DEVELOPING A FRAMEWORK FOR ANALYZING MATHEMATICS TEXTBOOKS USED IN THREE DIFFERENT COUNTRIES

1. Introductory Activity:

- Select one of the textbooks on the table.
- Is this a good textbook? Why?
- On what criteria did you base your decision?
- Are these criteria appropriate? Sufficient?

2. Problem-Purpose

Several frameworks have been proposed to evaluate and synthesize strengths and limitations of mathematics textbooks. We identified limitations in many of the existing frameworks and tried to develop a framework that would be more comprehensive, clearly-structured and topic-generic.

3. Overarching Research Questions

- Could we synthesize data from existing literature to build a textbook analysis framework that incorporates this knowledge?
- Could we develop a framework that would allow a more in-depth and structured analysis of the opportunities for students to learn mathematics from textbooks?
- Could the framework be applied as a bifocal lens to analyze both generic mathematical topics (although at this stage we confine it to fractions) and more general characteristics of the textbook?

4. Method

- Interactive literature review of textbook analyses and fourth grade mathematics textbooks from Taiwan, Ireland and Cyprus.
- Discussion of literature in light of researchers' educational experience and knowledge of diverse cultures to create an integrated, pragmatic framework.
- Application of part of the framework to analyze (at a horizontal level) textbooks from the three countries.

6. Results

- We used existing literature to develop a framework to analyze textbooks on three levels: mathematical content, mathematical practices and attitudes.
- We made several connections in the framework that we did not see in other frameworks: between horizontal and vertical analyses, between content, practices and attitudes, between presentation and expectations. The framework also evaluates connections between topics within textbooks.
- Cross-cultural analyses of textbooks challenges assumptions that may be unquestioned if textbooks are only analyzed within one culture.
- Analyzing textbooks reveals important information about how textbooks might be used (e.g. Expectations that authors have for covering content may be gleaned by comparing features such as the number of pages, their surface area and the density of the pages and comparing this to the time available in a country for studying mathematics) but such data remain speculative without studying how textbooks are used.

HORIZONTAL ANALYSIS OF TEXTBOOKS

Background information	*Overall structure*	*Relation to other curriculum materials*
• Title • Publisher and year of publication- Profile of authors • Number of books • Accompanying materials (e.g., teachers' guides, resource materials). • Quality of production (paper, color, cover) • Pages (number, surface area, density of material)	• Number of units/lessons and average number of pages per unit/lesson. • Structure of units/lessons. • Topics covered. • Sequencing of topics.	• Reference to a local curriculum. • Reference to a national curriculum

VERTICAL ANALYSIS OF THE TEXTBOOKS

	What is presented?		*What is expected?*
Mathematical content	• ***Overview of the content*** • ***Relation to the construct*** - e.g. for fractions: part-whole, ratio, operator, quotient, measure-number • ***Kernels*** - Definitions, rules, conventions ▪ *consistency, clarity, genuineness, suitability* • ***Illustrations*** - Power: *irrelevant, relevant to the context but not to the mathematics, supporting the mathematics* - Representations that support learning	• ***Connections*** -Connecting (within and between strands) -Classroom-textbook connections -Connecting to life outside school	• ***Types of tasks*** - Exercises(drill and practice) - Problems (routine, non routine) • ***Potential Cognitive demands*** - Memorization - Procedures with connections - Procedures without connections - Doing mathematics • ***Performance expectations*** - Answer only - Explanation - Justification - Evaluation
Mathematical practices	• ***Worked-out examples*** - Presentation of algorithms (consistency, clarity) • ***Modeling thinking*** - Drawings illustrating mathematical thinking		
Attitudes	• ***Equity*** - Representation of race, gender, age, physical state • ***View of mathematics***		

7. Future Plans

- This poster represents a snap-shot of work on our project to date. We would like to develop the project in several ways.
- The vertical-level analysis framework needs to be tested and reconsidered in light of such testing.
- We intend to integrate the results of each level (horizontal and vertical) analysis to understand the opportunities to learn provided by a particular textbook.
- We would like to extend the vertical-level analysis to investigate other topics in detail.
- The study can also be extended to look at textbooks in other countries.

8. Relevance

The framework provides a means to evaluate the mathematical content of textbooks and this evaluation can help with selection of textbooks by a school or district and with the design of future textbooks. Therefore it is relevant to:

- Educational researchers.
- Textbook publishers and designers.
- Committees evaluating or selecting textbooks.
- Teachers

by
Hui Yu Hsu, huiyuhsu@umich.edu
Seán Delaney, sdelaney@umich.edu
Charalambos Y. Charalambous, cbcharal@umich.edu
Vilma Mesa, vmesa@umich.edu