Design and Implementation of Korean Mathematics Textbooks

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Outline

I  Introduction: Background
II Overview of Textbook Development
III Writing of Textbooks
IV Textbooks Selection and Use
V Closing Remarks
I. Background

- Importance of Mathematics Textbooks
  - Curricular materials are influential
  - Directive, coherent, & uniform changes
  - Korean teachers use textbooks as main instructional resources → Development of good textbooks: Important in shaping K-12 mathematics education.

- Design & Implementation
  - Linked to changes in the national curriculum.

Korean math education reform centers around revising the curriculum in concert with textbooks and teacher guidebooks.

Explore the processes: Principles of school math come to influence textbook development.
I  Introduction: Background

II  Overview of Textbook Development

- Guide: Transition from Curriculum to Textbook
- Types of Textbooks
- Textbook Authors
II-1. Transition from Curriculum

Textbooks follow & specify what the curriculum intends.

Curriculum
- Level-based structure
- Students’ active learning activities

Textbooks
- Provide students with opportunities to nurture their own self-directed learning

MOE
Guide

- General directions for writing textbooks
- Curriculum summary: Goals & characteristics
- External forms: Size, quality of paper, color, length, font size
- Very specific cautionary notes: What to include/exclude, how to structure textbooks, how to choose & present contents
II–1. Transition from Curriculum

8th grade: With regard to ‘Division of polynomial expression’, you treat only the case that the quotient of dividing a polynomial by a monomial expression is a polynomial.

- General directions for writing textbooks
- Curriculum summary: Goals & characteristics
- External forms: Size, quality of paper, color, length, font size
- Very specific cautionary notes: What to include/exclude, how to structure textbooks, how to choose & present contents
II–1. Transition from Curriculum

General guidelines: Textbooks should

- Select content that students can use to improve their creative thinking and reasoning ability
- Contribute to improving the process of teaching & learning
- Be easy, interesting, & convenient to follow on the part of students
- Be flexible in a way that teachers can revise them

Comparison: Recommended VS Traditional Textbook

- Perspectives of textbooks, statements in textbooks, structure of a unit, selection & construction of contents, and process of R & D
II–1. Transition from Curriculum

Selection of Contents

Traditional

- Knowledge-based Contents
- Teacher-based contents
- Minor connections to real-life contexts

Recommended

- Real-life experience related to important concepts
- Case-based, student-based contents
- Consideration of utility
II–1. Transition from Curriculum

Construction of Contents

Traditional
- Linear construction in terms of mathematical structure
- Monotonous construction of sentences & illustrations

Recommended
- Non-linear construction considering relevant knowledge & real-life experience
- Various designs & editing
II–2. Types of Textbooks

3 Models for Textbook Development

1. MOE consigns development to an university or research institute
   - Elementary
     - 1 elementary math textbook series
     - 11th ~ 12th: 1 probability & statistics, 1 discrete math

2. Multiple teams write textbooks → approved by MOE
   - Secondary
     - 7th ~ 10th: 16 math textbooks
     - 11th ~ 12th: 12 math I, II; 8 calculus; 4 practical math

3. Non-educators write textbooks → adopted by MOE
   - Religion
     - 11th ~ 12th: 1 probability & statistics
II–3. Textbook Authors

Construction of a Team: Elementary

- Select a R & D institute
- Appoint a principal researcher: lead the overall process of textbook development

No direct connection with MOE & publishers

MOE

Research Team
- 10 people
  - professors (math. ed.)
  - 2-3 from MOE
- Works across grades

Framework constituted by the institute

Writing Team
- 8-10 for each math book
  - in-service teachers;
  - 3 professors
  \(\rightarrow\) 50 teachers (total)
- Operates per grade
II–3. Textbook Authors

Construction of a Team: Secondary

- Many people volunteer to write textbooks
- 3~8 professors with in-service teachers
  - mathematics > mathematics education
  - teachers’ active participation is a new trend
- Authors work for publishers

Characteristics

- Collaboration between professors and teachers: Negotiation between theory and practice.
- Authors: Not have released time from regular jobs → Entails a substantial commitment: Willingness.
- Inducement is related more to the honor of being a textbook author than to any direct economic reward.
Outline

I Introduction: Background

II Overview of Textbook Development

III Writing of Textbooks

- General Flow of Textbook Development
- Contributing Factors
- Construction of Contents and Problems
- Revisions and Approval of Textbooks
### III. Writing Textbooks

#### Outline of Textbook Development & Implementation

<table>
<thead>
<tr>
<th>Grade</th>
<th>1997</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
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<tr>
<td>1st, 2nd</td>
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<td>D</td>
<td>E</td>
<td>I</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3rd, 4th</td>
<td></td>
<td>D</td>
<td>E</td>
<td>I</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5th, 6th</td>
<td></td>
<td>D</td>
<td>E</td>
<td>I</td>
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<td></td>
<td></td>
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<td>7th</td>
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<td>D</td>
<td>A</td>
<td>I</td>
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<td>8th</td>
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<td>9th</td>
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<td>A</td>
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<tr>
<td>10th</td>
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<td>D</td>
<td>A</td>
<td>I</td>
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<td>11th</td>
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<td>12th</td>
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<td>D</td>
<td>A</td>
<td>I</td>
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</tr>
</tbody>
</table>

- **Announcement of national math curriculum**
- **Development (D)**, **Experiment (E)**, **Implementation (I)**, **Approval (A)**

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**Note:** The table outlines the development and implementation phases of national math curriculums for each grade level from 1997 to 2004.
### III–1. General Flow: Elementary

<table>
<thead>
<tr>
<th>Process</th>
<th>MOE</th>
<th>Institute</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decision of institute</td>
<td>O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establishment of criteria &amp; guidelines for writing textbooks</td>
<td>O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Writing &amp; submitting a R &amp; D proposal</td>
<td>O</td>
<td>O</td>
<td>Review team &amp; writing team</td>
</tr>
<tr>
<td>Review &amp; approval of the proposal</td>
<td>O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Writing &amp; submitting a detailed proposal</td>
<td>O</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Constructing a review committee &amp; deciding details of writing textbooks</td>
<td>O</td>
<td></td>
<td>10 professors &amp; 10 teachers or supervisors</td>
</tr>
<tr>
<td>Writing textbooks (revisions)</td>
<td>O</td>
<td>O</td>
<td>8~12 month for each book</td>
</tr>
<tr>
<td>Submitting &amp; Reviewing a 1st draft</td>
<td>O</td>
<td>O</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Process</th>
<th>MOE</th>
<th>Institute</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructing &amp; submitting a revised draft</td>
<td>O</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Reviewing the draft</td>
<td>O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ready for school experiment</td>
<td>O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School experiment</td>
<td>O</td>
<td>O</td>
<td>One year</td>
</tr>
<tr>
<td>Reflecting school experiment</td>
<td></td>
<td>O</td>
<td>Revision section</td>
</tr>
<tr>
<td>Constructing, submitting, &amp; reviewing 2\textsuperscript{nd} draft</td>
<td>O</td>
<td>O</td>
<td>School-based results</td>
</tr>
<tr>
<td>Constructing final version of a textbook</td>
<td>O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implementation</td>
<td>O</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
III–1. Flow: Secondary

**MOE**
- Establish an overall plan of textbook development & a basic approval plan (guidelines & criteria)
- Appoint an approval committee
- Announce textbooks approved

**KICE**
- Evaluate & ask for revisions (by committee)
- Check if the revisions have been completed
- Evaluate

**Publishers**
- Apply for approval → Submit 1st draft
- Resubmit 2nd draft
- Submit teacher guidebook

7~8 months from submitting 1st draft to getting approved
III–2. Contributing Factors

- **Influence of Research**

The degree to which research influences the selection and presentation of lessons is rather limited and indirect.

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**KTRF**
- Deals with overall aspects of textbook development e.g.) systems of textbook development

**KICE**
- Focuses on subject-bound textbook research e.g.) model of math textbook, implementation

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- **Many Individual studies**
- It is up to textbook writers whether such research has a direct influence on textbook development
III-2. Contributing Factors

Influence of Research

- **Elementary**: Research interests & issues of principal writers tend to the key elements.
- **Secondary**
  - Teacher guidebooks include summary of characteristics of math curricula of other countries & learning theories.
  - Writers consult textbooks from other countries to find info. on how to relate concepts to everyday life, or for insights into how to present ideas.

It depends on the **textbook writers** as to whether & how much research influences the selection & presentation of math lessons.
### III-2. Contributing Factors

#### Influence of Research: Grade Placement

- **Curriculum developers** determine topics & contents specific to each grade level.
- **Research conducted by individuals & KICE**

<table>
<thead>
<tr>
<th>Individual</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Cross-national comparative study of specific mathematical concepts</td>
<td></td>
</tr>
<tr>
<td>• Surveys of major mathematical areas for specific grade levels</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KICE</th>
<th></th>
</tr>
</thead>
</table>
| • **Systematic survey**: Whether topics & contents are appropriate at each grade level  
  e.g.) amount of learning, level of significance & interest of main topics, or appropriateness of approaches  |  |
| • **National Assessment of Educational Achievement**: Monitor the appropriateness of curriculum |  |
III–3. Construction of Contents

- **Non-repeating Structure**
  - ✔ Built on block learning
  - → Each topic presented at a certain grade is expected to be mastered at that grade level.
  - ✔ Level-based differentiated structure: Students at each grade have to master the expected levels.

- **Textbook VS Workbook**
  - ✔ Textbook activities are limited in terms of the number, type, & difficulty level of problems.
III–3. Construction of Contents

**Assumption:** Most students take advantage of workbooks/self-learning books to anchor key skills & understanding.

- **Workbooks**
  - Reinforcing concepts by various problems
  - Used for homework or self-practice

- **Textbooks**
  - Math activities & thinking processes
  - Basic problems
  - Employed in classroom instructions

- **Self-learning books**
  - Summary of textbook contents, reading materials, or many problems
  - Not used by teacher
III–4. Revisions & Approval

- **Effort to Develop a Good Textbook**
  - Systematic & continuous review process leading up to the final version

- **Revisions of Elementary Math Textbooks**
  - 4 formal revisions made + writing team’s revisions
  - Year-long pilot experiment in schools (30): purposes
    - to confirm whether new series is appropriate
    - to collect data & feedbacks for revisions
    - to have the schools play a role in demonstrating the use of the new textbooks
III-4. Revisions & Approval

Revisions of Elementary Math Textbooks

- Teachers prepare 2 kinds of feedback: overall evaluation of textbooks & guidebooks + description of specific problems and possible solutions

- Appropriateness (5): Can instructional materials be easily used?
- Correctness (5): Are contents or terms correct?
- Novelty (4): Are contents realistic and creative?
- Connection (3): Are connections across grades reflected?
- Others (3): Are there contents that should be added?
## Approval of Secondary Math Textbooks

<table>
<thead>
<tr>
<th>Steps</th>
<th>Contents of Evaluations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic examination</td>
<td>• Contents examination • Vocabulary check • Korean language notation • Analysis of editing</td>
</tr>
<tr>
<td>Main examination (1st)</td>
<td>[Common criteria] e.g.) • Educational law-observance • Copyright</td>
</tr>
<tr>
<td></td>
<td>[Subject-specific criteria] • Reflection on curriculum • Teaching &amp; learning method</td>
</tr>
<tr>
<td></td>
<td>• Representations &amp; notations • Editing and outlook • Selection &amp; organization of contents</td>
</tr>
<tr>
<td></td>
<td>• Innovation</td>
</tr>
<tr>
<td>(2nd)</td>
<td>• Confirm whether feedbacks from the 1st exam are reflected</td>
</tr>
<tr>
<td>Teacher guidebooks</td>
<td>• Same as the process of textbooks • Both textbooks &amp; guidebooks need to be approved.</td>
</tr>
</tbody>
</table>
III-4. Revisions & Approval

Math-specific criteria (20)

- Does the textbook sufficiently reflect the nature, objectives, contents, teaching and learning methods, and assessment of the national curriculum?

- Does the textbook provide various and effective teaching and learning methods to foster logical thinking, inquiry, problem solving, creativity, reasoning, and applications based on mathematical concepts, principles, and rules?

- Does the textbook take advantage of novel ideas and organize contents in an innovative way?
II-4. Revisions & Approval

- **2 aspects emphasized**
  - Area of innovation → Encourage writers to pursue novel ideas contrary to long-term practices of “identical” textbooks
  - Approval of guidebooks → Urge publishers to produce high quality guidebooks

- **Alignment with the Curriculum**
  - Elementary: Review & Assessment Board
  - Secondary: Approval Committee
    - If not aligned, textbooks can’t be approved.
    - Mid 90’s: MOE limited # of approved textbooks (8/43)
      → Current: Approved by 20 criteria
    - Approval rates: 1/3 (middle), ½ (high)
I. Introduction: Background

II. Overview of Textbook Development

III. Writing of Textbooks

IV. Textbooks Selection and Use

- Selection and Payment
- Use of Textbooks
IV–1. Selection & Payment

Selection

✓ Elementary: Same textbooks
✓ Secondary: Great concern → Simple to Complex Procedure e.g.) committee comprised of all math teachers

Individual: Look over and score all math textbooks

Committee: Provide strengths & weaknesses of top 3 textbooks

Committee of school management: Finally select one

Payment for textbooks

✓ Government: elementary & middle school students
✓ Parents: high school students
→ Students own their math textbooks
IV-2. Use of Textbooks

- **Textbooks**
  - Regarded as a bible: Cover all topics
  - Absolute impact on students’ mathematical experience

- **Teacher orientation to new textbooks**
  - New curriculum is ready → Professional development provided in a top-down format
  - Difficult to develop deep understanding of the curriculum
  - Emphasize teacher autonomy in implementing the curriculum

The curriculum is interpreted locally by provincial educational offices, and in turn by each individual school, and finally reconstructed by the teacher.
IV-2. Use of Textbooks

Teachers

- Use as the most important teaching material.
- Tend to teach what it says.
- Reconstruction is limited e.g.) substituting manipulative, changing sequence

Students

- Regard as the main learning material.
- Elementary: Tend to solve every problem.
- Secondary: Learn basics → Tackle self-study or examinee’s book
IV-2. Use of Textbooks

Multiple Studies on the Curriculum Implementation through

- Review of curriculum materials
- Interviews with teachers
- Questionnaires for teachers & supervisors
- Classroom observations

How do we monitor if the teacher is using the curriculum correctly?
The more teachers understand the intention of the curriculum, the greater the likelihood they will implement it as intended.

+ • Aware of the **overall characteristics** of the curriculum
  • Attempt to activate the ideas of **student-centeredness** in classrooms as reflected in teaching objectives, contents, methods, & assessment.

− • Implementation at the local school level has been **insufficient**. e.g.) teachers’ limited reconstruction of the contents
Outline

I. Introduction: Background

II. Overview of Textbook Development

III. Writing of Textbooks

IV. Textbooks Selection and Use

V. Closing Remarks
V-1. Contents & Design

Good quality of textbooks encompasses both contents & design

**Contents**
- Alignment with the curriculum
  - Confirmed by multiple means (elementary); approval criteria (secondary)

**Design**
- Cheap or free textbooks → many restrictions
- New concern

- Current: Induce students’ engagement and interest by considering editing & design of textbooks
V-2. Teacher Involvement

✅ Teacher involvement called for & increased

+ • More than 50 elementary school teachers
  • Almost all teams developing secondary math textbooks include middle or high school teachers
  • Half of the approval committee are secondary school teachers

− • Breadth of real engagement is limited
e.g.) Professors determine the overall directions → Vertical collaboration seems dominant.

⚠️ Work load of authors
✅ Not have released time → difficult to focus on authoring textbooks → greater institutional efforts needed
The regularity and depth of research have been insufficient.

**Basic research needed**
- Essential contents in school math
- Critical criteria for approval
- Main functions & types of textbooks
- Models of textbooks

**More comprehensive study called**
- Various needs of society
- Educational environment
- Students’ learning of math at each grade level
- Textbooks usage & concomitant analysis
Concern: Once developed or approved, the textbook is used all the way.

Teacher interviews & surveys

- Field test of textbooks needs to receive greater emphasis & scrutiny

Classroom observations & subsequent analyses

Errors or mistakes of textbooks

- Constant evaluation or revision system needs to be implemented while the textbook is being used

Degree of fit with the curriculum, Opportunity to learn, Appropriateness of themes, etc

Whereas textbook development has been the sole focus, its revision is now being called for.
V-4. Variety of Textbooks

 Variety: 3 different meanings

 ✓ Various textbooks: constructions of contents: media

 1st: Various textbooks

 ✓ Related to the issue of government-issued, - approved, or free-issued.

 ✓ Elementary: Open question as to whether multiple teams authoring various textbooks would be better

 ✓ Secondary: Criteria & process of approval

  - Criteria: strict for alignment & inclusive for creativity
  - Process: problem of staffing an approval committee & lack of time for careful examination.
2\textsuperscript{nd}: Various constructions of contents

- Single textbook covers both basic math & applied math.
- Low- & high-achieving students tend to study the same contents.

3\textsuperscript{rd}: Various media

- Related to different types of textbooks (e.g.) e-textbooks & other materials using multimedia.

How to evaluate students within Korean education system & culture.

- 3 different textbooks?
- 1 main textbook with 3 learning materials tailored to students’ ability?
V-5. Students’ Interest

Concern: Negative dispositions & lack of confidence

How to promote students’ interest & dispositions

- More concrete activities
- Episodes related to students' daily lives
- Historical contents
- Various games & puzzles

Not enough?
V-6. Teacher Guidebooks

Current

• Powerful in shaping instruction
• Teachers: Less satisfied
• Secondary: Once the textbook is approved, its guidebook is easily approved

Future

• Include more detailed explanations of curriculum & various instructional materials
• Need to go through systematic evaluation & revision procedure
Thank You