How spatial thinking could help children learn math

January 24 2023, by Emily Farran

Credit: AI-generated image (disclaimer)

Do you struggle to visualize how to rotate your shoes so that they nest together in a shoe box?

How are you with flat-packed furniture?

Are you good at giving directions?

These everyday activities require spatial thinking. Spatial thinking is important for mathematics, and it is what we use to understand the properties of objects, such as their location, size and shape, as well as the relationship between objects.

When we manipulate objects in our mind's eye—such as visualizing how to rearrange our living room—we are using spatial abilities. When we navigate our way home from a trip out, we are using spatial abilities.

People who have strong spatial skills are more likely to be interested in science, technology, engineering and math (STEM) and to choose STEM degrees and STEM careers.

This association is unsurprising when you think about the skills required for STEM: using graphs to visualize patterns of data in math, understanding the scale of a diagram of the solar sySTEM, or using the spatial layout of the periodic table to understand chemical relationships.

Nevertheless, spatial thinking is given little emphasis within the English national curriculum. It has recently been de-prioritized as an "early learning goal" for young children.

Lacking math skills

Prime Minister Rishi Sunak recently announced his ambition for all children to continue with math education to age 18, citing the need for math skills in the workforce. And it does seem that these skills are lacking.

The UK STEM industry is thought to lose £1.5 billion annually as a result of STEM skills shortages. Around half of working-age UK adults

have only primary school level math, and math difficulties are estimated to cost the UK around £20.2 billion each year, according to the charity National Numeracy.

Sunak proposes to continue math education past 16. But focusing on spatial training for younger children is one promising avenue for increasing math enjoyment and math achievement, as well as nudging the next generation towards STEM careers.

Spatial skills can be improved by training, and spatial training consistently increases achievement in mathematics and other STEM disciplines, including at degree level.

The largest effects of spatial training among children are for those from disadvantaged backgrounds. This means that spatial training provides an opportunity to reduce attainment gaps. It could bolster catch-up after pandemic school closures for the children most affected by this learning loss.

What's more—and particularly important for math's sometimes dull image—spatial activities are enjoyable. Engagement scores for our spatial activities and training suggest that children like learning in this way.

Improving spatial ability

There are some easy ways to improve spatial ability. Visualization—imagining a process in your head—has been linked to stronger science and math performance and it can be improved through training.

Younger children could discover visualization by being encouraged to imagine rotating jigsaw pieces in their head, rather than trying to fit

pieces in a puzzle through trial and error. Older children could be prompted to use visualization as a mental sketchpad when rearranging math formulae.

Small-world play—such as with dolls houses or toy farm sets—can be used to help children learn to see things from other viewpoints and understand differences in spatial scale. Both of these are spatial skills which help with math and science.

In a preprint study (which means it has not yet been reviewed by other scientists) colleagues and I have also found that following visual instructions when using construction toys, such as Lego, can help spatial skills.

It helps with mental rotation (rotating a piece in your mind to figure out which way round it should go) and understanding the relationship between parts and a whole, such as the individual bricks in a Lego model. This is useful for fractions and math proficiency more generally.

As a final example, children who hear more spatial language have stronger spatial skills, and stronger spatial language is associated with better math performance.

This means using words as simple as "in," "on," and "next to" to describe the spatial relationships between objects, or "small" and "big" to draw attention to the properties of objects. More difficult words like "parallel" and "separate" can help children to conceptualize otherwise difficult spatial concepts, particularly if hand movements are also used to help explain the meaning.

I am a member of the Early Childhood Math Group, an independent group of early years mathematics enthusiasts and experts who work together to promote early childhood mathematics. The group has

launched the Spatial Reasoning Toolkit to help adults support children's development in spatial activities.

Introducing more spatial thinking to the curriculum could reduce attainment gaps, increase confidence and nudge children towards STEM careers. Children's enjoyment of spatial activities could also help to change attitudes towards math.

Provided by The Conversation