International Practices in K–12 Mathematics Education (NAS)
Feb 24, 2026

Korea: Technology Tools & Frameworks for K–12 Mathematics

From Block-based coding with AlgeoMath to AI Mathematics with Python

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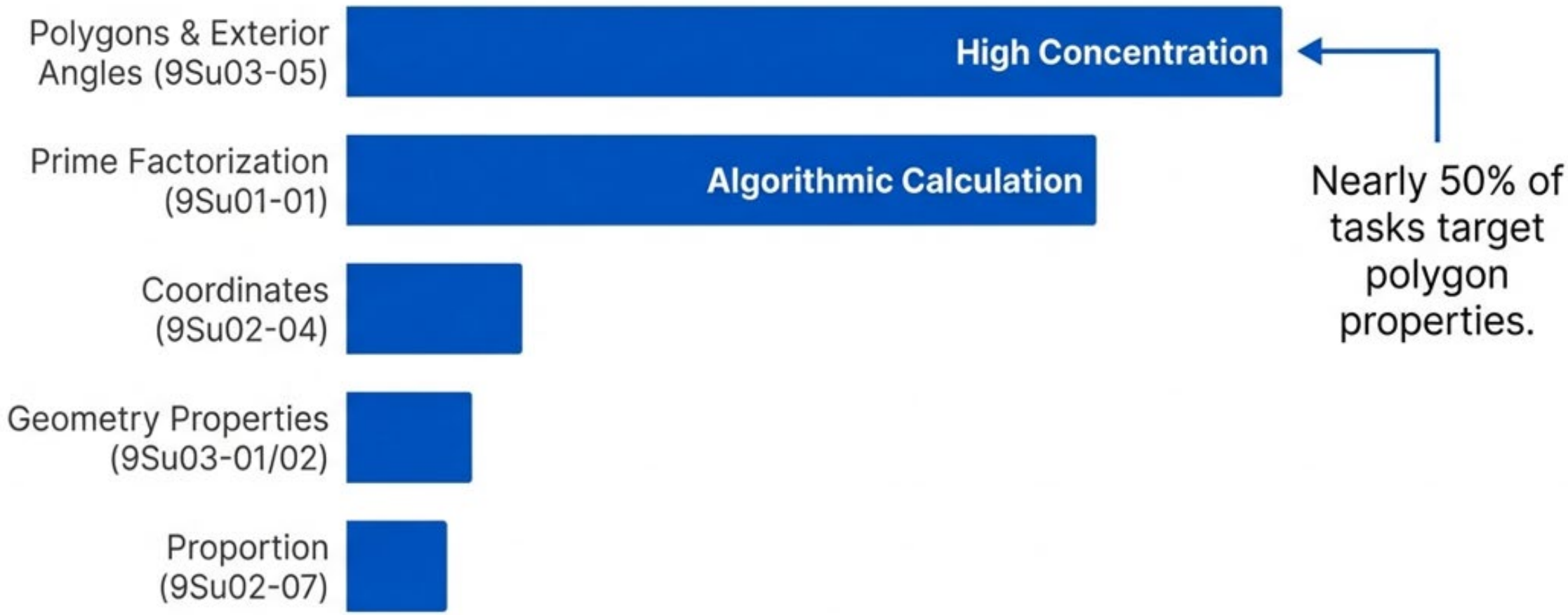
Block-based coding has shifted from rare to routine.

2015 Revised Curriculum	2022 Revised Curriculum
10 textbooks analyzed	9 textbooks analyzed
2	19
Total Tasks Found	Total Tasks Found

All nine of the 2022-revised textbooks include at least one block-coding task.

Coding concentrates where math is naturally algorithmic



Moving beyond ‘Click-and-See’.

A key classroom Challenge is the gap between

Observation:
“I saw it happen”.

Explanation:
“I know why”.

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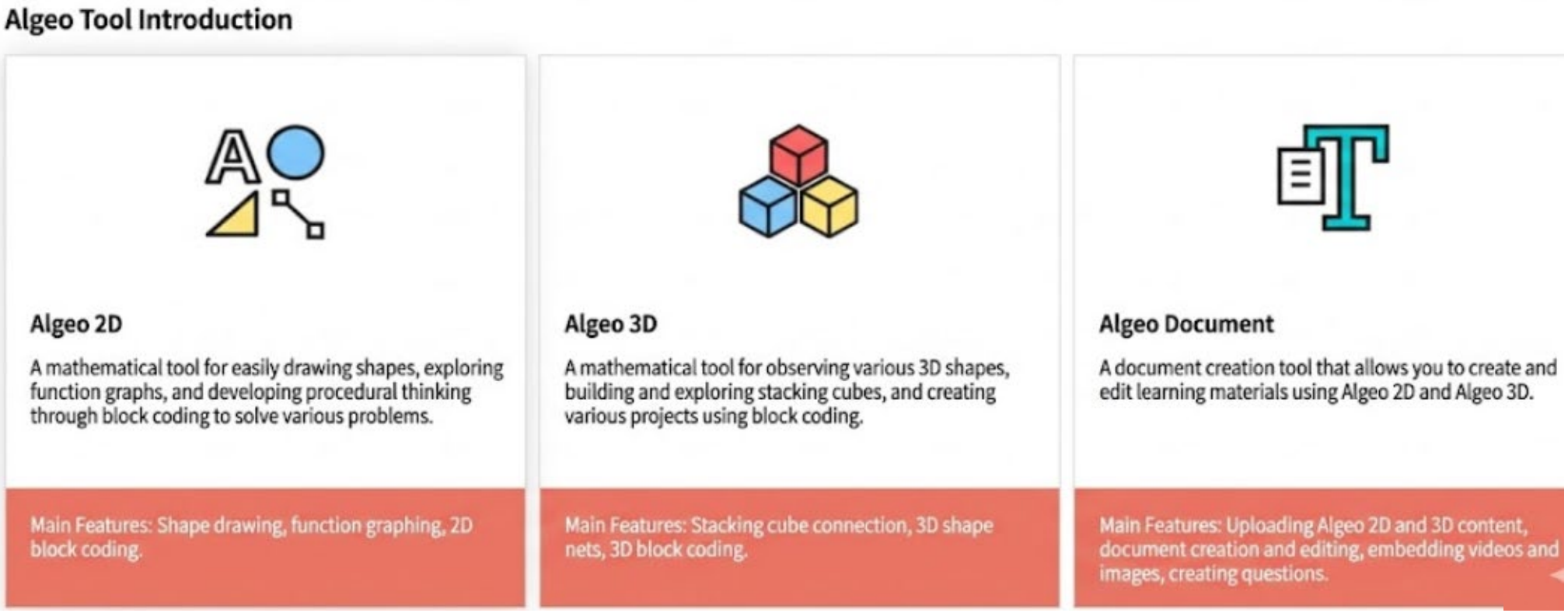
Tasks require students to modify, extend, or write new code.

Most these textbook tasks use AlgeoMath

Algeomath

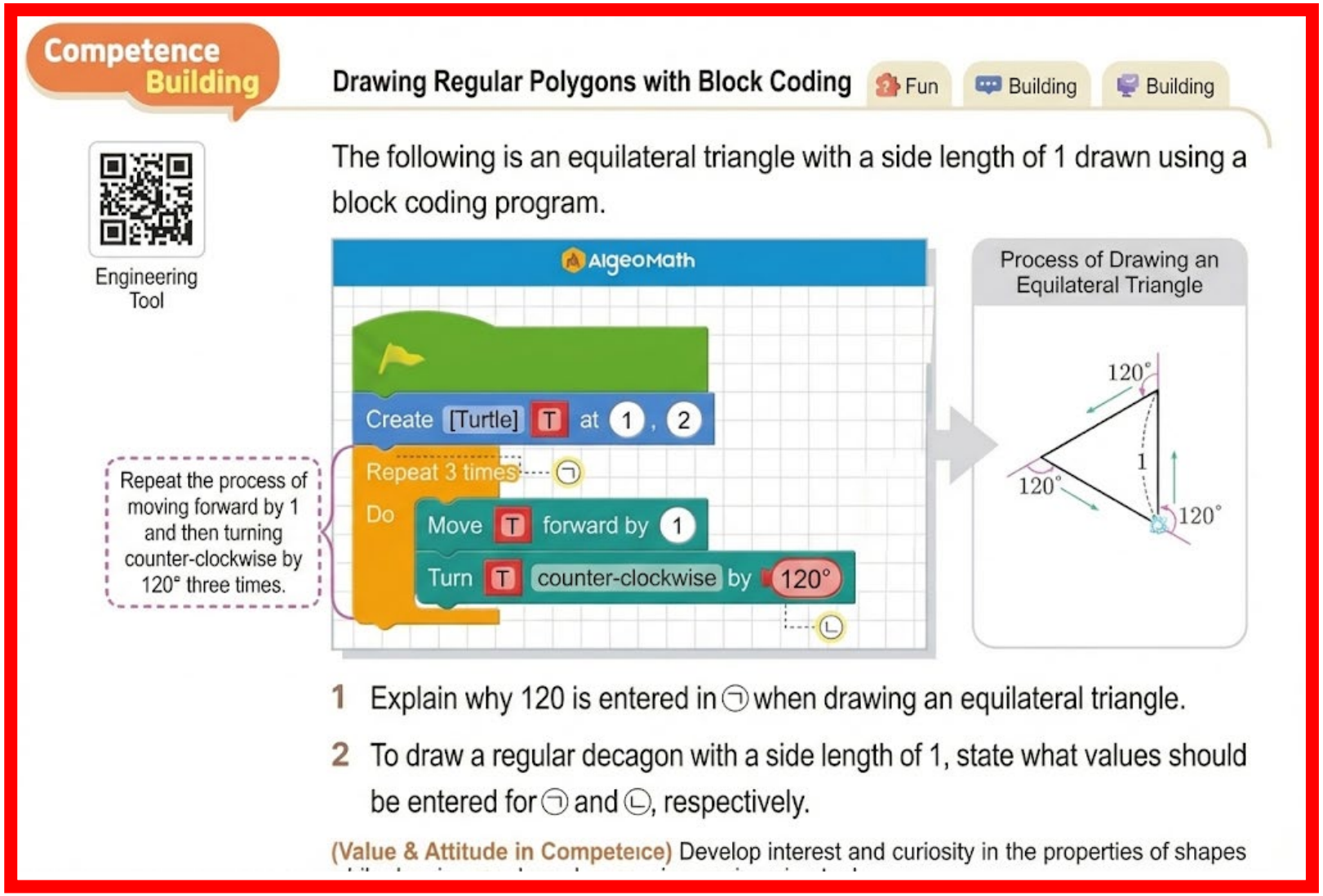
https://www.algeomath.kr/algeo/intro/tool



AlgeoMath is a free, national platform developed under the leadership of Korea's Ministry of Education, with support from KOFAC. From the start, the project intentionally included practicing teachers so it could reflect real classroom needs. Discussing the overall direction and sharing practical suggestions to make AlgeoMath more teacher- and student-friendly.

Today, it's built for school mathematics: Algeo 2D for constructions and graphs, Algeo 3D for solid geometry, and Algeo Document for creating and sharing activities. It also includes built-in block-based coding, with a JavaScript mode.

Examlpe A : Regular Polygons & Exterior Angle



Competence Building

Drawing Regular Polygons with Block Coding Fun Building Building

Engineering Tool

The following is an equilateral triangle with a side length of 1 drawn using a block coding program.

1 Explain why 120 is entered in ㉠ when drawing an equilateral triangle.

2 To draw a regular decagon with a side length of 1, state what values should be entered for ㉠ and ㉡, respectively.

(Value & Attitude in Competeice) Develop interest and curiosity in the properties of shapes

Typical structure (block logic)

- The code repeats n times, moves forward, and turns by 360/n—so the turning angle is the exterior angle.
- Students start with an equilateral triangle and are asked why the turn is 120 degrees, then extend the same logic to other polygons.

Lee, J., Kim, S., Lee, S., Hwang, Y., & Lee, Y. (2025). *Middle school year 1 (Grade 7) Textbook*. Visang Education.

Korea's "AI Mathematics" as a National High-School Elective (2021–)

Table 4. K–12 AI curricula, endorsed and implemented by governments

Country/ region	Curriculum title	Curriculum developer[15]	Educational levels		
			Primary	Middle	High
Armenia	Curriculum of ICT	Government		X	X
Austria	Data Science and Artificial Intelligence	Federal Ministry of Education, Science and Research			X
Belgium	IT Repository	*Fédération Wallonie-Bruxelles* (French-speaking Community of Belgium)			X
China	AI curriculum embedded in the Information Science and Technology curriculum	The Ministry of Education of the People's Republic of China	X	X	X
India	Atal Tinker Labs AI modules	Atal Tinker Labs, Atal Innovation Mission, NITI Aayoag		X	X
Republic of Korea	'AI Mathematics' under the Mathematics Subject Group for high schools	Korea Foundation for the Advancement of Science and Creativity			X
	'AI Basics' under Technology Home Economics Subject Group for high schools	Korea Foundation for the Advancement of Science and Creativity			X
Kuwait	Standards curriculum	Curricula technical guidance experts and teachers	X	X	
Portugal	Information and Communication Technologies	State school teachers of ICT and Mathematics	X	X	X
Qatar	Computing and Information Technology	Binary Logic, Ministry of Education and Higher Education	X	X	X
	Computing and Information Technology (High Tech Track)	Binary Logic, Ministry of Education and Higher Education			X
Serbia	Informatics and programming – Grade 8	Ministry of Education working group		X	
	Modern technologies in gymnasiums – Grade 3 and 4	Ministry of Education working group			X
United Arab Emirates	AI curriculum embedded under the Technology Subject Framework	Ministry of Education	X	X	X

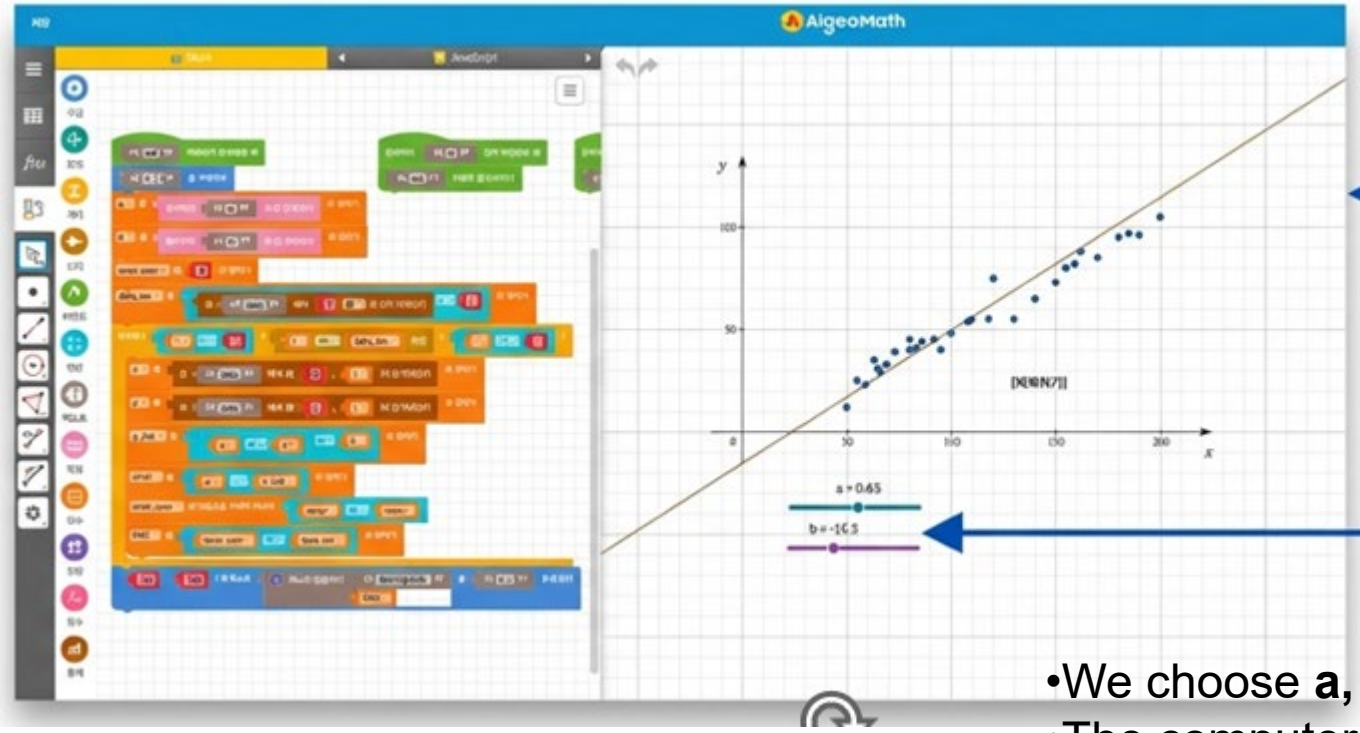
Source: UNESCO (2021*b*)

- Launched as an official high-school elective (from 2021, 2nd semester)
- Limited national precedents internationally (UNESCO global mapping, based on 2021 survey
- Korea appears as a rare case: "AI Mathematics" under the Mathematics subject group
- **Design choice:** align AI ideas with the existing math curriculum progressio

Source: UNESCO, *K-12 AI curricula: A mapping of government-endorsed AI curricula* (survey 2021; report published 2022)

Mini Project: Predicting Fine Dust from Visitor Count

- **Question:** Does fine dust increase when more people visit?
- **Data:** x = visitors, y = fine dust (PM)
- **Model:** y=ax+b
- **Activity:** move sliders for **a** and **b**, compare **error**
- **Key takeaway:** *better fit* → *smaller loss* (idea of "training")



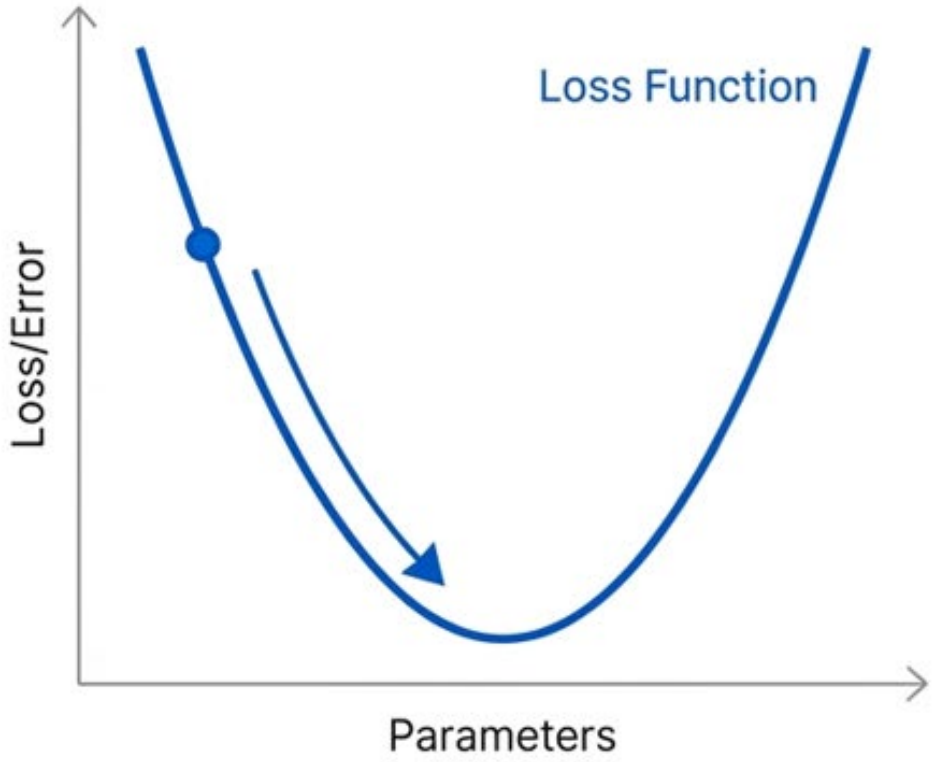
Manual Parameter Tuning (a, b)

Visualizing 'Best Fit' vs 'Error'

- We choose **a, b** to make predictions closer to real data
- The computer measures "how wrong" we are → **loss**
- Minimizing loss is the basic idea behind **model training**

Prediction and Optimization

1. **Loss Function:** Mathematically defining the total error.
2. **Update Rule:** Replacing sliders with Gradient Descent.
3. **Learning Rate:** Interpreted as 'step size'.



Change in parameters → Change in error surface.

From “moving sliders by hand” to “updating parameters by a rule.”
That rule is the start of **machine learning** thinking.

Gradient Descent Using Python in the *AI Mathematics* Textbook

Do it Yourself

Proceeding with the Optimization Process by Modifying the Code

Activity In the program code, modify the ❻ learning rate, ❼ loss function, ❽ derivative of the loss function, and the ❹ number of updates. Then, check the value of *a* according to the number of updates.

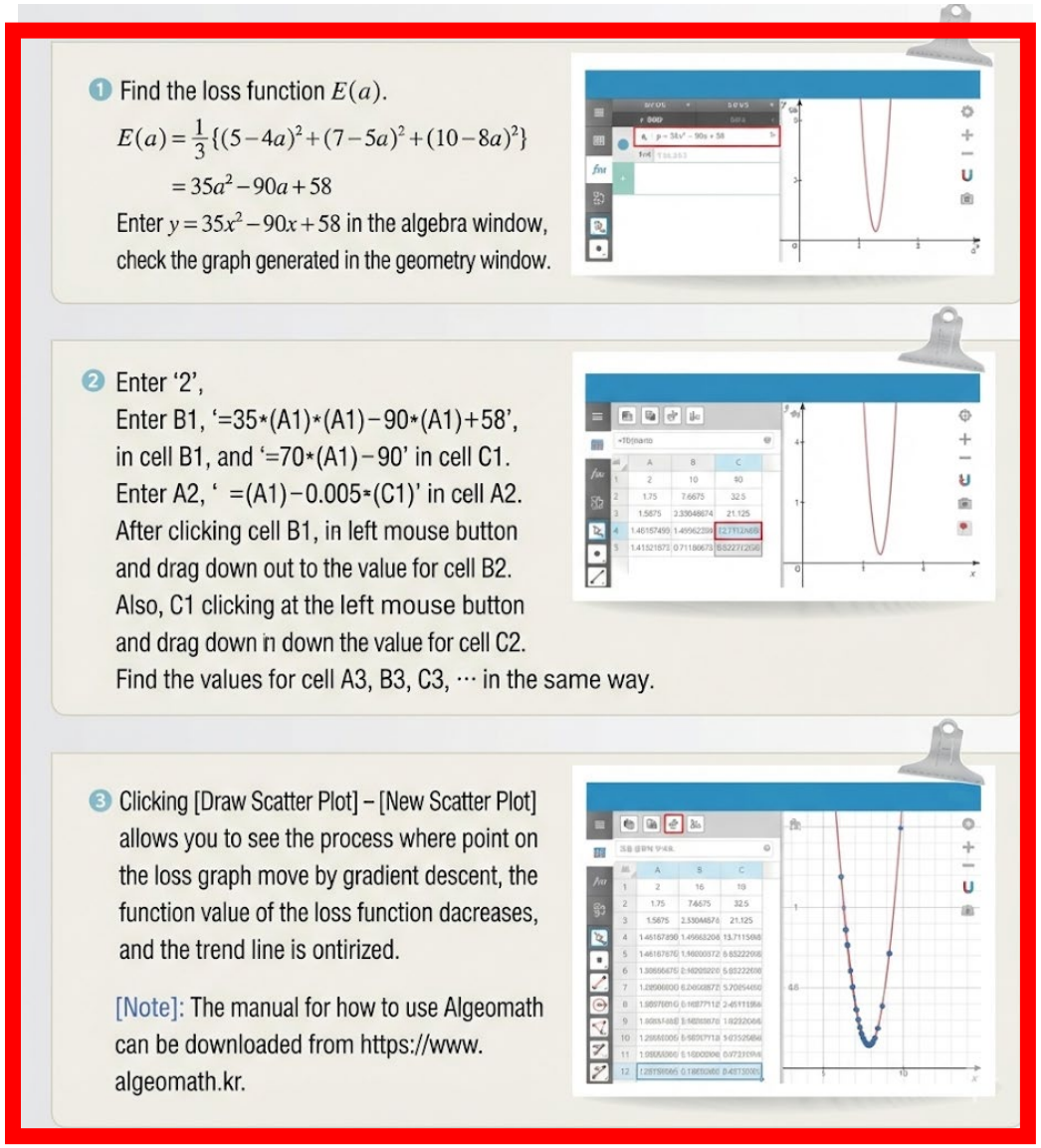
```
a = 0 #@param {type:"number"}                                    ❻
learning_rate ="0.1" #@param [0.001,0.01, 0.1,1]
precision = 0.00001

# the function that we want to find a minimum
loss_fn = lambda a: 3(a - 1) ** 2 + 2/3                          ❼

gradient = lambda a: 6 * a - 6                                   ❽
```

```
def main():

  minimum = []

                                                                 ❹
  iters = [1,10,50,100,1000,2000]
  for i in iters:
```

Yoon, S., Jeong, Y., Kim, K., Kim, T., Park, J., Lee, K., & Ha, J. (2025). High *school artificial intelligence mathematics Textbook*. Cmas.

Students actually change the code: learning rate values, the loss function, the derivative, and the number of iterations. They see how different choices affect convergence and that's a very concrete form of AI literacy.

Gradient Descent Using AlgeoMath in the *AI Mathematics* Textbook



❶ Find the loss function $E(a)$.

$$E(a)=\frac{1}{3}\{(5-4a)^2+(7-5a)^2+(10-8a)^2\}$$
$$=35a^2-90a+58$$

Enter $y=35x^2-90x+58$ in the algebra window, check the graph generated in the geometry window.

❷ Enter '2',
Enter B1, '=35*(A1)*(A1)−90*(A1)+58',
in cell B1, and '=70*(A1)−90' in cell C1.
Enter A2, ' =(A1)−0.005*(C1)' in cell A2.
After clicking cell B1, in left mouse button
and drag down out to the value for cell B2.
Also, C1 clicking at the left mouse button
and drag down in down the value for cell C2.
Find the values for cell A3, B3, C3, ⋯ in the same way.

❸ Clicking [Draw Scatter Plot] – [New Scatter Plot] allows you to see the process where point on the loss graph move by gradient descent, the function value of the loss function dacreases, and the trend line is ontirized.

[Note]: The manual for how to use Algeomath can be downloaded from https://www.algeomath.kr.

AlgeoMath can also show gradient descent with tables and graphs. Students can watch a point move down the loss curve as updates repeat so the algorithm becomes visible before they worry about full Python syntax.

Hong, J., Park, J., Seol, J., Oh, S., Park, M., & Park, S. (2021). *High school artificial intelligence mathematics Textbook*. Chunjae Education.

References

Hong, J., Park, J., Seol, J., Oh, S., Park, M., & Park, S. (2021). *High school artificial intelligence mathematics Textbook*. Chunjae Education.

Kim, D., Choi, G., Won, Y., Kim, S., & Kang, H. (2025). *Middle school year 2 (Grade 8) Textbook*. Chunjae Textbook.

Kwon, O. N., Lee, K., Oh, S., & Park, J. S. (2021). An analysis of "related learning elements" reflected in *Artificial Intelligence Mathematics* textbooks. *Communications of Mathematical Education, 35*(4), 445–473. https://doi.org/10.7468/jksmee.2021.35.4.445

Ministry of Education. (2015). *Mathematics curriculum* (Notification No. 2015-74 [Supplement]). Sejong, Korea: Author.

Ministry of Education. (2022). *Mathematics curriculum* (Notification No. 2022-33 [Supplement]). Sejong, Korea: Author.

Lee, J., Kim, S., Lee, S., Hwang, Y., & Lee, Y. (2025). *Middle school year 1 (Grade 7) Textbook*. Visang Education.

Oh, S. (2024). An analysis of the current status of technology tool use in high school mathematics textbooks based on the 2015 revised curriculum. Communications of Mathematical Education, *38*(2), 263–286. https://doi.org/10.7468/jksmee.2024.38.2.263

Oh, S. (in press). An analysis of the implementation patterns of block-based coding tasks in Grade 7 mathematics textbooks. The Journal of Educational Research in Mathematics.

Yoon, S., Jeong, Y., Kim, K., Kim, T., Park, J., Lee, K., & Ha, J. (2025). High *school artificial intelligence mathematics Textboo*. Cmas.

UNESCO. (2022). *K-12 AI curricula: A mapping of government-endorsed AI curricula* (ED-2022/FLI-ICT/K-12 REV). UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000380602

Thank You!

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