

An overview of the Korea's 2022 revised mathematics curriculum



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02

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Before we begin, let's think about...



- 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?



2022.01.19. ppkjm@newsis.com

더 나은 미래, 모두를 위한 교육
2022 개정 교육과정 총론 주요사항시안

2022교육과정
모두를 위한교육
개정 총론주요사항



(교육과정정책과)

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.

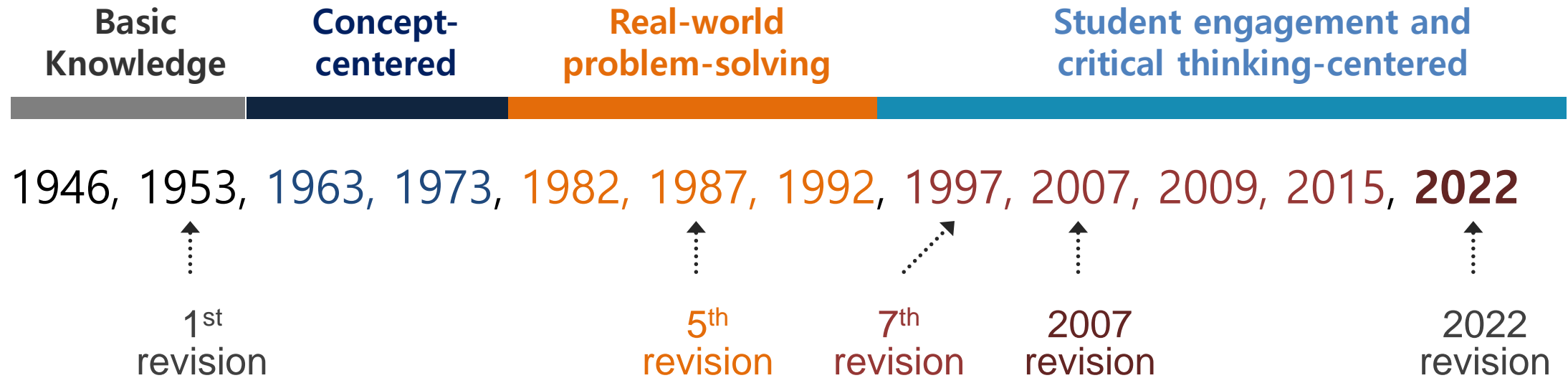
1980 ~ 1990

Qualitative growth completed by improving curricula and the educational environment as well as training for teachers.

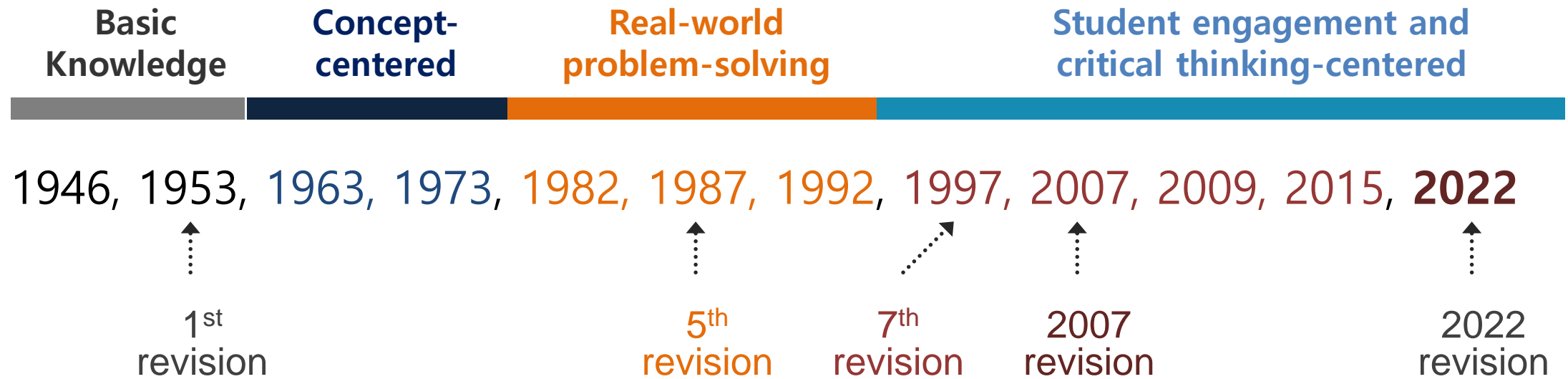
1990 ~ present

The rights of students, parents and teachers are stressed while leaning towards decentralization and autonomy of education

Historical background: Modern mathematics education in Korea



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.

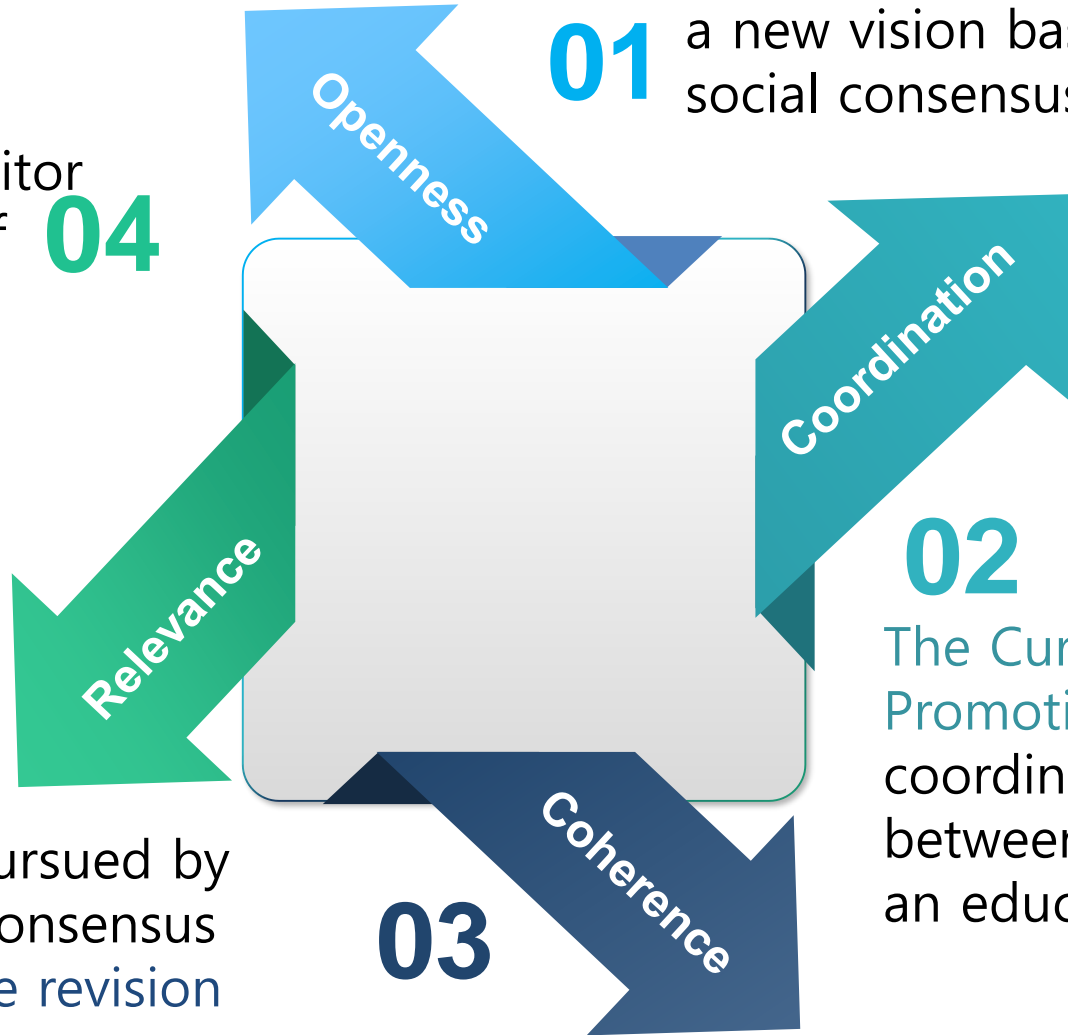
The catchphrase for the 2022 revision was Consensus-based curriculum

(MOE, 2021b)

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

04

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



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

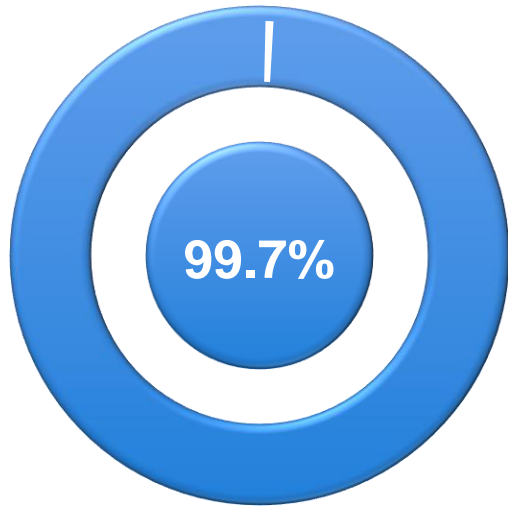
The Curriculum Revision Promotion Committee coordinated conflicts between subjects to reach an educational consensus.



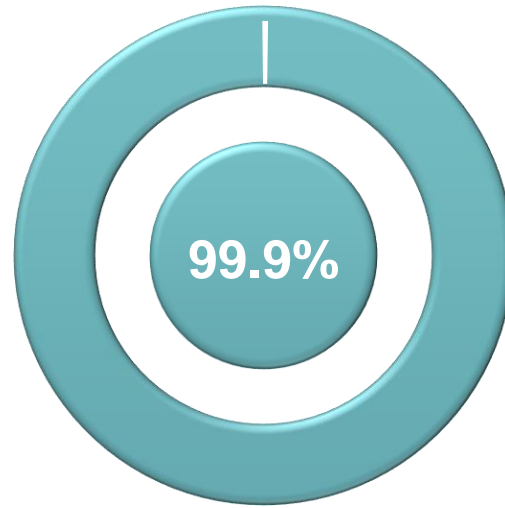
Discussions on and on and on...

→ 4 major issues emerged

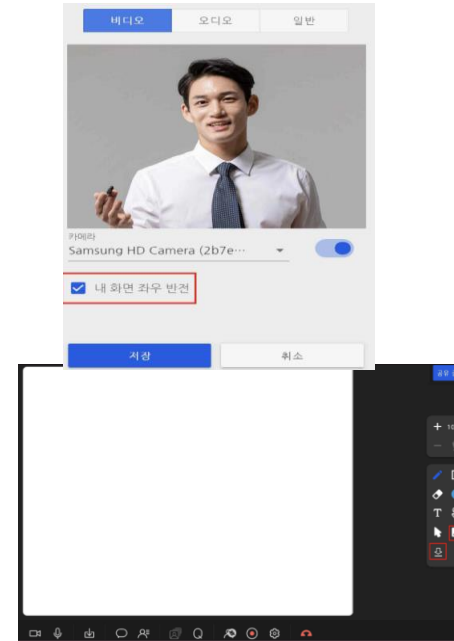
Issue 1: To narrow the achievement gap



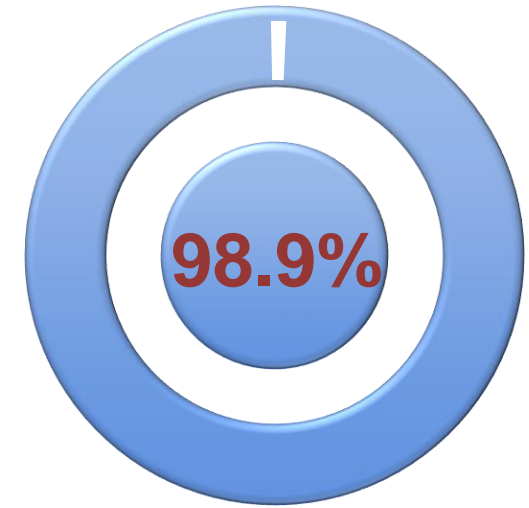
Households with internet access



Adolescents with internet access



MOE(2020)



K-12 students participated in online education

- 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



BBC NEWS

ChatGPT banned in Italy over privacy concerns

<https://www.bbc.com/news/technology-65139406>



<https://robbreport.com>

<https://www.thestar.com.my>

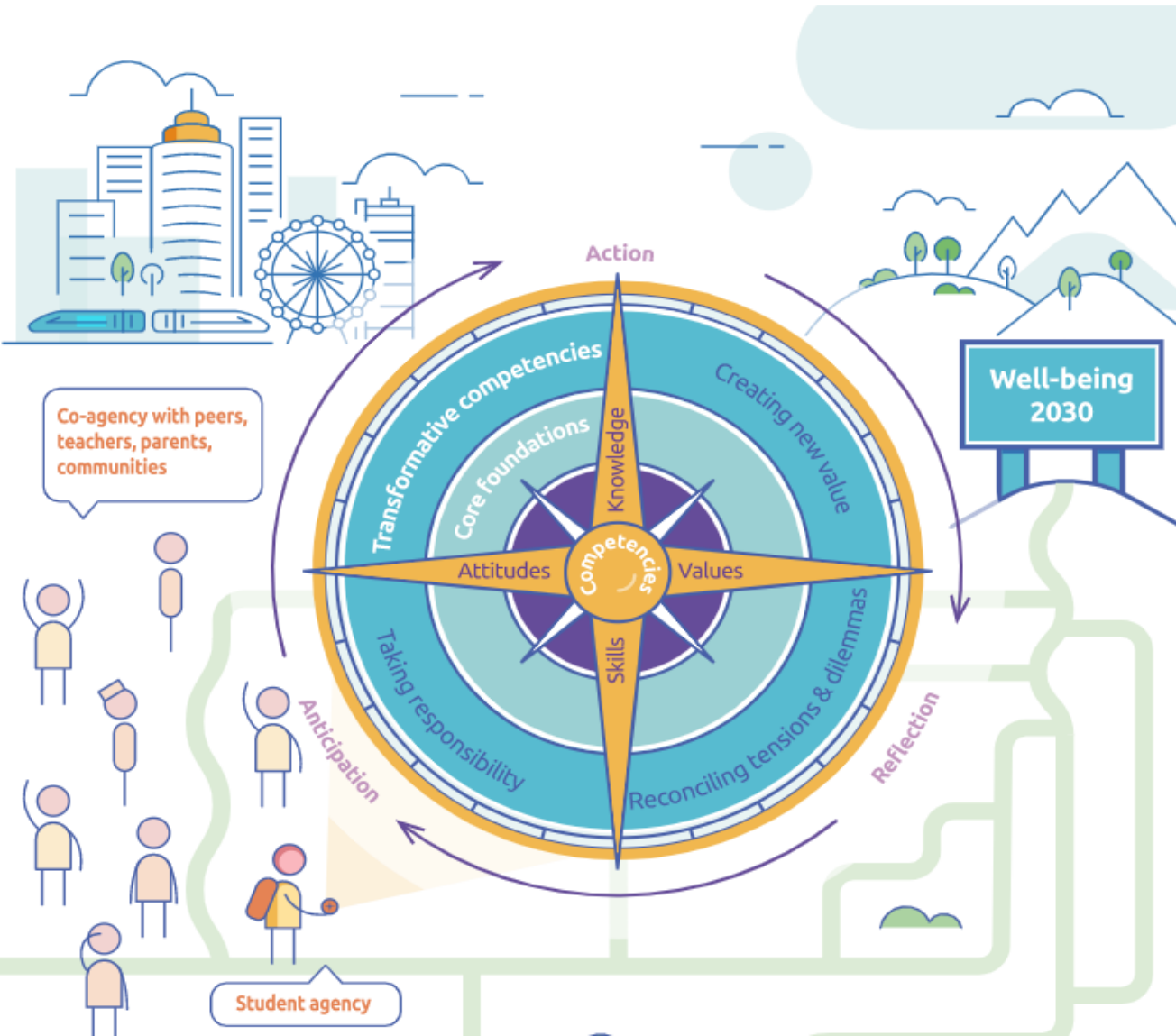


Shiohira, K. (2021)

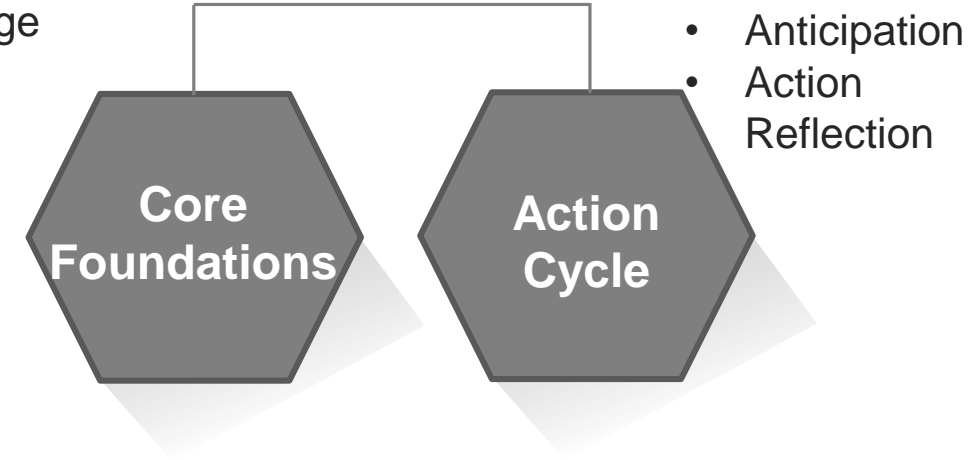
Issue 3: To pursue equity and inclusivity



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



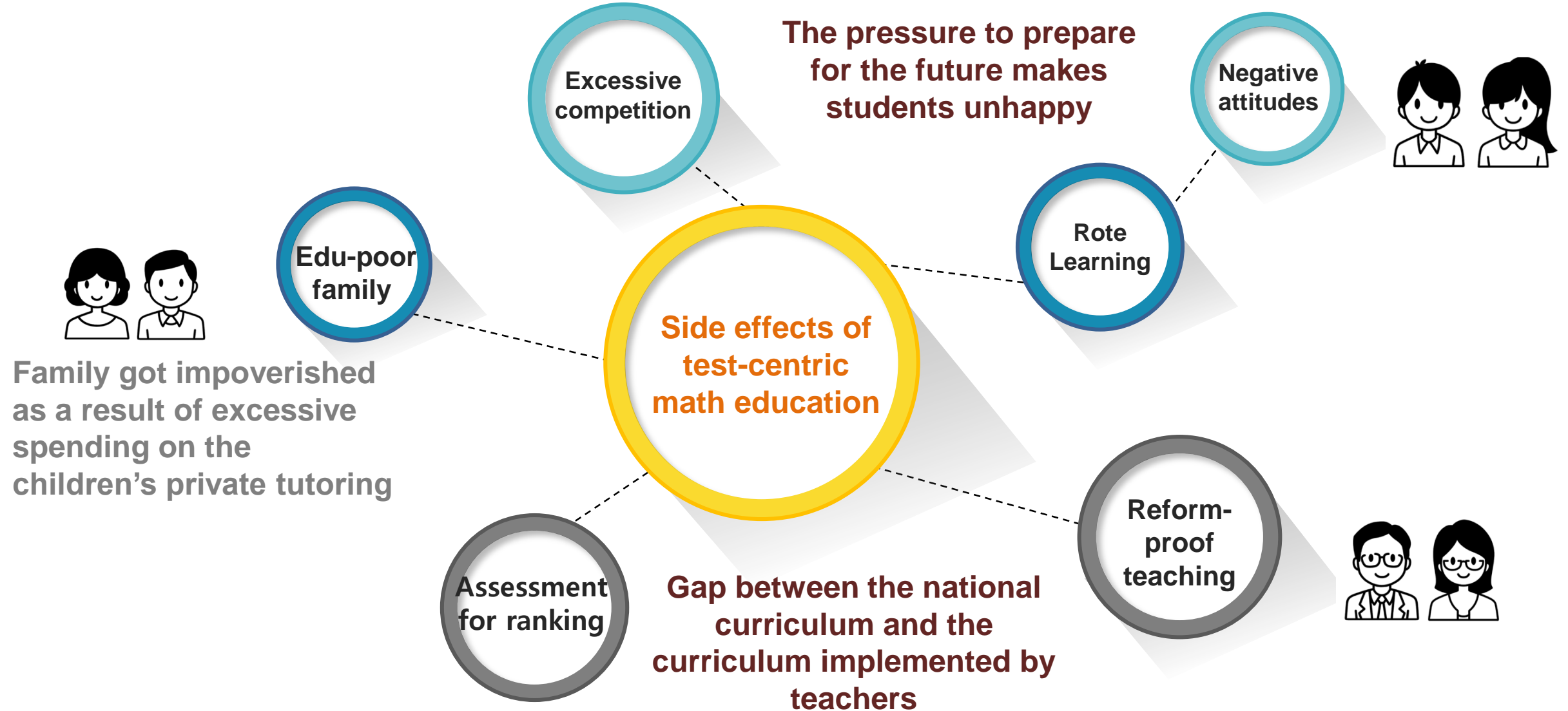
- Knowledge
- Skills
- Attitudes
- Values

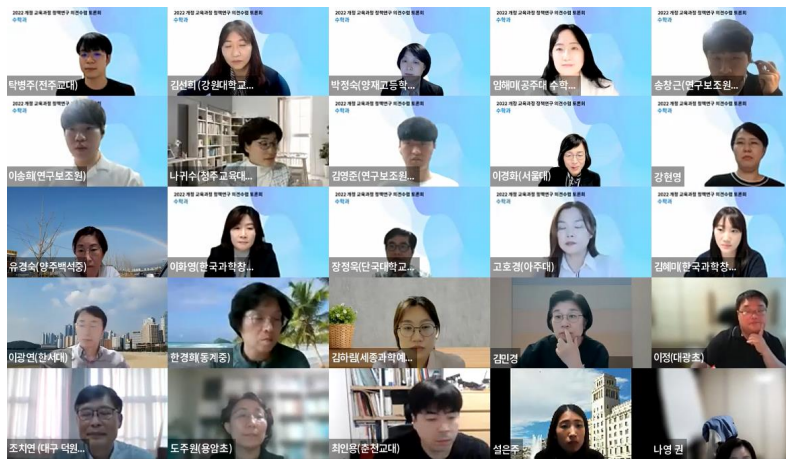


Transformative competencies

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

Issue 4: To break the test-centric mathematics education





**Discussions on
and on and on...**



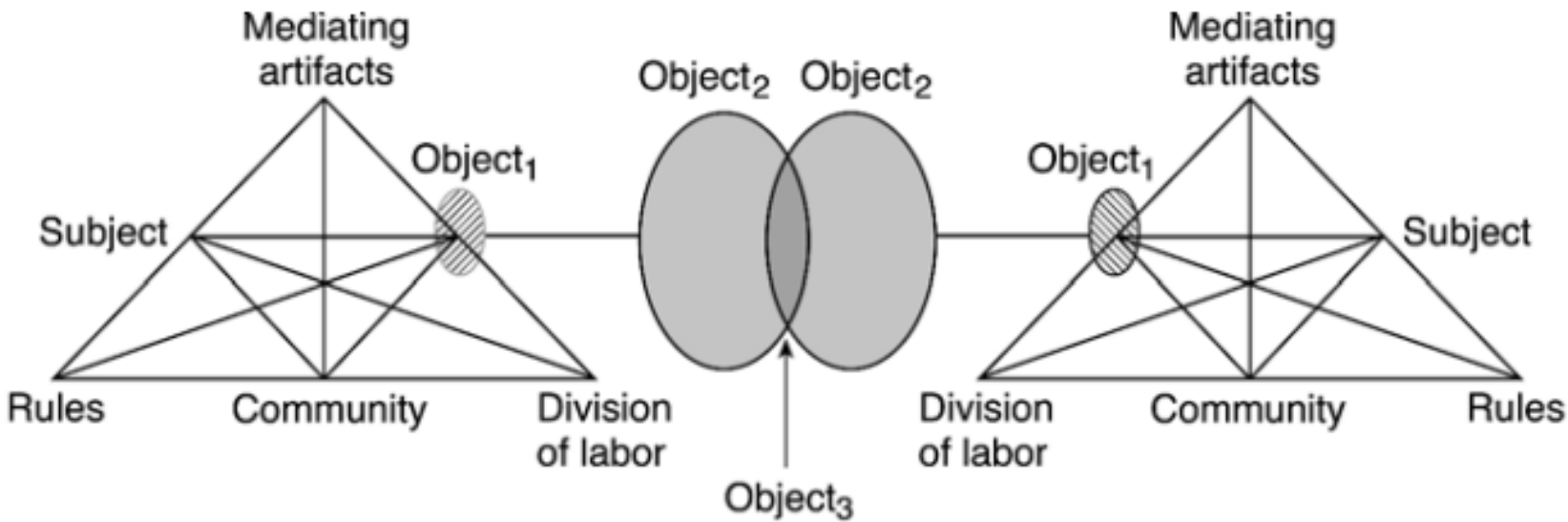
➔ Resolving the four issues was already complex, but since new issues were constantly being added throughout the entire process, the 2022 revision was extremely complex.

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**.



Two interacting activity systems as minimal model for the third generation of activity theory (Engeström, 2001, p.136)

Activities are open systems. ... contradictions generate disturbances and conflicts, but also innovative attempts to change the activity.

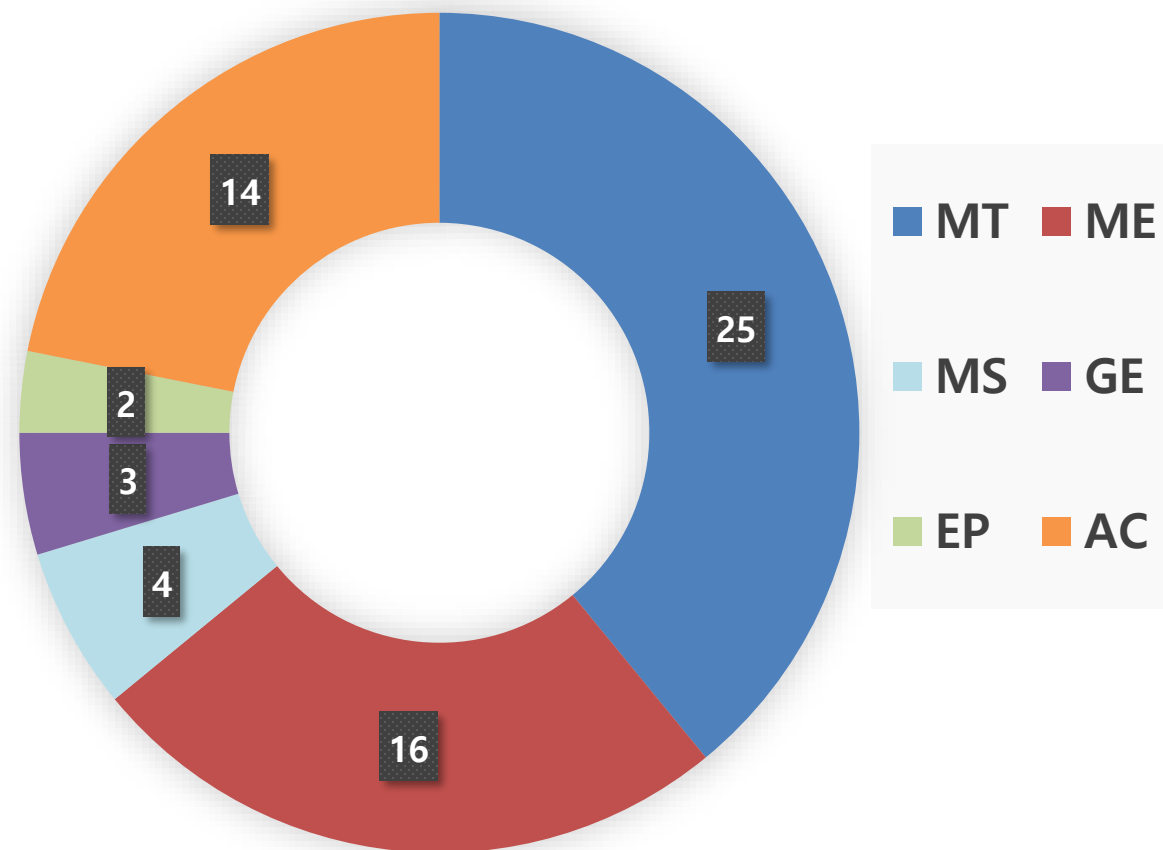
(Engeström, 2001, p.137)

→ 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)

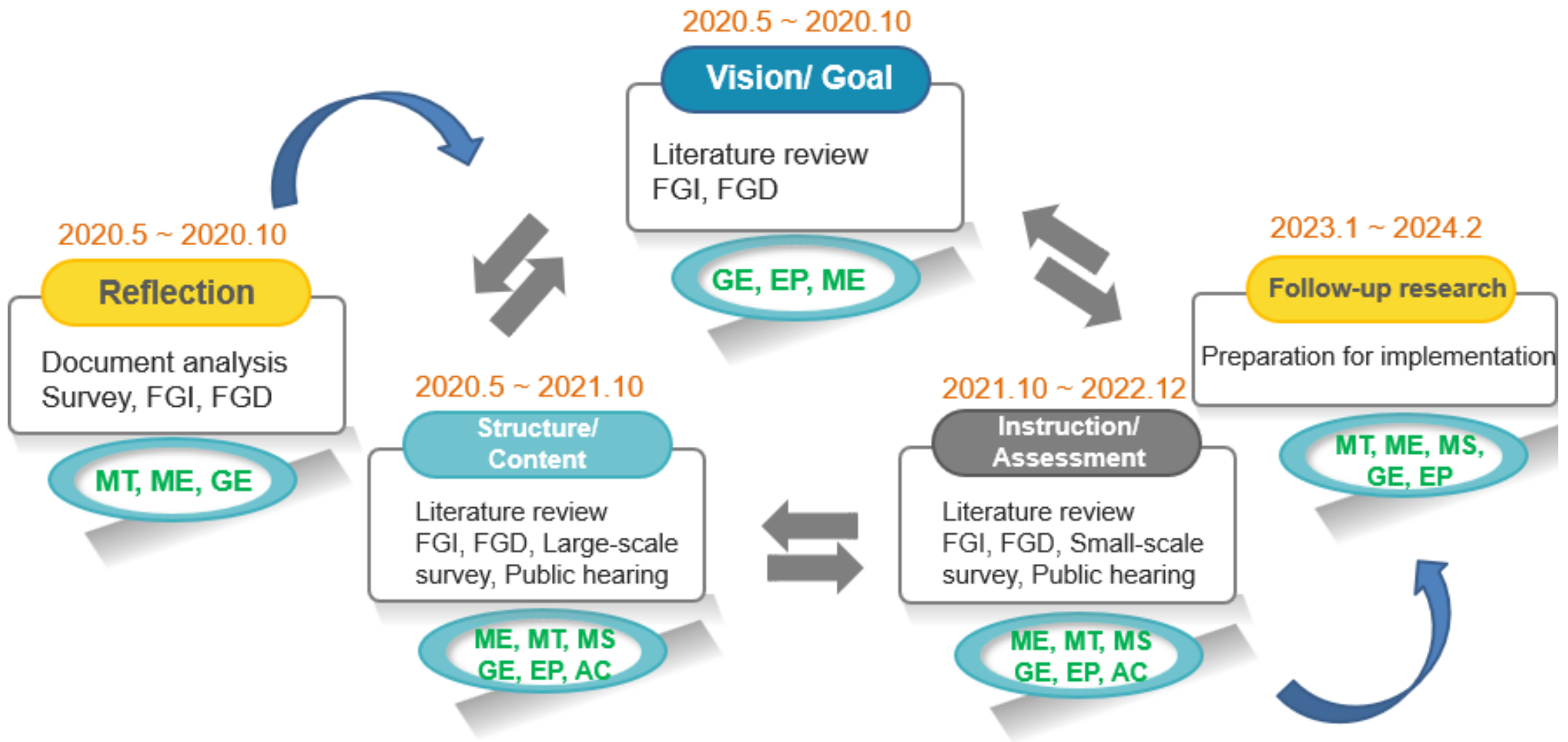
Number of Participants of Sub-teams



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



INNOVATION & CONTRIBUTION

Seoul National University College of Education



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?



Teacher-friendly curriculum



2022 revision

- Directions of the revised curriculum



- Nature of mathematics
- Goals

- Content framework
- Achievement standards

- Explanation on achievement standards

- Teaching and learning standards
- Assessment standards

2015 revision

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.

- To support teachers to interpret and implement specific achievement standard in a relevant way

Voices from the six activity systems



It is important not only to acquire knowledge but also to cultivate **processes and attitudes towards** mathematics and learning mathematics. (GE, ME perspective)

- Nature of mathematics
- Goals

- 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)

2020.5 ~ 2020.10

Reflection

Document analysis
Survey, FGI, FGD

MT, ME, GE

2020.5 ~ 2021.10

Structure/ Content

Literature review
FGI, FGD, Large-scale
survey, Public hearing

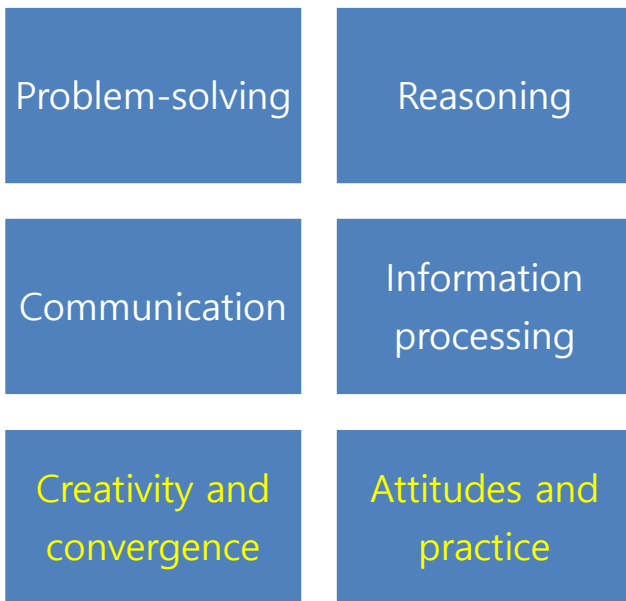
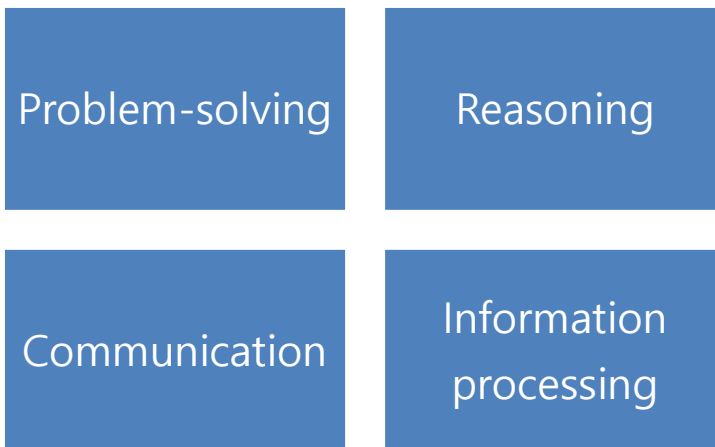
ME, MT, MS
GE, EP, AC

Lee et al. (2021)
Kim et al. (2021)

Changes to the goals



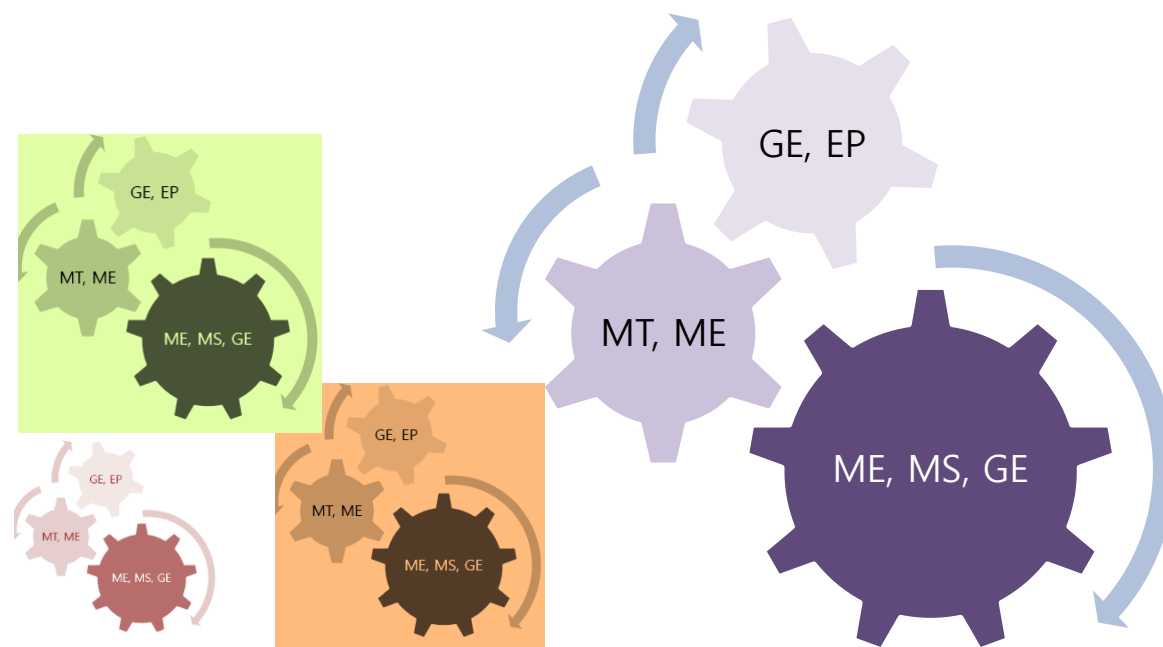
2022 revision



Connections

2015 revision

- The conflicts were negotiated by replacing "creativity and convergence" for "connections"



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

The updated goals are to ensure that all students:

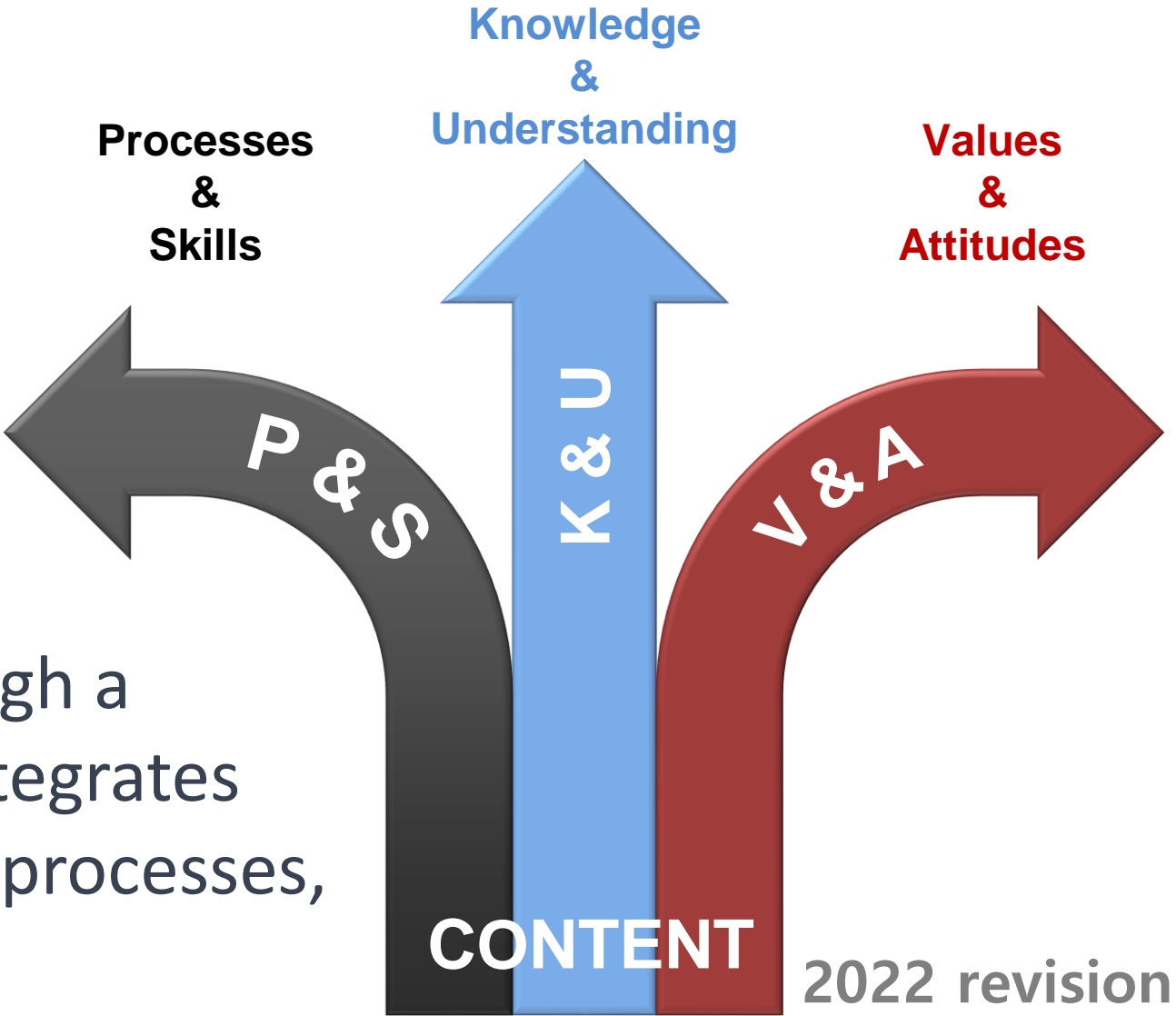
- (1) **actively and confidently** solve various problems by understanding and utilizing **mathematical knowledge**. (**Problem-solving**)
- (2) develop **interest and curiosity** in **mathematical facts**, make conjectures and reason through justifications. (**Reasoning**)
- (3) communicate about mathematical 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?

Reconceptualized content

- 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.



Updating the content framework



2022 revision

- Directions of the revised curriculum



- Nature of mathematics
- Goals

- Content framework
- Achievement standards

- Explanation on achievement standards

- Teaching and learning standards
- Assessment standards

2015 revision

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

<p>Core-Ideas</p>	<ul style="list-style-type: none"> Plane figures are categorized into various forms, and each plane figure has its own unique properties
	<p style="text-align: center;">Content elements</p> <p style="text-align: center;">Grade 7 ~ 9</p>
<p>Knowledge & Understanding</p>	<ul style="list-style-type: none"> 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)
<p>Processes & Skills</p>	<ul style="list-style-type: none"> 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
<p>Values & Attitudes</p>	<ul style="list-style-type: none"> 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**

- 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. MOE (2022)

Core-Ideas		
	Content elements of data and chance	
	Elementary (Grade 1~6)	Middle (Grade 7~9)
Knowledge & Understanding		
Processes & Skills		
Values & Attitudes		

Number and operation

Changes and relations

Figures and measurement

Data and chance

- 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.

Core(核心, 핵심)-ideas



Core-Ideas	Content elements of Numbers and operations	
	Elementary (Grade 1~6)	Middle (Grade 7~9)
Knowledge & Understanding		
Processes & Skills		
Values & Attitudes		

- 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

Integration

Means of horizontal connections

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

The upper structure of vertical connections

Ideas that are helpful to view various mathematical topics from a higher perspective

Advanced viewpoint

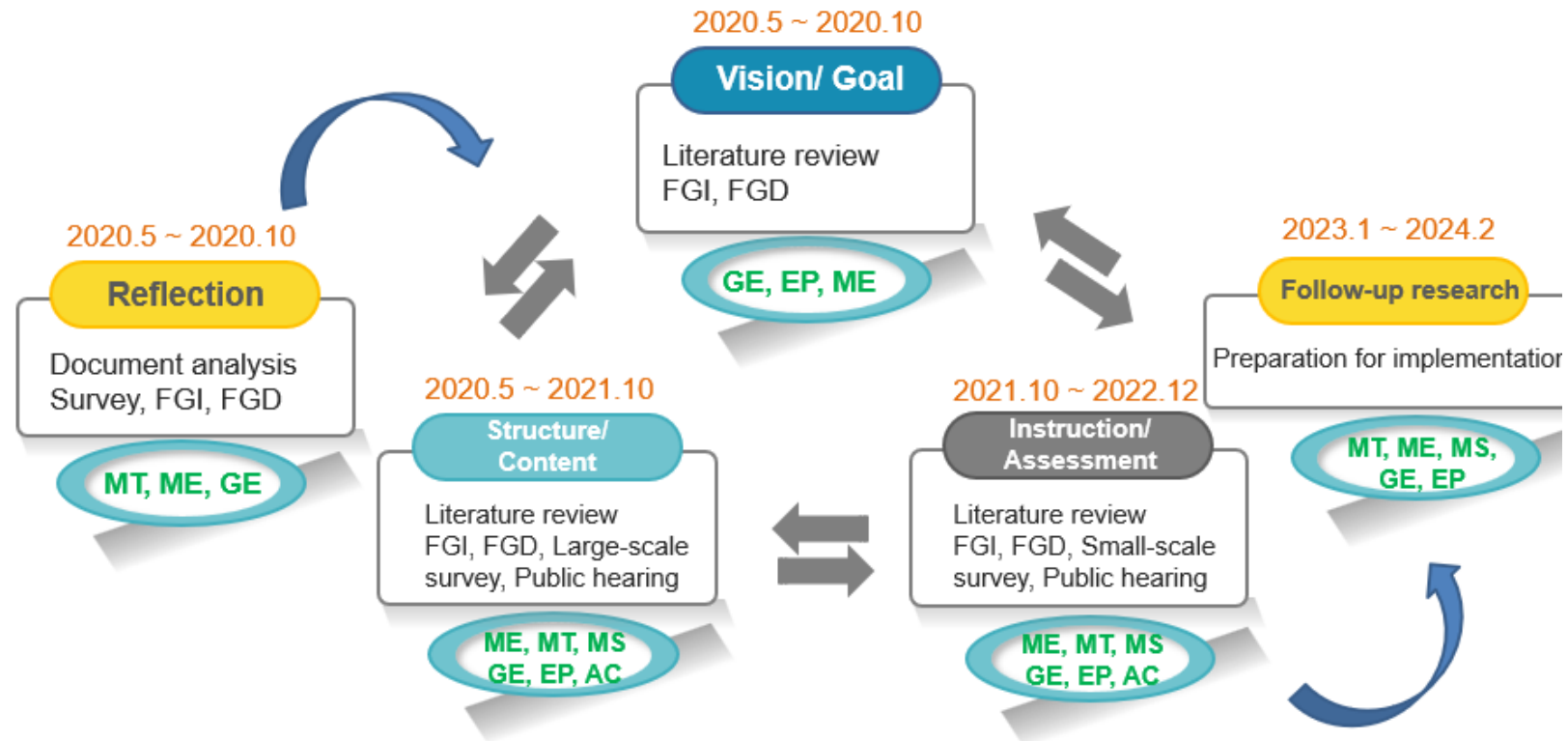
Value

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

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

Core-Ideas	Content elements of data and chance	
	Elementary (Grade 1~6)	Middle (Grade 7~9)
Knowledge & Understanding		
Processes & Skills		
Values & Attitudes		

- 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)

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.

Major changes

02

Changes to the elementary and middle school content and methods

- 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?



Changes to the elementary school math



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.

Changes to the elementary school math



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

Changes to the middle school math



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.

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

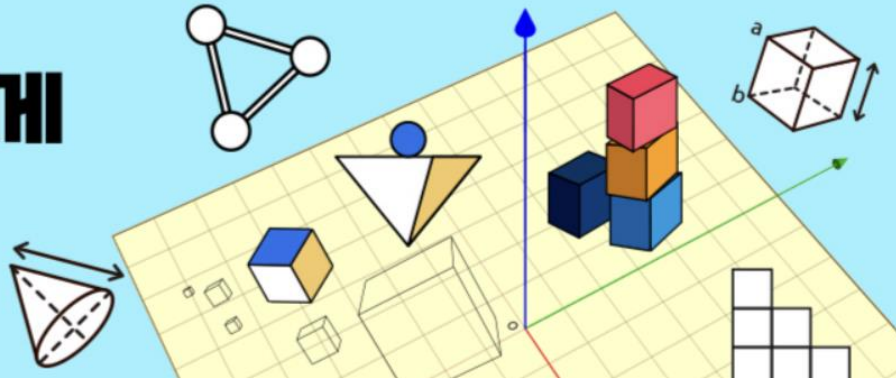


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알지오 3D와 함께

입체도형! 쌓기나무! 블록코딩!으로
다양한 콘텐츠를 만들고 탐구해보세요.



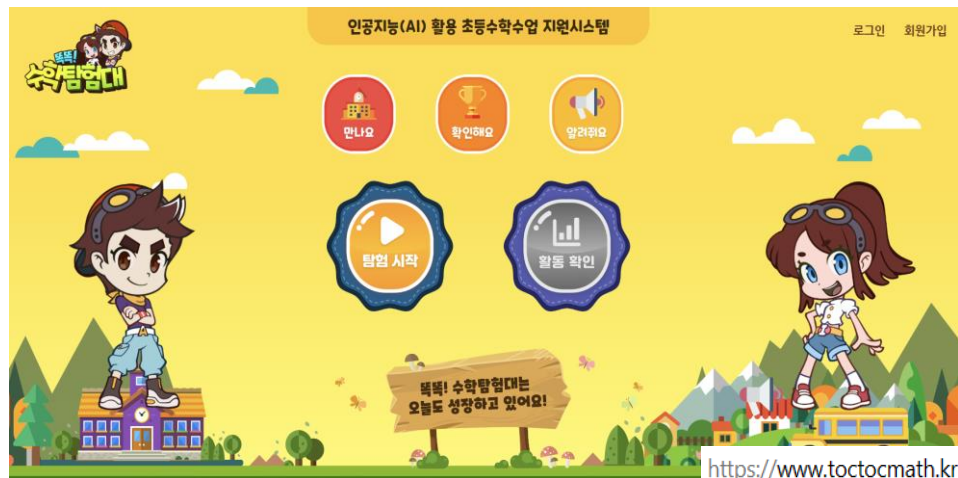
알지오 2D

알지오 3D

알지오 문서

Inquiry-based
(All school level)

Statistics-focused
(All school level)



AI-based (Grade 1 & 2 Math)



설문조사

이용방법 안내

이용방법 안내
새 설문지 작성



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.

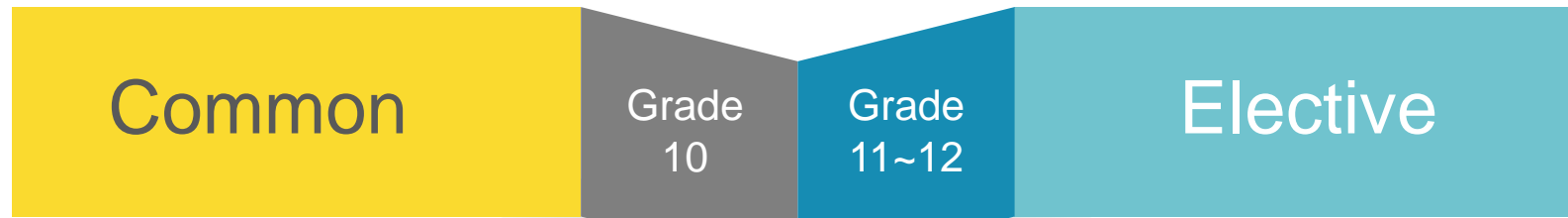
- Support students by providing guidance on high school mathematics curriculum and related career paths, to help them prepare for their future more concretely.

Changes to the high school math



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



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



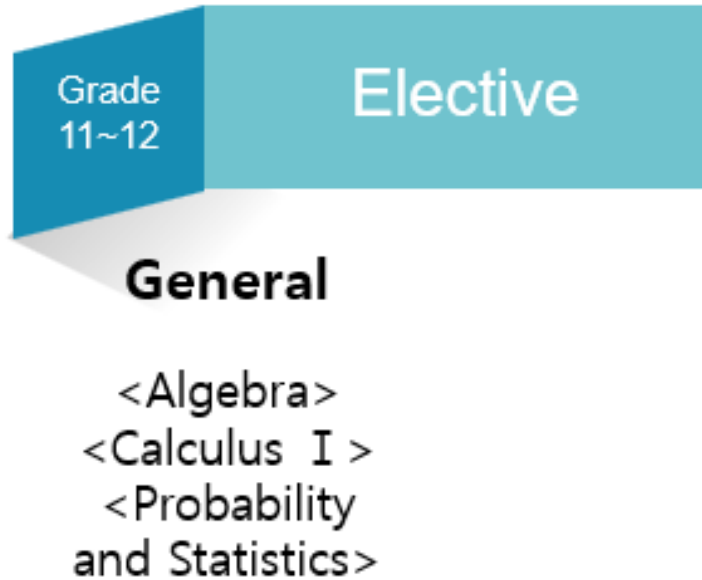
<Algebra>
<Calculus I >
<Calculus II >
<Geometry>

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

Career-related
<Calculus II >, <Geometry>, <Mathematics for Economics>, <Mathematics for Artificial Intelligence>, <Mathematics for Workplace>
<Specialized Mathematics>, <Discrete Mathematics>, <Advanced Geometry>, <Advanced Algebra>, <Advanced Calculus>

Convergence
<Mathematics and Culture>, <Practical Statistics>, <Mathematical Investigation>

Conflicts between the activity systems



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>
<Specialized Mathematics>, <Discrete Mathematics>, <Advanced Geometry>, <Advanced Algebra>, <Advanced Calculus>

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)

Conflicts between the activity systems



<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)

Convergence

<Mathematics and Culture>,
<Practical Statistics>,
<Mathematical Investigation>

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)

Changes to the high school math



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)

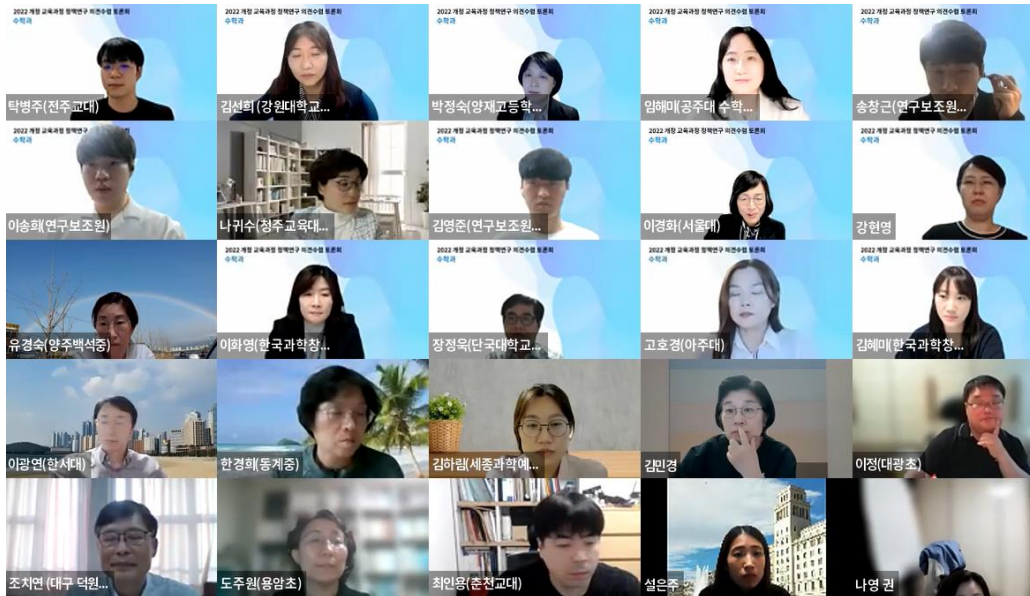
Case 1: Matrix



- 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



국민과 함께하는 미래형 교육과정 역량함양 교과 재구조화 연구 공청회 수학과



이경화 서울대학교 교수



- 주요 제점 다시보기
- 1. ...
 - 2. ...
 - 3. ...
 - 4. ...
 - 5. ...
 - 6. ...
 - 7. ...
 - 8. ...
 - 9. ...
 - 10. ...

Case 2: Definite integral

2009 revision

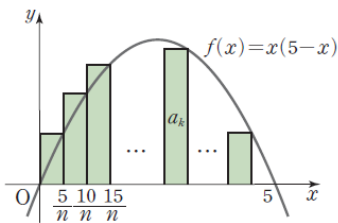
The limits of Riemann sums

2015 revision

Anti-derivatives

2022 revision

The area under the curve

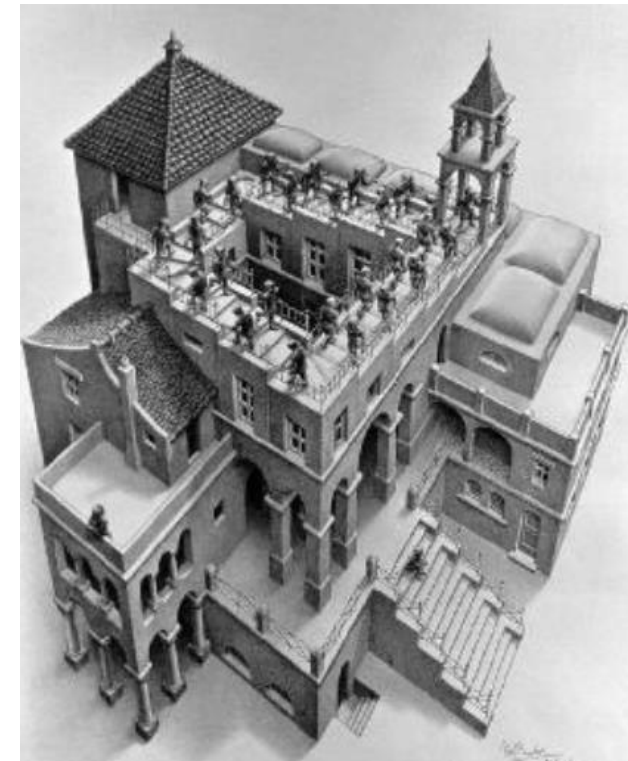
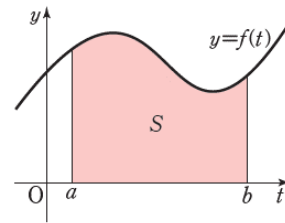


함수 $f(x) = 2x$ 의
세 부정적분 $F(x)$,
 $G(x)$, $H(x)$ 를 각각
정하고, 다음 값을
구하여 비교하시오.

$$F(3) - F(1),$$

$$G(3) - G(1),$$

$$H(3) - H(1)$$



Ascending and Descending
(M.C. Escher, 1960)

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

Squid game(Netflix)



Changes to the high school math



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.

Lessons learned and prospects



- 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.

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Thank you for your attention



Q & A

