An overview of the Korea’s 2022 revised mathematics curriculum

Kyeong-Hwa Lee
Seoul National University, South Korea
Contents

01 Background of the 2022 revision
02 Major changes in the 2022 revision
03 Lessons learned and prospects
• China and Korea share many cultural similarities, but would the school mathematics curricula and revision processes for the two countries be similar as well? If not, why and how?

• How can we research the processes as well as the outcomes of the curriculum revision for the two countries?
01 Background of the 2022 revision
The curriculum revision I will introduce today is called the '2022 Revision.' Can you guess what '2022' means here. Is it:

1. the year the revision study was begun?
2. The year the revised curriculum was first applied?
3. The year the final outcome of the revision was released?
Historical background: 5 major periods of Korean education

- **Until the 19th century**: Focused on ethics based on Confucianism and Buddhism, mainly for fostering the moral character of students.

- **1945 ~ 1960**: After the independence and the Korean War, education played a pivotal role in national recovery and overcoming the crisis.

- **1960 ~ 1980**: Rapid quantitative growth achieved in education to foster talents required for industrial development.

- **1980 ~ 1990**: Qualitative growth completed by improving curricula and the educational environment as well as training for teachers.

- **1990 ~ present**: The rights of students, parents and teachers are stressed while leaning towards decentralization and autonomy of education.
1. **1946~1953**: A list of topics to be covered with broad instructional recommendations was presented.

2. **1963~1973**: A list of topics to be covered with pedagogical principles and strategies to promote conceptual understanding was presented.
3. **1982~1992**: Real-world problem-solving was emphasized throughout the math curriculum.

4. **1997~2022**: Diagnostic teaching and process-oriented assessments to facilitate students’ self-regulated learning and critical thinking, were highlighted in the curriculum documents.
The catchphrase for the 2022 revision was **Consensus-based curriculum** (MOE, 2021b)

Diverse voices from academic societies, teachers, and NGOs to monitor the process of getting consensus

1. The National Education Commission established a new vision based on social consensus

2. The Curriculum Revision Promotion Committee coordinated conflicts between subjects to reach an educational consensus.

3. Coherence pursued by acquiring a consensus among all the revision research teams

4. Openness

Discussions on and on and on...

➔ 4 major issues emerged
Issue 1: To narrow the achievement gap

- Compared to other countries, the transition to online education has been relatively successful.
- Still, the achievement gap, deepened even further by the digital divide, is significant and undermines academic performance among low-income, underserved students and school districts.
Issue 2: To update content and pedagogy to fit the era of AI

ChatGPT banned in Italy over privacy concerns

Shiohira, K. (2021)

https://robbreport.com
https://www.thestar.com.my
Issue 3: To pursue equity and inclusivity

The OECD Learning Compass 2030 (https://www.oecd.org/education/2030-project)

- Knowledge
- Skills
- Attitudes
- Values

Transformative competencies
- Creating new values
- Taking responsibility
- Reconciling tensions & dilemmas

Core Foundations
- Anticipation
- Action
- Reflection

Action Cycle
Family got impoverished as a result of excessive spending on the children’s private tutoring.

Issue 4: To break the test-centric mathematics education

- Excessive competition
- Negative attitudes
- Rote Learning
- Reform-proof teaching
- Gap between the national curriculum and the curriculum implemented by teachers

The pressure to prepare for the future makes students unhappy.

Side effects of test-centric math education
Resolving the four issues was already complex, but since new issues were constantly being added throughout the entire process, the 2022 revision was extremely complex.

This is a good time to ask, What do we really know? How much of what we think we know is based on a firm knowledge base, how much on informed guesswork, how much is really just opinion? How much of what we plan to do reflects cultural biases, rather than established fact? (Schoenfeld, 1994, p.55)
Conflicts and contradictions

• Majority of diverse voices were **criticisms** or some kinds of demands to the 2015 revised math curriculum.

• Depending on which institution or community they belong to, such as teachers, students, parents, researchers, NGOs, policy makers, industry, universities, etc., the language and logic used were different. This includes different rules, strategies, division of labor, purposes, and tools in terms of the aspects, meanings, and solutions of the raised issues. Even the same term such as mathematical learning can be used with **different meanings by different participants**.
Activities are open systems. ... contradictions generate disturbances and conflicts, but also innovative attempts to change the activity. (Engeström, 2001, p.137)

➔ Is it possible and relevant to analyze the contradictions in each activity system and the communicative conflicts arose between the activity systems to explore the process as well as the outcomes of the 2022 revision? Why not?
Six activity systems interacted in the process of the 2022 revision

- Mathematics teaching (MT)
- Mathematics education (ME)
- General education (GE)
- Mathematics and statistics (MS)
- Educational policy (EP)
- Advisory committee (AC)

Number of Participants of Sub-teams:
- MT: 25
- ME: 14
- MS: 3
- GE: 4
- EP: 16
- AC: 2
Roles and contributions

- **MT**: Reflect on and examine the current mathematics curriculum, propose what should be maintained and improved
- **ME**: Review international mathematics curricular revision trends, utilize findings to suggest innovative changes, communicate with and reconcile diverse stakeholders’ voices
- **MS**: Analyze the vertical and horizontal connections in school mathematics to refine core ideas of each content stream and learning objectives
- **GE**: Establish a vision and goals to pursue, as well as a desired human character to cultivate, in the curriculum of each subject, and develop a common document structure for all subject curricula to follow
- **AC**: Scrutinize the revised version and present suggestions for improvement
- **EP**: Monitor the entire process of revising the curriculum
The 2022 revision refers to the curriculum that started the revision study in 2020, and completed the study to finally announce the curriculum in 2022, and it will be first implemented in elementary schools in 2024 and in high schools in 2025.
The curriculum revision I will introduce today is called the '2022 Revision.'
Can you guess what '2022' means here. Is it:

1. the year the revision study was begun in 2020
2. the year the revised curriculum will be first applied in 2024 for elementary and in 2025 for high school
3. the year the final outcome of the revision was released
02 Major changes in the 2022 revision
Major changes

01. Changes to the goals and content framework

02. Changes to the elementary and middle school content and methods

03. Changes to the high school content and methods
Major changes

01 Changes to the goals and content framework

- How can we better present goals to support practitioners’ deeper understanding of the revision perspective?
- What would be a better form of content framework to enhance epistemic quality of mathematics teaching and learning?
The significance and meaning of the main items in the document presented. It also provides directions for understanding and utilizing the curriculum document, to enable informed decision-making on mathematics teaching.

- **2015 revision**
  - Nature of mathematics
  - Goals
  - Content framework
  - Achievement standards
  - Explanation on achievement standards
  - Teaching and learning standards
  - Assessment standards

- **2022 revision**
  - Directions of the revised curriculum

• To support teachers to interpret and implement specific achievement standard in a relevant way.
It is important not only to acquire knowledge but also to cultivate **processes and attitudes towards** mathematics and learning mathematics. (GE, ME perspective)

Overall, there is a consensus among all parties involved, but when it comes to specific details, there are noticeable discrepancies in their respective positions.

It is impossible to implement competency standards if they cannot be **clearly observed and evaluated**. (MT perspective)

An increasing number of students who have not properly learned the foundational knowledge are **experiencing difficulties in their tertiary education**. (MS perspective)

Lee et al. (2021)
Kim et al. (2021)
Changes to the goals

• The conflicts were negotiated by replacing “creativity and convergence” for “connections”

2022 revision

Problem-solving  Reasoning
Communication  Information processing

Connections

Problem-solving  Reasoning
Communication  Information processing
Creativity and convergence  Attitudes and practice

• Nurturing the six competencies were the goals of the 2015 revised math curriculum

2015 revision

GE, EP
MT, ME
ME, MS, GE
The updated goals are to ensure that all students:

(1) actively and confidently solve various problems by understanding and utilizing mathematical knowledge. *(Problem-solving)*

(2) develop interest and curiosity in mathematical facts, make conjectures and reason through justifications. *(Reasoning)*

(3) communicate about mathematical thinking and strategies, and recognize the convenience of mathematical expressions. *(Communication)*

(4) explore the relationships between mathematical concepts, principles, and laws, and recognize the usefulness of mathematics by applying it to real-life situations or other subjects. *(Connections)*

(5) use manipulatives and digital tools appropriately to suit the purpose, collect and process data, and make reasonable decisions based on information. *(Information processing)*

→ Are there any patterns you can identify among the phrases colored in red, black, and blue in the sentences above?

MOE (2022)
• The blue represents mathematical knowledge, the black represents mathematical processes, and the red represents values and attitudes.

⇒ The goals can be achieved through a balanced learning approach that integrates the three categories of knowledge, processes, and values.
Updated the content framework to promote a more comprehensive understanding and a balanced approach to learning.

Updated the achievement standards to enhance students’ deeper understanding of mathematics and the world, fluency with mathematical processes, and positive attitudes towards mathematics and learning.
The framework aims to support teachers in planning and delivering high-quality mathematics lessons that incorporate not only knowledge and key activities, but also affective aspects that students may experience throughout the process of activities.

The framework is designed as a tool for teachers’ autonomous judgement and artistic choice, like a palette, rather than a restriction.  

**Core-Ideas**
- Plane figures are categorized into various forms, and each plane figure has its own unique properties

**Knowledge & Understanding**
- Basic figures, geometric construction and congruence, properties of plane figures (Grade 7)
- Properties of triangles and quadrilaterals, similarity of figures, Pythagorean theorem (Grade 8)
- Trigonometry, properties of circles (Grade 9)

**Processes & Skills**
- Connection of points, lines, and planes in various situations
- Explaining properties of figures and the process of constructing a triangle
- Distinguishing between congruent and similar triangles
- Finding the length, area, surface area, and volume of figures
- Using concrete models or digital tools to solve problems
- Justifying the properties of figures
- Finding the ratio of similarity, values of basic trigonometric ratios
- Solving problems using trigonometric ratios

**Values & Attitudes**
- Recognizing the need for proof and the usefulness of Pythagorean theorem and trigonometry
- Interest and curiosity in Pythagorean theorem and trigonometry
- Interest and curiosity in architecture, cultural heritage, and art works that utilize properties of figures
- Adopting a systematic approach to thinking and persuading others rationally by utilizing various methods of justification
- Developing a critical thinking attitude based on mathematical evidence through justification

Content framework of the 2022 revision
<table>
<thead>
<tr>
<th>Core-Ideas</th>
<th>Content elements of data and chance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Elementary (Grade 1~6)</td>
</tr>
<tr>
<td>Knowledge &amp; Understanding</td>
<td></td>
</tr>
<tr>
<td>Processes &amp; Skills</td>
<td></td>
</tr>
<tr>
<td>Values &amp; Attitudes</td>
<td></td>
</tr>
</tbody>
</table>

- Same content streams for elementary and middle school mathematics
- Same core-ideas for elementary and middle school mathematics

➢ The integration of elementary and middle school math aims to resolve the transition problem from elementary to middle school.

MOE (2022)
The introduction of core ideas was intended to pursue a deep understanding and teaching mathematics with high transferability. Three to four core-ideas presented for each content stream that connect concepts, processes, and attitudes vertically as well as horizontally. It is expected that teachers will design their lessons by relating the core ideas to specific content elements.
Four types of Core-ideas

The underlying structure of vertical connections
Ideas that serve as the basis for various mathematical topics

Basis

Means of horizontal connections
Ideas that enables integration with real-life and cross-curricular connections

Integration

The upper structure of vertical connections
Ideas that are helpful to view various mathematical topics from a higher perspective

Advanced viewpoint

The aesthetics and usefulness of mathematics
Ideas that relate understanding the beauty of mathematics as a pattern science and the value of mathematics within and outside the mathematical world

Value
The process of developing the content framework was by no means smooth.

What conflicts do you think we encountered during this time?
Voices from the activity systems

• Although the processes and skills, values and attitudes are all important and should be nurtured during the learning of mathematics, there is a possibility that some teachers may consider only the processes and skills, values and attitudes presented in the content framework as important. This could lead to a distortion of the processes and skills, values and attitudes during evaluation.

(ME and MT perspective)

Lee et al. (2021)
Voices from the activity systems

• If processes and skills, values and attitudes are integrated, then we should evaluate them in a reasonable way. How can we observe and evaluate students’ affective achievements in relation to specific knowledge, and why is this important? (MT, ME and MS discussion)

• To teach processes and skills, and values and attitudes along with knowledge, sufficient class time is necessary. Currently, there is not enough time to teach only the required knowledge. Isn't this demanding too much? (MT, AC perspective)

→ Discussions about the burden of learning and difficulties in class continued until the final moments of the 2022 revision, but an agreement was reached based on the content framework presented earlier, taking into consideration alignment with the initially set goals and visions.

Lee et al. (2022a,b)
Major changes

How can we change the content and methods of elementary and middle school mathematics to reflect the demand for narrowing achievement gap, AI-based, equity and inclusivity-based mathematics education and move away from test-centered mathematics education?
1. Updated the content to alleviate the learning load, to pursue in-depth learning, to facilitate statistical modeling and problem solving, to promote digital literacy, and to cultivate mathematical competencies. For example,

• Removed achievement standards (to alleviate the learning load)
  Ex) [4M02-05] Use the movement of plane shapes to create regular patterns

• Added achievement standards (to pursue in-depth learning)
  Ex) [4M02-03] Use the equal sign to express that two quantities have the same magnitude.
Changes to the elementary school math

• Revised achievement standards (to facilitate statistical modeling and problem solving)
  Ex) [6M04-03] Pose a statistical question, collect and describe relevant data, represent it using appropriate graphs, and interpret it.

• Integrated achievement standards (to alleviate the learning load)
  Ex) [6M02-01] Understand the meaning of congruence of shapes through specific manipulative activities and identify congruent shapes, and [6M02-02] Find corresponding points, sides, and angles in two congruent shapes and understand their properties have been integrated into [6M03-01] Understand congruence of shapes, explore and explain the properties of congruent shapes.

MOE (2022)
2. Updated the teaching and learning methods to
   • enhance self-regulated learning
   • encourage tailored instruction for students
   • integrate cross-curricular learning themes and connect with other subjects
   • balance between online and offline teaching and learning
   • strengthen career-linked mathematics education
   • increase the weight of process-centered assessment
   • link elementary and middle mathematics
1. Updated the content to alleviate the learning load, to pursue in-depth learning, to facilitate statistical modeling and problem solving, to promote digital literacy, and to cultivate mathematical competencies.

- Removed achievement standards
- Revised achievement standards
- Integrated achievement standards
- Added achievement standards (to promote statistical modeling and digital literacy)

Ex) [9M04-08] Use digital tools to present data in box plots and compare distributions.

MOE (2022)
Digital tools for math teaching and learning (Developed with government support)

AI-based (Grade 1 & 2 Math)

Inquiry-based (All school level)

Statistics-focused (All school level)
2. Updated the teaching and learning methods to
   • enhance self-regulated learning
   • encourage tailored instruction for students
   • integrate cross-curricular learning themes and connect with other subjects
   • balance between online and offline teaching and learning
   • increase the weight of process-centered assessment
   • link elementary and middle mathematics
   • strengthen career-linked mathematics education
Changes to the middle school math

• Ways of strengthening career-linked mathematics education
  
  • Design and implement a statistical project by setting inquiry questions that match the interests, concerns, and career goals of students during the free-learning semester.

※ ‘Free-learning semester system’ refers to a program where middle school students can take a semester off from their regular coursework to pursue independent study, internships, or other activities related to their personal interests or career goals. The aim of the program is to provide students with an opportunity to explore their passions and develop practical skills that can help them make more informed decisions about their future career paths.

• Support students by providing guidance on high school mathematics curriculum and related career paths, to help them prepare for their future more concretely.

Lee et al. (2022a)
High school math subjects were restructured to comply with the credit system that will be adopted starting from 2025.

※ The purpose of introducing the high school credit system is as follows:
• to stimulate students' learning motivation and interests through personalized education
• to cultivate the ability of students who will live in a rapidly changing future society to explore their own career paths and learn independently
• to maximize the abilities of each individual student with diverse skills and aptitudes, rather than vertically ranking students with different learning speeds and goals (MOE, 2021a)
Revised structure of high school math courses

**Common**

- <Common Math 1, 2>  
  (<Basic Math 1, 2>)

**Grade 10**

- <Algebra>
- <Probability and Statistics>
- <Mathematics for Economics>
- <Practical Statistics>

**Grade 11~12**

- <General>
  - <Algebra>
  - <Calculus I>
  - <Probability and Statistics>

- <Career-related>
  - <Calculus II>, <Geometry>, <Mathematics for Economics>, <Mathematics for Artificial Intelligence>, <Mathematics for Workplace>

- <Convergence>
  - <Mathematics and Culture>, <Practical Statistics>, <Mathematical Investigation>
There is a high possibility that only three general elective subjects will be reflected in the university entrance exam, so to cultivate manpower in STEM fields, students only study mathematics in the amount that is just enough, which is clearly insufficient. Therefore, there is a need to increase the number of general elective subjects or to reflect some of the career elective subjects in the university entrance exam. (MS, ME, MT, & AC perspective)

It is necessary to alleviate the burden of learning. However, allowing students to take only some of the three general elective subjects is not sufficient to establish the foundation for future learning. Since there are advantages and disadvantages depending on which subjects are chosen, it is not appropriate to leave the choice to students. (MT, ME, MS, & AC perspective)
Conflicts between the activity systems

Career-related

<Calculus II>, <Geometry>, <Mathematics for Economics>, <Mathematics for Artificial Intelligence>, <Mathematics for Workplace>


To meet the demands of students, many subjects need to be opened, but it becomes difficult to run high-quality classes when there are too many subjects to handle. (MT & ME perspective)

Letting students choose important math courses is a contradiction. If students are allowed to choose, there is a higher probability that they will choose courses that are more interesting to them rather than the fundamental ones. (MS & ME perspective)

Lee et al. (2022a,b)
<Mathematics and culture> will stimulate the interest in mathematics for underachieving students, but it may not be helpful for university entrance exams or career exploration. How should teachers respond when parents and students have conflicting opinions regarding subject selection? (MT perspective)

All of the convergence elective subjects consist of enjoyable content that can be learned through self-directed student learning. If properly operated, it is an excellent opportunity to foster a positive attitude towards mathematics. (Ge & ME perspective)
1. Updated the content to alleviate the learning load, to pursue in-depth learning, to facilitate statistical modeling and problem solving, to promote digital literacy, and to cultivate mathematical competencies.

- Removed achievement standards
- Revised achievement standards
- Integrated achievement standards
- added achievement standards (to cultivate mathematical competency)
Case 1: Matrix

- Important concept to learn for the next generation
- Essential tool in mathematical modeling
- Adding learning content is inappropriate
- Matrix should only be taught in the elective subject
Case 2: Definite Integral

- 2009 revision: The limits of Riemann sums
- 2015 revision: Anti-derivatives
- 2022 revision: The area under the curve

Balance between alleviating the learning load and pursuing in-depth learning
What do we really know about students’ learning?

Ascending and Descending (M.C. Escher, 1960)
2. Updated the teaching and learning methods to

- enhance self-regulated learning
- encourage tailored instruction for students
- integrate cross-curricular learning themes and connect with other subjects
- balance between online and offline teaching and learning
- strengthen career-linked mathematics education
- increase the weight of process-centered assessment
03 Lessons learned and prospects
• It is expected that the achievement gap issue will be partially resolved through improvements in achievement and assessment standards, the teaching and learning environment, teaching and learning strategies, and assessment.

• The updated learning content, elective courses, career-linked education, and digital literacy education will create more equitable and inclusive opportunities for students who will live in the age of artificial intelligence.
The problem of test-centered mathematics education is chronic, so it is difficult to expect it to be solved immediately. In the 2022 revision, we have specified that process-oriented assessment will be used as feedback for diagnostic teaching, rather than as a ranking system. This change may alleviate the negative effects of test-driven mathematics education.
Lessons learned and prospects

• We believe that the revised document is a valuable compromise that has been reached after countless clashes of perspectives from various stakeholders, including not only a group of curriculum experts but also teachers, researchers in other fields, policymakers, students, parents, NGOs, and others.

• Given the diversity of the participants in the revision process, the interpretation of the 2022 revision should be conducted with care and creativity while considering the mixture of thoughts, demands, language, logic, and evidence.
It is uncertain whether the consensus-based approach we have tried to depend on has worked really well as a strategy for revising the math curriculum. However, we are sure that it has been a way to break the fixed image of the math curriculum that many of us have held and to move away from a "transparency illusion" (Chevallard, 1992) about the math curriculum and the process of revising it.
References

Thank you for your attention
Q & A