LESSONS LEARNED FROM THREE DECADES OF TEXTBOOK RESEARCH

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• Dozens of authors of textbooks
OUTLINE OF SESSION

• Share and expand on the conference paper
  • Background on the UCSMP
  • Lessons learned from UCSMP research

• Opportunity for discussion and questions
UCSMP BACKGROUND

- University of Chicago School Mathematics Project (UCSMP)
  - Founded 1983
  - K-12 curriculum development & research project
    - Elementary component
    - Secondary component
    - Evaluation component
    - Resource component
  - Funded with private and federal grants
  - Goal was to develop curriculum materials based on recommendations for mathematics reform at that time
Secondary Component

- Developed instructional materials for grades 7-12 (and since 2005 for grades 6-12)
  - *Pre-Transition Mathematics* (grade 6)
  - *Transition Mathematics* (grade 7)
  - *Algebra* (grade 8)
  - *Geometry* (grade 9)
  - *Advanced Algebra* (grade 10)
  - *Functions, Statistics, and Trigonometry* (grade 11)
  - *Precalculus and Discrete Mathematics* (grade 12)
Common Features of Textbooks

- Wide mathematical scope, incorporating data analysis and discrete mathematics to update curriculum
- Multi-dimensional approach to understanding
  - Skills, Properties, Uses, Representations (SPUR)
- Integration of technology as appropriate
  - Calculators (graphing, CAS)
  - Spreadsheets
  - Dynamic geometry
- Expectation for students to read and write mathematics
- Modified mastery learning
RESEARCH AND EVALUATION OF SECONDARY TEXTBOOKS

• School year long studies

• Formative aspect
  • Give feedback to authors prior to commercial publication

• Summative aspect
  • Investigate the effectiveness of textbooks in comparison to materials already in use at school

• Studies conducted since the beginning of the project in the 1980s
Multiple Cycles of Development & Research: An Example

- *Transition Mathematics*
  - First Edition
    - Initial development and small scale pilot testing: 1983-1984
    - Research and evaluation: 1984-1986
    - Commercial publication: 1990
  - Second Edition
    - Field Trial and Evaluation: 1992-1993
    - Commercial publication: 1995
  - Third Edition
    - Field Trial and Evaluation: 2005-2006
    - Commercial publication: 2008
Lessons Learned
Lesson 1: When studying the effectiveness of a textbook, the classroom is the appropriate unit of analysis.

- Instruction occurs in classrooms.
- We’ve used matched-pair, quasi-experimental design.
  - Match classes on basis of one or more pretests
  - Each pair is a mini-study
  - Ensures comparability of groups, even if random assignment is not possible
  - Avoids methodological difficulties from trying to match students or controlling for differences through ANCOVA
LESSON 2: Compare classes within the same school when possible.

• Schools have their own culture.
• Example: *Geometry* study (2006-2007)
  • 12 teachers from 12 schools using the same textbook
  • Instructional time: 215-300 minutes/week
  • Percent of 114 textbook lessons taught: 51-91%
  • Percent of 43 textbook lessons taught on congruence: 60-100%
• Homework expected:
  • 16-30 min per night – 5 teachers
  • 31-45 min per night – 5 teachers
  • 46-60 min per night – 2 teachers
LESSON 2: Compare classes within the same school when possible.

- Posttest scores in some schools are lower than pretest scores in other schools. (U represents UCSMP classes and C represents Comparison classes.)

**TM: Percent Correct on Common Pretest and Posttest Items**

![Graph showing percent correct on common pretest and posttest items for different schools.](image)
LESSON 3: Select more classes for study initially than you think you may need.

- Teachers
  - Fail to give all pretests.
  - Decide things are too difficult and quit using the textbook.
  - Leave the school.
- Classes in a pair don’t match.
  - On pretests
  - On some other important characteristic
- Students switch classes during the school year.
LESSON 4: Collect data from teachers about the opportunities they have provided students to learn the mathematics in the textbook.

- Measure opportunity to learn mathematics in lessons and practice homework
  - *Algebra* study example (2005-2006):
    - 6 UCSMP teachers
    - Taught 47-100% of 103 lessons
    - Only 1 of 13 chapters had all lessons taught by all 6 teachers.
    - In this chapter, teachers assigned 25-97% of homework questions.
LESSON 4: Collect data from teachers about the opportunities they have provided students to learn the mathematics in the textbook.

- Measure opportunity to learn (OTL) on posttests
  - Teachers indicate whether they taught or reviewed the content for EACH posttest item.
  - In *Algebra* study, all 6 UCSMP teachers taught only 16 of 32 items on a standardized test.
  - In *Transition Mathematics* study, among 5 matched pairs of classes:
    - On standardized test, OTL 68-90%
    - On UCSMP designed multiple-choice test, OTL 50-100%
    - On UCSMP designed constructed-response test, OTL 38-100%
LESSON 4: Collect data from teachers about the opportunities they have provided students to learn the mathematics in the textbook.

• Posttest OTL used to report results three ways
  • No control for OTL – results given for entire test with OTL reported
  • Control for OTL at pair level (Fair Test) – results given for those items in each pair for which both UCSMP and comparison teachers reported “yes”
  • Control for OTL at study level (Conservative Test) – results given for those items for which ALL UCSMP and comparison teachers reported “yes”
### OTL Examples: Fair and Conservative

<table>
<thead>
<tr>
<th></th>
<th>PTM</th>
<th>TM</th>
<th>Algebra</th>
<th>Geometry</th>
</tr>
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<tbody>
<tr>
<td><strong>No. Teachers</strong></td>
<td>14</td>
<td>10</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td><strong>No. Schools</strong></td>
<td>9</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td><strong>Standardized Test</strong></td>
<td>TerraNova CAT Survey 17</td>
<td>Iowa Algebra Aptitude</td>
<td>TerraNova Algebra</td>
<td>High School Subjects: Geometry</td>
</tr>
<tr>
<td><strong>Number of Items</strong></td>
<td>32</td>
<td>63</td>
<td>32</td>
<td>40</td>
</tr>
<tr>
<td><strong>Items Common within Pair</strong></td>
<td>50-97%</td>
<td>68-90%</td>
<td>62-100%</td>
<td>65-80%</td>
</tr>
<tr>
<td><strong>Items Common Across Schools</strong></td>
<td>34%</td>
<td>67%</td>
<td>50%</td>
<td>48%</td>
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</tbody>
</table>
LESSON 5: Collect multiple measures of implementation of the textbook, and when possible, collect implementation data from both teachers and students.

- Data collected from teachers
  - Chapter evaluation form for each chapter
  - Pre and post questionnaires about goals and instructional practices
  - Interviews
  - Classroom observations
  - Focus group meetings
LESSON 5: Collect multiple measures of implementation of the textbook, and when possible, collect implementation data from both teachers and students.

• Data collected from students
  • Pre and post tests
  • End of year Student Survey
    • Many questions similar to those on teacher end-of-year questionnaire
    • Amount of time spent on homework
    • Frequency and nature of use of technology
    • Frequency and nature of reading and writing mathematics
• Opportunity to compare teacher and student perspectives on instruction
LESSON 6: Pilot everything, including items, instruments, and procedures.

• Unanticipated issues arise even when tests are constructed by knowledgeable individuals
  • Incorrect graph
  • Items that provide clues to other items
  • Items with numbers that enable correct answers from wrong methods
  • Constructed response items that are not rich enough to be scored using the planned rubrics
Questions for DISCUSSION

• To what extent would these lessons be issues that you would face in conducting such research in your own country?

• What other lessons have you learned or what other issues have you encountered when conducting textbook research?
References


References


• Thompson, D. R., & Senk, S. L. (2012). Instruments used by the University of Chicago School Mathematics Project to study the enacted curriculum. In D. J. Heck, K. B. Chval, I. R. Weiss, & S. W. Ziebarth (Eds.), *Approaches to studying the enacted mathematics curriculum* (pp. 19-46). Charlotte, NC: Information Age Publishing.


References


