Improving Curriculum Use for Better Teaching

PI's: Janine Remillard, University of Pennsylvania & Ok-Kyeong Kim, Western Michigan University

1 Curriculum Analysis

Analysis of the teacher's guides along the following dimensions:

- How the text communicates to the teacher, what it communicates about, and how the text positions the teacher;
- Cognitive demand of the central tasks of the lesson;
- Primary instructional approach, which includes the teacher's and students' roles throughout the lesson.

How Text Communicates with Teacher

The teacher's guides were coded at the sentence level to characterize the type of support provided to teachers. (See codes below.)

Code	Intent of Support
Directing Action	Direct the teacher's or students' actions related to the lesson or provides orienting information about materials and/or objectives.
Explaining Rationale	Articulate the purpose behind author decisions in order to help the teacher make decisions while enacting the lesson that are inline with the intent of the curriculum designers.
Anticipating Student Thinking	Focus the teacher's attention on student thinking and understanding and, in some cases, guide the teacher to respond to student thinking.
Explaining Math	Communicate mathematical concepts, relationships, or insights to the teacher or specify the mathematical importance of particular concepts.
Signaling Decision Making	Communicate that flexibility in how the program is used is expected or that that teacher is expected to make decisions based on his/her assessment of their students' needs.

Initial Findings

Curriculum	EM	INV	SF	SM*	TB
Sentences/lesson	116.4	114.8	83.3	59.8	128.6
Code	%	%	%	%	%
Directing action	78.6	74.3	86.5	87.9	65.5
Explain Rationale	8.3	6.8	0.5	1.0	14.0
Student Thinking	7.5	12.8	10.0	5.2	13.2
Explain Math	5.6	3.9	3.0	5.9	10.5
Decision Making	7.5	2.2	2.2	0.8	5.8

SF and SM provide less support as measured by number of sentences. TB provides the most support overall and distributes this support more evenly amongst the five categories.

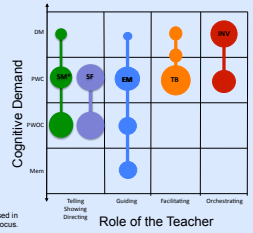
Cognitive Demand and Instructional Approach

Major tasks of each lesson were coded using Stein et al.'s (1996) categories of cognitive demand. Teacher's role was determined by explicit and implicit cues for teaching action.

Levels of Cognitive Demand	Role of the teacher
Memorization	Telling, showing, directing
Procedures without Connections	Guiding
Procedures with Connections	Facilitating
Doing Mathematics	Orchestrating

Initial Findings

High demand tasks call for more demanding pedagogy. The complexity of the teachers' role is also greater. Thus, as the tasks become more difficult to predict and manage, the teacher is expected to adopt a less directive and more facilitative role.



* Primary Mathematics, based on a previous edition of the textbook used in Singapore was the subject of our initial analysis, rather than Math in Focus.

Overview

ICUBIT is a research and development project focused on conceptualizing and measuring *pedagogical design capacity* or the capacity required to use curriculum resources productively to design instruction (Brown, 2009).

Goals

1) To identify the teacher capacities needed for productive use of mathematics curriculum materials;
2) To design tools to measure these capacities.

Five elementary mathematics programs were selected as the basis for research and development activities. Three are standards-based programs, developed with NSF funding; one is commercially developed in the U.S.; on was developed in *Singapore* and is marketed in the U.S.

Everyday Mathematics (EM) | *Investigations in Numbers, Data, and Space* (INV) | *Math Trailblazers* (TB)

Math in Focus or "Singapore Math" (SM) | *Scott Foresman-Addison Wesley Mathematics* (SF)

Components

1. **Curriculum Analysis:** We analyzed teacher's guides of each program focusing on two questions:
   1. What demands does the curriculum place on teachers as users and enactors of the curriculum?
   2. What supports does the curriculum provide the teacher to aid in enacting the curriculum?
2. **Curriculum Embedded Mathematics Assessment (CEMA) design and pilot:** This assessment measures teachers' knowledge of the mathematics underlying tasks, instructional designs, and representations in curriculum materials.
3. **Investigating Teacher Curriculum Use** Use tools to collect and analyze data on how 25 teachers *read* and *use* curriculum materials. Analyze data to identify the capacities needed for effective curriculum use and patterns among teachers' mathematics knowledge, the quality of their curriculum use, and the nature of their instruction. Construct framework to identify, measure, and further develop PDC.

2 CEMA

CEMA is a tool to measure teachers' understanding of the mathematics embedded in tasks and representations in elementary curriculum resources. Our aim is to develop conceptualize this specialized form of knowledge and develop a proof of concept of a tool to measure it.

Key Components

Four dimensions

1. Mathematical ideas
2. Surrounding knowledge
3. Problem complexity
4. Connections across representations

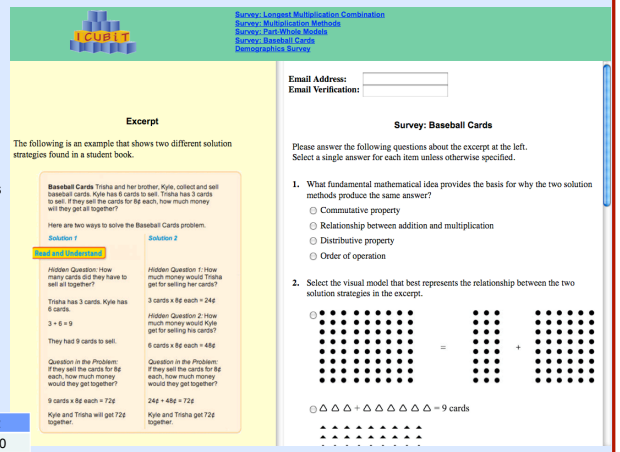
Format

Designed using excerpts selected from 5 curriculum programs; each excerpt is followed by 4-6 items that assess math knowledge with respect to the dimensions.

Field Test, IRT Analysis

CEMA was taken in online format by 150 teachers, using 2 forms.

Form	1	2
Reliability	.69	.80
Difficulty	-3.16–1.4	-1.9-.008



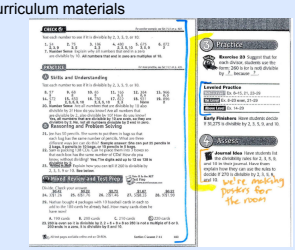
Sample CEMA excerpt and item

3 Investigating Teacher Curriculum Use

Data collection and analysis of 25 teachers (grades 3-5) using the 5 different curriculum programs.

Data Collected

1. *Introductory Interview*: Teacher's background and general orientation towards the curriculum materials
2. *Curriculum Reading Log*: Teachers highlight the teacher's guide to indicate the parts
   - ✓ they read (yellow)
   - ✓ they plan to use (blue)
   - ✓ that influenced their thinking, but will not be used as written (orange)



3. *Table-of-Contents Implementation Record*: Teachers use copy of contents from text to indicate lessons they taught over an entire year.
4. *Observations:* Teachers are videotaped as they teach 6 lessons also included in CRL.
5. *Post-observation interview*: Asks teachers to reflect on their use of the teacher's guide as it relates to what occurred in the classroom.
6. *Assessments*: Teachers take the CEMA as well as Mathematical Knowledge for Teaching (MKT) assessment (Hill, et al., 2011).

Data Analysis

Initial analysis will be within teacher and within curriculum. We will then contrast teachers using different curriculum programs.

- ✧Curriculum reading and use to design instruction: using CRLs and interviews, we will characterize and compare what and how teachers read to plan instruction.
- ✧Enacting instruction: Classroom observations will be coded for *design moments*, where teachers enact instructional moves in response to classroom events. Enacted lessons will be compared to planned and written lesson in text.
- ✧Interviews will supplement analysis by providing insight into teacher intention and decisions-making processes.
- ✧Analysis of mathematical knowledge will involve comparing teachers' scores on the MKT and CEMA to examine the relationship between these two constructs and both scores to quality of curriculum use.

The ultimate aim is to identify patterns among teachers' mathematics knowledge, the quality of their curriculum use, and the nature of their instruction. These patterns will be used to develop a model of PDC and describe the role that teacher knowledge and other capacities play in curriculum use. By contrasting these findings with analysis of curriculum materials, we will consider how curriculum features influence PDC.

References and Acknowledgements

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Research Team

UPenn	Western Michigan
Nine Hoe, Emily Magee	Napthalin Atanga
Luke Reinke, Joshua Taton	Shari Lewis, Dustin Smith

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