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Students Can Learn by Explaining, Studies Say

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Children are quick to ask "why?" and "how?" when it comes to new things, but research suggests elementary and preschool students learn more when teachers turn the questions back on them.

In a symposium at the annual Association for Psychological Science research meeting here this month, panelists discussed how and when asking students for explanations can best enhance their learning.

"Often students are able to say facts, but not able to understand the underlying mathematics concept, or transfer a problem in math to a similar problem in chemistry," said Joseph Jay Williams, a cognitive science and online education researcher at the University of California, Berkeley.

For example, a student asked to explain why 2x3=6 cannot simply memorize and parrot the answer, but must understand the underlying relationship between multiplication and addition, Mr. Williams said. Students who can verbally explain why they arrived at a particular answer have proved in prior studies to be more able to catch their own incorrect assumptions and generalize what they learn to other subjects.

"We know **generating explanations** leads to better educational outcomes generally. When **children explain events**, they learn more than when just getting feedback about the accuracy of their predictions," said Cristine H. Legare, an assistant psychology professor and the director of the Cognition, Culture, and Development Laboratory at the University of Texas at Austin.

In forthcoming research with UC-Berkeley, Ms. Legare brought in 96 children ages 3 to 5 and set before them a complex toy made up of colorful, interlocking gears with a crank on one end and a propeller on the other.

With half the children, the researchers asked each one, "Can you explain this to me?" With the other half, they simply said, "Oh look, isn't this interesting?"

The two groups of children focused on different things, researchers found. Children who were asked to observe noticed the colors of the toy, while those asked to explain focused on the chain of gears working on each other to eventually turn the propeller when the child turned the crank at the other

end.

Children who had explained the toy were better at re-creating it and not being distracted by ornamental gears, and they were better able to transfer what they had learned about how gears work to new tasks.

The children who had observed the toy outperformed the children in the explanation group on a memory task focused on the toy's colors.

Framing the Question

The differences show that it's important for educators to be explicit in how they focus students' attention when they ask for an explanation of something.

"We can't assume what we want to teach is something kids are just going to pick up on," Ms. Legare said.

Dedre Gentner, the director of the cognitive science program at Northwestern University in Evanston, Ill., agreed. She said that teachers introducing a concept can improve students' understanding by giving examples of close comparisons, moving to less closely connected analogies, and then asking children to explain how concepts are related.

In a series of experiments with 3- to 7-year-olds, she found **children can be confused by comparisons** that focus on a relationship rather than a direct-object match.

For example, a 3-year-old shown a picture of two turtles facing each other and told "this is a toma" and then asked to find another "toma" will choose a picture of a turtle over one of two cats facing each other 98 percent of the time. A 7-year-old, by contrast, is more likely to recognize the more abstract comparison of a relationship.

However, Ms. Gentner and her colleagues found that 3-year-olds can think more like 7-year-olds if they are given multiple examples and asked to explain them.

If shown a "toma" with turtles and another with cats, and then asked, "Can you say why both of these are tomas?" the students chose a relational match 57 percent of the time, rather than focusing just on matching the animals on the previous cards.

Mr. Williams warned, though, that students asked to explain something that seems inconsistent with a previous rule or belief can end up learning less, if they discount the new information.

He found that elementary students who inaccurately interpret one pattern and then are given a single anomaly **tend to "explain it away"** and believe their mistaken interpretation more strongly. When they are given multiple exceptions to explain, it becomes easier for them to recognize their mistakes.

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