Hands-On Science: Using Manipulatives in The Classroom

Teaching abstract concepts like potential and kinetic energy can be quite a challenge for any elementary school teacher. How do you arouse young children's interest in exploring such "dry" subjects? Studies have shown that the best way to introduce or reinforce abstract scientific concepts is by using manipulatives--small objects that can be touched and moved about by students in ways that enable textbook descriptions to come alive.

When the Association of American Publishers' School Division surveyed 2,000 teachers about their use of various types of instructional materials, manipulatives ranked second as a teaching tool only to textbooks. Teachers used them far more frequently than workbooks, original source materials, hand-outs, videos, CD-ROMs, audio recordings, slides or film presentations, and computer simulations. The survey also revealed that manipulatives were rated as a "highly effective" teaching tool by approximately 55 percent of the teachers, compared to 25 percent for textbooks.

LEARNING BY DOING Let's review how students actually learn what they are taught. Given the opportunity to experiment, they will make use of all their senses to discover and digest scientific principles for themselves. They will investigate ways to solve problems, talk about their solutions and those of other students, and observe procedures used by others. Learning about science--or any other subject--requires students to connect new information with knowledge and skills previously acquired. But we must be sure that the connections between old and new knowledge are sound.

One effective means of doing this is to incorporate new ideas and techniques into the learning activities of small groups of students working cooperatively with manipulatives. These activities invite active student involvement and enable the teacher to be flexible in accommodating each student's developmental level.

TRANSFORMING SCIENCE TEACHING The kind of hands-on investigations that manipulatives make possible is indispensable in science instruction. It's one thing to talk about potential and kinetic energy, for instance, and quite another to race vehicles powered by springs or rubber bands down a ramp surrounded by excited students. In fact, one of the most satisfying aspects of using manipulatives in the classroom, from a teacher's point of view, is the high level of enthusiasm these teaching tools generate.

A study of elementary-age children conducted by Dorothy Singer, co-director of the Yale University Family Television Research and Consultation Center, confirms the

value of manipulatives as educational tools. "We found that they kept the children involved and entertained...with a very high level of attention and concentration," Singer reported. At St. Rose of Lima School in Haddon Heights, New Jersey, a relatively new manipulative resource is being used to teach principles of force, energy, and motion. The teaching tool, a set of manipulatives developed by the K'NEX Education Division, consists of 790 plastic interlocking pieces that can be used to build as many as six different racing cars. A teacher's guide provides lesson plans that encourage open-ended problem solving with experiments involving speed, distance traveled, scientific method, prediction, data collection, and graphing.

SOCIAL INTERACTION Manipulatives like these allow students to design and experiment with their own vehicles in an environment that encourages social interaction. In fact, students using these manipulatives exhibited a number of signs indicating positive social development:

Cooperation and empathy. Students gave suggestions to one another in a friendly manner, acknowledging each other's contributions.

Peaceful conflict resolution. They negotiated and compromised on disagreements about various aspects of the exercise.

Creativity. They created variations of racing vehicles, like motorcycles and dune buggies.

Self-esteem. They displayed a sense of accomplishment and satisfaction. Learning is an interactive process. The more avenues in which knowledge passes into students' minds, the more concrete will be their understanding. When science comes alive for young children, the impact extends far beyond the subject. It provides a strong link to art, music, and health programs, helps develop reading and math skills, and encourages creative writing. Manipulatives help make that happen!

HELP FROM HOME Manipulatives can help students think critically and gain confidence in their abilities to solve problems. Consider these examples:

* To demonstrate Newton's First Law of Motion, students calculate average speed based on their observations of a rolling marble. Answers will vary depending on the distance and speed at which the marbles roll.

* Using a ball and bat, students can observe Newton's Second Law of Motion by increasing the force of their swings to make the ball travel faster and farther.

* The concept of inertia becomes visible when students stack four or five dominoes and use a ruler to knock the bottom domino out repeatedly until there is only one left.

* A creative science teacher can demonstrate any number of scientific theories by having students bring in such things as soap, miniature toy cars, balance scales, toothpicks, modeling clay, rope, and coins.

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