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Eye on Research

Studies Find That Use of Learning Toys Can Backfire

Though some children helped, others distracted by in-class 'manipulatives.'

By Debra Viadero

Learning toys have become big business in the United States. At home and in their classrooms, children use plastic letters to master the alphabet, interlocking blocks to learn arithmetic and the base-10 system, and pretend money to work out word problems.

A growing number of studies, though, suggest that such learning toys, or "manipulatives" in eduspeak, don't guarantee learning success.

While many studies show that using concrete objects can boost children's understanding of abstract concepts, others suggest they make no difference at all, and sometimes can even be counterproductive.

"Concreteness and abstractness are difficult and nuanced concepts," said David H. Uttal, an associate professor of psychology at Northwestern University, in Evanston, Ill. "The critical question for researchers now is to find out how and when manipulatives should be used."

With Judy S. DeLoache, a psychologist from the University of Virginia, in Charlottesville, and other researchers, Mr. Uttal has been conducting a series of experiments with preschoolers and elementary-age children to find out how educational toys affect their learning.

In one recent study, which has not yet been published, the researchers divided 35 5-year-olds into two groups, giving each a different set of toys to play with. One group played with plastic letters; the other—the control group—played with a variety of other toys, such as shapes or figures of familiar objects, like butterflies or triangles.

After 10 days, the researchers found that the children in the control group had actually learned more letters than the children using the alphabet shapes had.

Taking More Time

In a similar series of experiments at the elementary-school level, the researchers found that children taught to do two-digit subtraction by the traditional written method performed just as well as children who used a commercially available set of manipulatives made up of individual blocks that could be interlocked to form units of 10.

Later on, though, the children who used the toys had trouble transferring their knowledge to paper-and-pencil representations. Mr. Uttal and his colleagues also found that the hands-on lessons took three times as long as the traditional teaching methods did.

One problem is that children, and adults as well, sometimes fail to grasp the symbolic value of the objects they're using, according to a panel of experts who presented research on the topic during a national meeting of the Society for Research in Child Development held in Boston last month.

Students might correctly perform the classroom procedure, connecting 10 blocks here, for instance, or taking away blocks from another pile, without thinking about what the objects are meant to represent. Younger children, in particular, also can get lost in play with the toys or become distracted by superficial features of the toys, such as realistic details or bright colors, that have nothing to do with the academic concept being taught.

Nicole M. McNeil, an assistant professor of psychology at the University of Notre Dame, in Indiana, found, for example, that children made more errors—but different kinds of errors—when they used highly detailed, realistic-looking play money to solve word problems.

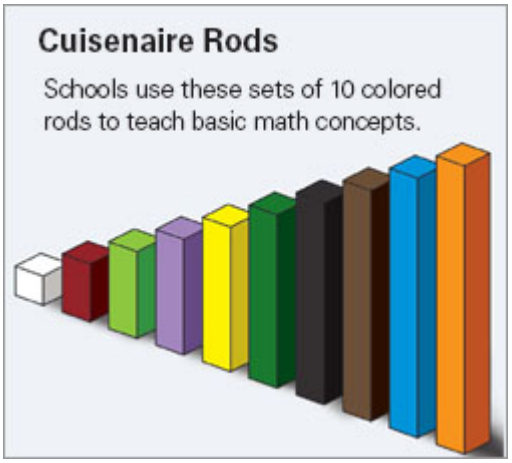
As part of that not-yet-published study, whose findings were also presented at the Boston meeting, 85 5th graders were divided into three groups and given 10 word problems involving money transactions. One group was allowed to use only paper and pencil. A second group used detailed, realistic play money, and the third group was given plain-looking black-and-white bills and coins.

While the students using the highly detailed concrete materials made the most errors overall, fewer of their mistakes involved conceptual misunderstandings. Instead, the students using the look-alike currency tended to stumble on simple arithmetic calculations.

Ms. McNeil's take-away message: "There are both costs and benefits to using highly concrete manipulatives. Because the use of manipulatives is so widespread, it's really important for teachers to stand back and think about what kinds of manipulatives to use."

And at least one study suggests that some teachers may not be using the tools quite so reflectively.

Cuisenaire Rods



SOURCE: Encyclopedia of American Education

Patricia S. Moyer-Packenham, a researcher from George Mason University, in Fairfax, Va., interviewed and observed 10 middle-grades teachers using manipulatives to teach math.

In a paper published in 2001, she noted that many of the teachers saw the classroom toys as a "fun" reward for students, rather than as a way to enhance their learning.

Douglas H. Clements, a professor of learning and instruction at the University at Buffalo, State University of New York, said, in some cases, teachers might also find that "virtual" manipulatives on a computer screen could be more effective than the real thing.

Computerized Geometry

With his colleague Julie Sarama, an associate professor of learning and instruction at the university, Mr. Clements has been testing a Logo computer program for teaching geometric concepts in middle school and comparing the results with those from other modes of instruction.

In the early 1990s, the researchers divided 223 middle school students into three groups—a textbook-only group, a group that used manipulatives in combination with paper and pencil, and a group that used the interactive software program—for a series of eight lessons.

What they found was that students using the software program and those given the hands-on objects both outscored the textbook group afterward on a test of geometric motion concepts—and at similarly high levels.

However, on a test given three weeks later, the computer-using group outperformed both of the other groups.

The researchers believe the software lessons may have been more effective in that case because they required students to be more explicit about their learning.

Instead of mindlessly rotating or taking apart a block, in other words, students had to type in commands to manipulate the shapes on their screens. What's more, the commands required them to quantify directions by giving the precise degree of the angle or the length of side.

Focus on Meaning

Such findings, Mr. Clements said, suggest that teachers may have to expand their definition of manipulatives to include computer-based tools.

It's not the "physicality" of the manipulatives that's important, Mr. Clements and Ms. Sarama write in a conference paper synthesizing research on manipulatives, "it is their manipulability and their meaningfulness that make them educationally effective."

"The main thing is to be very clear about the math that you're trying to teach," Mr. Clements added in an interview, "and to think about the kinds of mental actions you're talking about and that you want students to do."

Northwestern's Mr. Uttal said his own findings with preschoolers also carry implications beyond the classroom, for manufacturers of educational toys and parents who buy them.

"Most of these toys don't come with instructions for parents on the most effective ways to use them," he said. "It would be very easy to fix that."

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