

How Reflection and Math Skills Support Each Other

Imagine you're running late to work but can't find your house keys. Frantically searching gets you nowhere! What should you do? Stop and think deeply about where your keys could be. As you go back and reflect on the last time you had them, you recall using the keys when you got home after soccer practice and that you immediately went to bed. Now going into your bedroom, you see your soccer bag on the floor and your keys beside it. Problem solved!



What Is Reflection?

Psychologists define reflection as intentionally stopping and pausing to think deeply before acting. As a skill, reflection can improve with practice and even support the development of some executive function skills [1]. Executive function skills are cognitive skills used to intentionally evaluate and control our own thoughts and actions. Reflection provides an opportunity to practice executive function skills because it involves thinking about our thoughts and it may support controlling our behavior.

Why Is Reflection During Math Activities Important?

Reflection turns math activities into opportunities to build mathematical thinking. In other words, by encouraging reflection during a math activity, children have an opportunity to practice pausing and thinking carefully about math concepts, which can deepen math understanding [2].

How Can Teachers Help Children Practice Reflection During Math Learning ?

Teachers can help children learn to reflect while doing math by modeling and prompting the behavior:

- **Model evaluating what information you already have and thinking about what to do next.** For example, a teacher could say, “The instructions say to stand on triangles but not squares. To find all the triangles, I should carefully see how many sides each shape has.”
- **Prompt children to reflect on their own mathematical thinking by asking questions. For example:** “How did you know that shape was a triangle?” If children respond without reflecting, they may say something like, “I just know!” Prompt them to explain further. For example:
 - In the DREME Guided Small Group Math Activity: Don't Burn Your Feet, teachers use directive prompts such as, “If Serena doesn't know for sure what a triangle is, how would you describe a triangle to her?”
 - In the DREME Center/Small Group Math Activity: Zookeepers, children practice comparing the number of objects in different sets. Teachers prompt further explanation through questions like, “How can you figure out how many blocks you have?” and “How did you know to add a toy frog and not a wooden block?”

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The key is for teachers to provide children with opportunities to think about and explain their thinking, rather than just give children the explanation. In the following vignette of a child working on a shape puzzle, the teacher encourages the child to slow down, think about the problem in a new way, and reflect on what they already know about shapes. Notice how the teacher doesn't give away the answer.

Teacher: The puzzle has many different shapes! Which ones are rectangles?

Child: This one!

Teacher: How do you know it's a rectangle?

Child: 'Cause it's long, like this (motions over the rectangle).

Teacher: You're right that sometimes a rectangle has two sides that are longer than the other sides, but what else can you tell me about this shape?

Child: It has (counts) 1, 2, 3, 4 sides.

Teacher: Yes, it does have four sides. What do you notice about these two parallel sides (motions to the longer pair of opposite sides on the rectangle)?

Child: They are the same.

Teacher: Yes, you're right that the opposite sides of a rectangle are the same length (gestures length).

Child: These sides are smaller (points to the shorter sides).

Teacher: Yes, these are shorter than the longer sides (gestures the shorter length, then the longer length); these two short sides are opposite each other, and they're the same length. So a rectangle has four sides, and the opposite sides are the same length. How about this, is it a rectangle (pointing to a square)?

Child: No, it is a square.

Teacher: Hmm, how many sides does it have?

Child: 1, 2, 3, 4. Four sides!

Teacher: Yes! And are the opposite sides the same length?

Child: (traces the sides) Yes!

Teacher: Yes, four sides. Just like this rectangle here! So why isn't it a rectangle?

Child: Because these sides are not long. They're little, just like these little sides.

Teacher: Well, since a rectangle has four sides, and the opposite sides are the same, it is a rectangle. If all the sides are the exact same length, it is a special kind of rectangle, called a (pauses deliberately)

Child: Square! (Then, pointing to another square): Here's another square rectangle!

Teacher: I see you're finding different kinds of rectangles!

References:

[1] Espinet, S. D., Anderson, J. E., & Zelazo, P. D. (2013). Reflection training improves executive function in preschool-age children: Behavioral and neural effects. *Developmental Cognitive Neuroscience*, 4, 3–15. <https://doi.org/10.1016/j.dcn.2012.11.009>

[2] Banse, H. W., Clements, D. H., Day-Hess, C., Sarama, J., Simoni, M., & Ratchford, J. (2020). Teaching moves and preschoolers' arithmetical accuracy. *The Journal of Educational Research*, 113(6), 418–430. <https://doi.org/10.1080/00220671.2020.1846484>