to other outcomes, compared to the total number of potential outcome pairs. And this makes sense; if I had to ask just one question about it, I might recall that one professor we've probably all had, maybe in history class, who couldn't seem to resist linking each given event to a dozen others. He certainly had command of the subject matter. The trouble is, in his lectures he spent as much time shuttling between events as investigating any one of them, and his students never formed a vivid image of any single episode.

That worry aside, I do think one of the advantages of the 10 content standards we've used to organize the College and Career Ready document is that they support a number of obvious and important connections. At the same time, each forms, in itself, a concrete 'episode,' of which it is possible (and valuable) to form a vivid image.

Intuitively, I think of the coherence of a curriculum as the degree to which the curriculum fosters sense-making. On this view, coherence is to be sought not in the curriculum itself, but rather in the students' minds as they work through that curriculum. The curriculum hosts an encounter between the mind and the matter. And a coherent curriculum respects both. It respects the structure of the discipline; it draws connections to bind the matter together; and, crucially, by focusing on a small number of topics at any given time, the curriculum allows students to think, practice, and integrate each new idea into a growing knowledge structure. This integration has a natural timescale, which is not instantaneous; and for this reason, coherence likely cannot exist at all without focus.

Bill Schmidt has defined mathematical coherence of standards as the degree to which the standards respect the logical structure of the discipline, in their sequencing and patterns of emphasis. As this notion involves sequencing, we could not directly apply it in drafting the College and Career Readiness Standards - for that document is atemporal, lacking, as it does, any grade leveling or learning progressions.

Yet we still wanted the standards to respect, and even showcase, the structure of mathematics at this level of attainment. We did this in part by going beyond the traditional "checklist" format of standards to include narratives of coherence. We also created an explicit category of Core Concepts, which allowed us to freely describe *mathematics itself*, in the language proper to it, rather than in standards-speak, with its stilted litanies of active verbs.

Coherence also gave us a way to negotiate the sometimes conflicting evidence about the math all students should learn to meet the demands of international competitiveness, college readiness, and readiness for postsecondary training for Zone 3 jobs. We were charged by CCSSO and NGA with bringing evidence to bear on this question insofar as possible. And the evidence we drew on included

- Data from the ACT National Curriculum Survey, as well as smaller scale surveys, suggesting that college professors in introductory credit bearing courses value deeper understanding and greater fluency in a smaller range of topics than are typically covered in the high school general college Prep sequence.
- A large body of student performance data, giving (1) a rough picture of the math skill set of today's college ready students, as well as the skill sets of those well above and well below college ready; and (2) a rough sense of the convergence between the level of math performance necessary for success in introductory credit bearing math courses and for readiness for postsecondary training for zone 3 jobs.
- Other workplace analysis from Achieve.
- Advanced placement course descriptions from College Board, and survey data from CB as well.
- Data on college coursetaking patterns in math.
- Documents of diverse kinds, from international standards documents, to community and technical college course descriptions, to credit transfer agreements between 2 and 4 year colleges, to math standards of AMATYC.
- Various reports as detailed in the evidence base.

There were, and could be, no simplistic decision rules about what to include – everything was discussed, everything deliberated in terms of the facts at our disposal and the substantial input we received from states and reviewers.

That input accelerated after the first draft of the standards came to light, and we were able to use comments from a range of respondents to improve the draft. I could comment next on the major changes in the second draft, but let me pause here, come in on time, and save room for questions.