Korean Curriculum Development and Policy Implementation: Computational Thinking, Data Science, and AI
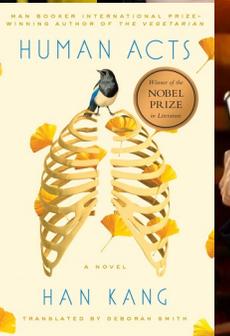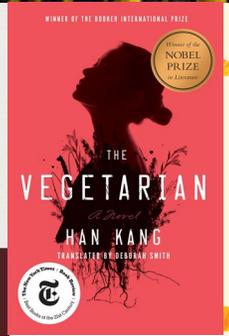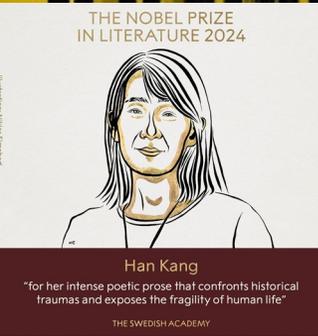
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Session 1
23 February (Mon) 13:00 ~ 14:30
A Workshop on International Practices in K-12 Mathematics Education:
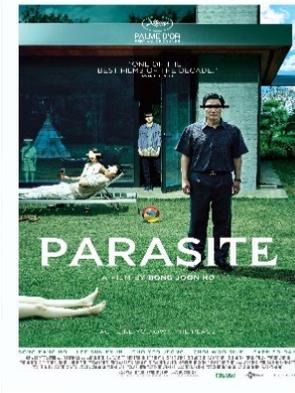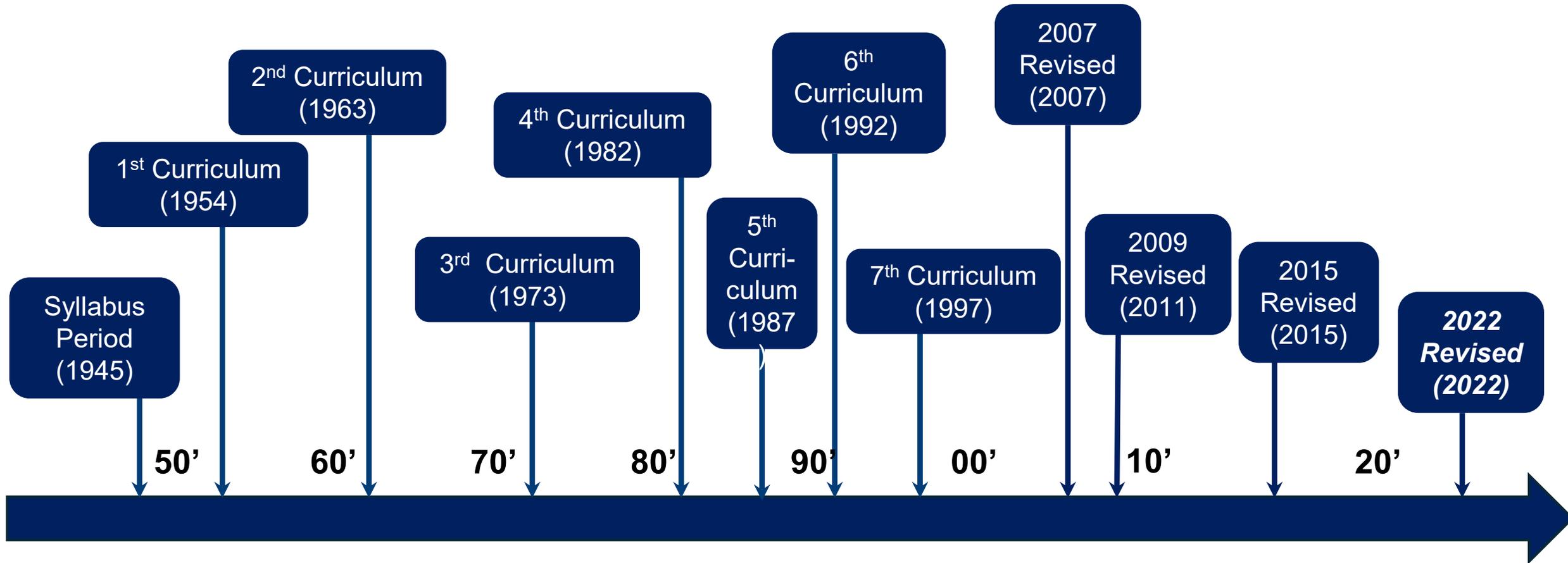**The Role of Computational Thinking, Data Science, and AI**

What do you know about Korea?

Periodic Revision of Mathematics Curriculum in Korea

Syllabus Period (1945)

1st Curriculum (1954)

2nd Curriculum (1963)

3rd Curriculum (1973)

4th Curriculum (1982)

5th Curriculum (1987)

6th Curriculum (1992)

7th Curriculum (1997)

2007 Revised (2007)

2009 Revised (2011)

2015 Revised (2015)

2022 Revised (2022)

50'   60'   70'   80'   90'   00'   10'   20'

The national curriculum in Korea is revised **approximately every six years** on average.

# The Main Directions of the 2022 Revised Curriculum
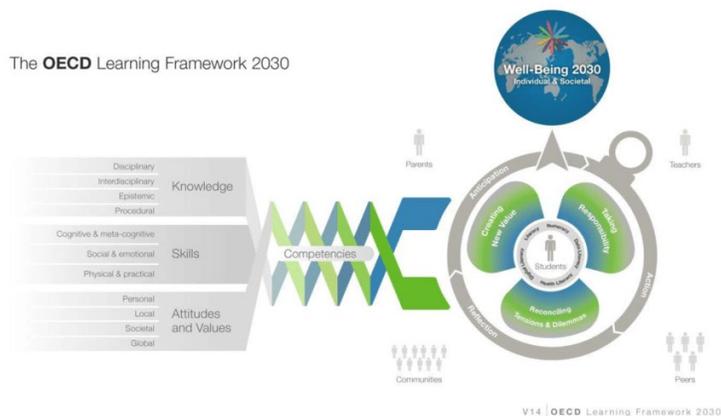
- The 2022 revised national curriculum was structured in alignment with the main directions of **the OECD 2030 report**.
- Main directions of the revision included **ecological transition education, democratic citizenship education, and digital/AI literacy**.

- The development of the 2022 revised curriculum also incorporated elements such as **language literacy, mathematical literacy, digital literacy, and cross-curricular learning themes**.

The capacity to collect and analyze information, critically understand and evaluate it, and produce and utilize new information and knowledge based on an understanding of digital knowledge and technologies and a strong sense of digital ethics.

In response to innovation in AI and software applications, **digital literacy is positioned as a key competence** for future generations and linked to improvements in instruction and assessment.

Framework in the 2022 Revised Mathematics Curriculum
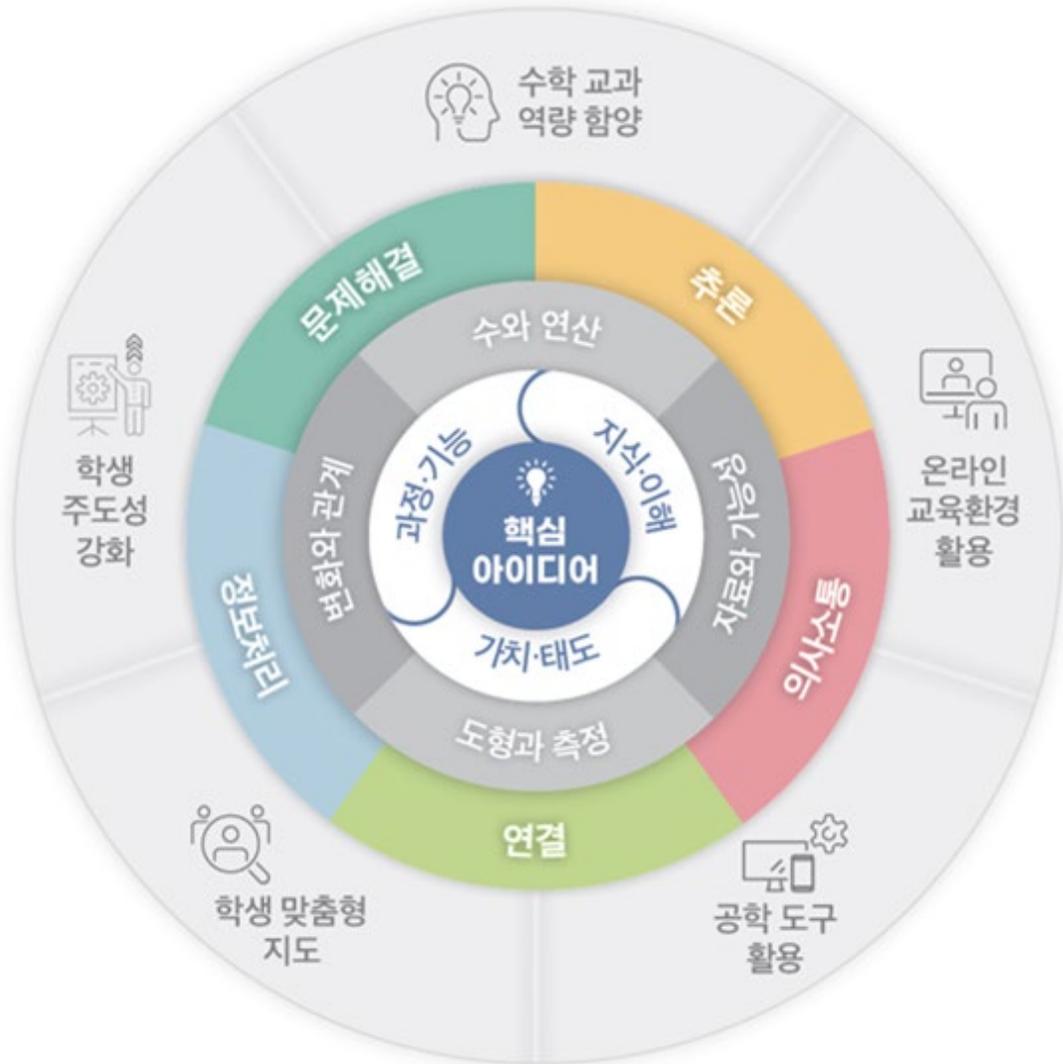
- **Innermost Circle (Key Components of Cultivating Competence)**
- Big Ideas
- Knowledge and understanding
- Processes and skills
- Values and attitudes
- **Middle Circle (Mathematical Content Domains)**
- Numbers and operations
- Change and relationships
- Geometry and measurement
- *Probability and statistics*
- **Outer Circle (Mathematical Competencies)**
- Problem solving
- Reasoning
- Communication
- Connections
- *Information processing*
- **Outermost Gray Ring (Instructional and Environmental Features)**
- Cultivating mathematical competencies
- *Utilizing online learning environments*
- *Utilizing digital tools*
- Personalized instruction
- Enhancing student agency

The Subject System in the High School Mathematics Curriculum

Category	School Level	Common Courses	Elective-Centered Courses		
			General Elective Courses	Career-related Elective Courses	Integrated Elective Courses
2015 Revised	High School	Mathematics	Mathematics I, Mathematics II, Calculus, Probability and Statistics	Geometry, **Practical Mathematics, Mathematics for Economics, Mathematics Project, Basic Mathematics, Artificial Intelligence Mathematics**	**Development of New Courses**
2022 Revised	High School	Common Mathematics 1,2, **Basic Mathematics 1,2**	Algebra, Calculus I, Probability and Statistics	Calculus II, Geometry, **Mathematics for Economics, Artificial Intelligence Mathematics,** **Job-Related Mathematics**	**Mathematics and Culture, Practical Statistics,** **Mathematics Project**	**Further Development of New Courses**

Continuous introduction of new courses
for the implementation of *the high school credit system.*

Mathematics Content Elements/Course Related to Data Science

Knowledge·Understanding in
<Practical Mathematics> Curriculum

Classification Category	Content Elements
Statistics and Statistical Problems	· Statistics and statistical problem solving · Population and sample
Data Collection and Organization	· Types of data and data collection · Data representation and summary
Data Analysis	· Statistical estimation · Statistical hypothesis testing
Statistical Inquiry	· Statistical inquiry activities

The R Project for Statistical Computing

- From a data science perspective, additional mathematical content elements (e.g., matrices, box plots, and estimation of population proportions) have been incorporated, and a new course titled *Practical Statistics* has been introduced.
- *Practical Statistics* serves as an entry point to data science by engaging students in statistical problem solving and inquiry, through which they learn the processes of data collection, organization, and analysis. Within this process, key content elements such as sampling, estimation, and hypothesis testing are addressed.

<AI Mathematics> Curriculum and Textbooks

Knowledge·Understanding in <AI Mathematics> Curriculum

Classification Category	Content Elements
AI and Big Data	· Concept and history of AI · Big data and AI
Text Data Processing	· Representation of text data · Analysis of text data
Image Data Processing	· Representation of image data · Analysis of image data
Prediction and Optimization	· Trends and prediction · Optimization
AI and Mathematical Inquiry	· Rational decision-making · AI and mathematical inquiry

An example from a textbook proposes an activity in which students implement a loss function and gradient descent through *text-based coding*. In this activity, the parameter a is iteratively updated to minimize the loss function $L(a)$ and identify an optimal value.

Mathematics Tasks Related to Computational Thinking (CT)

Middle School Mathematics 1

내딛다 탐구

소수 찾기

Identifying prime numbers (using the Sieve of Eratosthenes)

소수의 배수는 소수인 자기 자신을 제외하면 모두 합성수이다. 고대 그리스의 수학자 에라토스테네스(Eratosthenes, B.C. 276?~B.C. 194?)는 다음과 같이 수를 걸러 내는 방법으로 소수를 찾았다. 이 방법을 '에라토스테네스의 체'라고 한다.

1 1을 지운다.
2 2는 남기고 2의 배수를 모두 지운다.
3 3은 남기고 3의 배수를 모두 지운다.
4 5는 남기고 5의 배수를 모두 지운다.
5 이와 같은 방법으로 남은 수 중에서 처음 수는 남기고 그 수의 배수를 모두 지운다.
6 지워지지 않고 남은 수는 모두 소수이다.

탐구 1 에라토스테네스의 체를 이용하여 1부터 100까지의 자연수 중에서 소수를 모두 찾아 보자.

탐구 2 [블록코딩]으로 1부터 100까지의 자연수 중에서 소수를 찾은 후 탐구 1에서 찾은 소수와 비교해 보자.

▲ 알지오매스 [블록코딩]을 활용하여 소수 찾기

에라토스테네스의 체

1 2 3 4 5 6 7 8 9 10
11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40
41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60
61 62 63 64 65 66 67 68 69 70
71 72 73 74 75 76 77 78 79 80
81 82 83 84 85 86 87 88 89 90
91 92 93 94 95 96 97 98 99 100

돌우다 역량

Drawing regular polygons (e.g., equilateral triangles and regular pentagons) through block-based coding

다음은 알지오매스를 이용하여 한 변의 길이가 10인 정삼각형과 정오각형을 각각 그리는 블록코딩을 만든 것이다. 두 블록코딩의 차이점을 말하고, 한 변의 길이가 8인 정십이각형을 그리는 블록코딩을 만들어 보자.

정삼각형 그리기

정오각형 그리기

- Mathematics tasks that require algorithmic thinking are implemented through block coding.
- Students can verify the outcomes of automated coding processes via QR-code-based interfaces.

Beyond merely verification, task design should incorporate core CT processes, including decomposition, abstraction, and algorithmic thinking.

Mathematics Classrooms Integrating Digital Tools

- One-to-one tablet initiatives are being implemented, and in schools where deployment has been completed, mathematics lessons are conducted using these devices.
- In Korea, a range of freely available mathematics-related software applications has been developed and widely adopted, including *AlgeoMath* (graphing and block-based coding tools), *Easy Statistics*, *Tongrami* (statistical tools), and *Tok Tok Math* (AI-based personalized and game-based learning).

AI Digital Mathematics Textbooks (AIDTs)
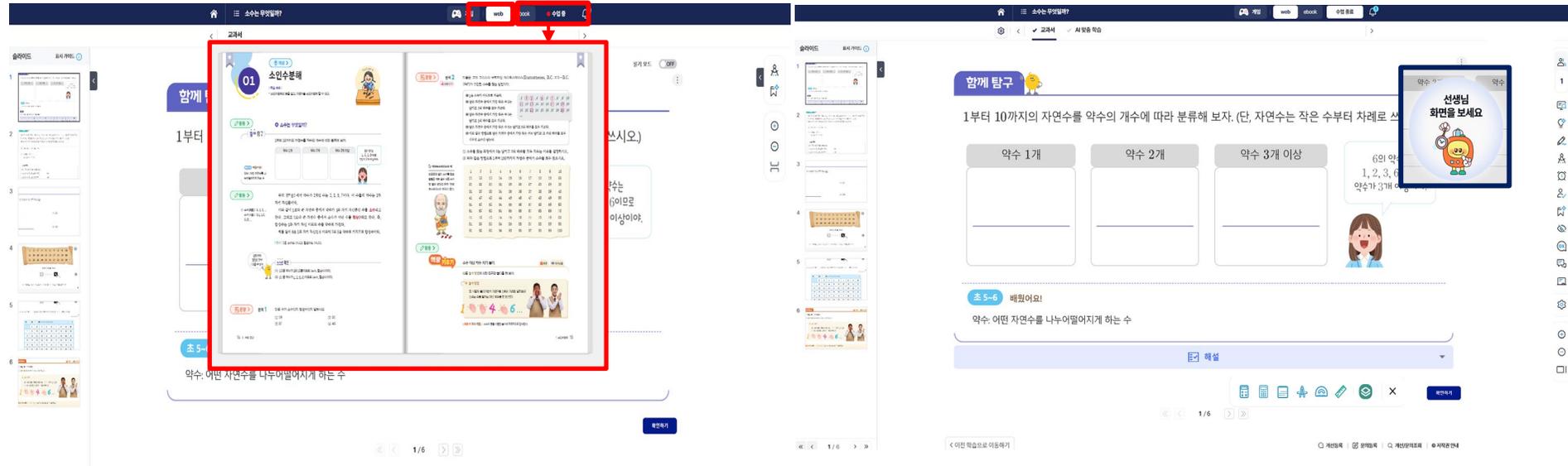
AI Digital Textbook Development Guidelines

An Example of AI Digital Mathematics Textbooks

- AI Digital Textbooks (AIDTs) were developed based on the AIDT development guidelines and the 2022 revised national curriculum. A key feature of AIDTs is personalized learning supported by diagnostic assessment and adaptive task recommendation.
- However, due to financial constraints (e.g., development and subscription costs), technical barriers (e.g., Wi-Fi and device availability), and concerns regarding students' exposure to AI-mediated environments, their status was reclassified **from "textbooks"** to supplementary educational **"materials".**

Generative Artificial Intelligence (genAI) Integration in Mathematics Classrooms
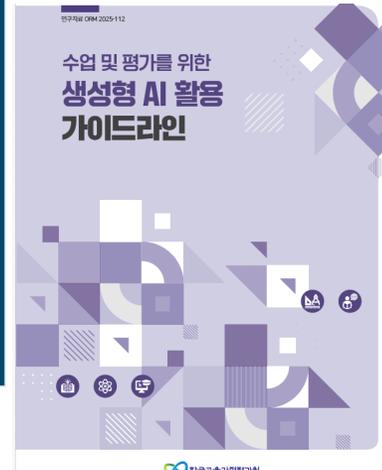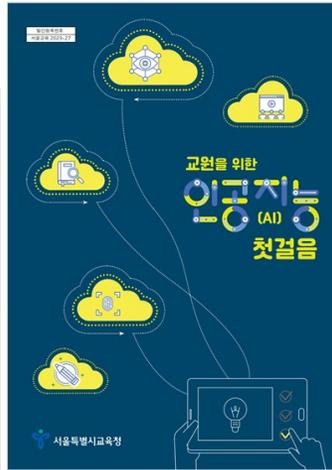
Generating images, videos, and songs using AI tools

Problem Posing
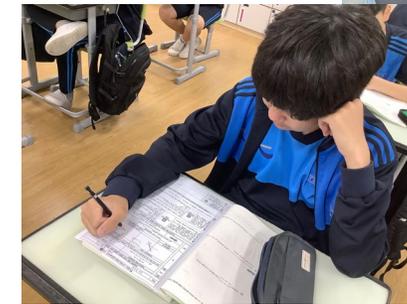
Error Analysis

- With the advancement of generative artificial intelligence (genAI), policy guidelines for its use have been developed by metropolitan and provincial offices of education as well as the Korea Institute for Curriculum and Evaluation (KICE).
- These guidelines address ethical considerations surrounding teachers' and students' use of genAI, approaches to its implementation in school settings, and illustrative examples of classroom practice.

- A range of mathematics lessons integrating genAI—such as error analysis, proving, problem posing, mathematical modelling, and data analysis—are actively being implemented (e.g., Lee & Kwon, 2025; Yoon et al., 2024).
- Instructional approaches that incorporate genAI are also continuously shared through mathematics teacher professional development programs in Korea.

Lee, K., & Kwon, O. N. (2025). Mathematical modelling with generative artificial intelligence: Insights from Korean middle school students' practices. *Journal of Educational Research in Mathematics*, 35(3), 775-802.

Yoon, H., Hwang, J., Lee, K., Roh, K. H., & Kwon, O. N. (2024). Students' use of generative artificial intelligence for proving mathematical statements. *ZDM–Mathematics Education*, 56(7), 1531–1551.

Final Remarks

- **The Korean national curriculum has introduced mathematical content elements, courses, and tasks related to data science, computational thinking, and artificial intelligence through curriculum documents and textbooks in response to evolving societal demands.** These developments suggest the potential for mathematics tasks to be meaningfully connected with these emerging areas. **Future curriculum revisions should move beyond the inclusion of new content toward the redesign of mathematical tasks and teacher professional learning in response to these developments.**

- **The 2022 revised national curriculum in Korea was developed prior to the widespread emergence of generative artificial intelligence (e.g., ChatGPT, Gemini, and Copilot).** It is therefore anticipated that future revisions will include national-level guidance on the use of generative artificial intelligence. **In this context, greater efforts are required to disseminate mathematics lessons, teacher professional development programs, and research and practice-based evidence.** These guidelines and practices may serve as a foundation for subsequent curriculum revisions.

Thank you 감사합니다 ☺

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