1

Thinking about Children's Thinking

(Or, Why We Take a "Constructivist" Approach)

Constructivist education takes its name from Swiss psychologist Jean Piaget's theory of *constructivism*. From his research he concluded that children actively create—"construct"—knowledge of the physical world from their experiences when they go beyond what they already know. Piaget's conclusion is now accepted in the early childhood field (see, e.g., Bredekamp 1987; Bredekamp & Copple 1997). We frequently hear and read that "children construct knowledge." In this chapter, we want to delve into the meaning of this statement, specifically into *what* knowledge children construct and *how* they construct it during constructivist classroom activities.

A process of construction

"Constructing" knowledge about the physical world means that children are actively creating, testing, and refining their own original, spontaneous ideas about how things work. Recall the opening vignette. Erica's effort to solve her gravel problem is a small example of the constructive process.

Erica knows from observing Sharon that the gravel on her teacher's gutter is moving faster than her own. However, she does not know how to make her gravel move that way. In an active mental effort to figure this out, Erica focuses on the shovels that scoop and dump the gravel.

When she asks her teacher to trade shovels, Erica shows she has already constructed some knowledge about how the world works. She correctly understands that to achieve a *different* result, she has to change something in what she is *currently* doing. Her idea is that she needs to change her shovel; that is, she forms a *hypothesis* that the shovel she uses to dump her gravel affects how fast the gravel moves down the gutter. She tests her hypothesis (which happens to be wrong; shovels have no effect on how fast gravel moves). Unconvinced by the unsatisfactory result, she tests her incorrect hypothesis a second time: "Can I have your shovel?"

hypothesis

An idea or assumption about how something works, before the idea has been tested.

This hypothesis about shovels and movement of the gravel is original to Erica (and perhaps new to the world!). It is not an idea she was taught by her teacher or parents. So how did she come to it? We can only speculate about her reasoning: Because the shovel Erica uses comes in contact with the gravel, she hypothesizes it must cause the gravel's movement down the gutter.

Children's construction of knowledge is a complex, active process in which their knowledge about the world is dynamic; that is, it is constantly changing. At any point a child's understanding will include correct ideas ("It is possible to make gravel move fast down a gutter so that it falls off the end" and "I have to change something to get a different result") as well as incorrect ideas ("What I have to change is my tool for dumping the gravel"). Understanding that children construct knowledge means that teachers try to figure out how children are thinking in the context of classroom activities—a distinguishing characteristic of constructivist teaching.

The evidence that children construct knowledge of the physical world is that they come up with so many ideas never taught to them about physical objects and object phenomena. For example, during Ramps & Pathways activities we often see young children lay a piece of cove molding flat on the floor, place a marble on it, and then gaze at it expectantly, waiting for the marble to move (see Photograph 3).

Consider another example of children's spontaneous ideas about the physical world:

> Three-year-old Josh, who does not understand the necessity of slope for movement of a marble, tries to make a marble go up a slope simply by placing it on the molding and releasing it. He makes many different hypotheses to get the marble to roll upward, including turning the ramp section 180 degrees.
>
> On another day, Josh sees a large marble roll off the end of a ramp section that is almost level. When he tries a small marble, however, it remains motionless. Puzzled that it does not move, he tries adding more small marbles behind the first, one at a time, making a long line of marbles in the groove of the ramp section. Dissatisfied when they, too, remain motionless, he places the large marble behind them (hypothesizing that the marble that moved before will make the small marbles move now). He seems surprised when the large marble fails to push the small marbles.

These kinds of behaviors indicate children's own original and often incorrect ideas about the physical world. These incorrect expectations support Piaget's conclusion that young children think in unique ways, compared with how older children and adults think. Young children do not just have *less* knowledge than adults and older children. The difference is that they so often experience the world in such a way that their knowledge is different in *quality* as well as quantity. For example, Erica did not yet know that it is the gutter's incline that affects how gravel moves; she incorrectly concludes on her own that it is the *shovel*!

Revealing misconceptions

In research on children's thinking, Piaget and many other psychologists found that young children typically have many misconceptions about how the physical world works. Sometimes misconceptions result when children cannot observe an object's movement or reaction. For example, Piaget (1971/1974) studied children's ideas about what makes the last in a line of marbles roll away when the first marble is released to hit the second. He noted that whereas children can actually observe the last marble moving, they cannot observe the force of the hit passing from the first marble to the second, from the second to the third, and so on down the line. To know this internal transmission of force occurs, children would have to make a *deduction*, going beyond what they can see, that transmission must be happening. Young children, however, are not yet mentally capable of that logical deduction.

It is impossible to disprove a young child's beliefs about something that is not observable. For example, some young children (ages 3 to 5) believe that their shadow is a permanent object that has gone inside them or run out of the room when it cannot be seen (DeVries 1986; DeVries & Kohlberg 1987/1990). Similarly, because they cannot see evaporation as it happens (as the liquid becomes gas), many young children believe that magic causes water to disappear. Children cannot test these beliefs, cannot try them out and see what happens. Therefore, they cannot modify the beliefs (until later in their development, when they become capable of logical reasoning about things that are not observable).

deduction

A conclusion come to by reasoning, rather than by direct observation.

For this reason, we recommend physical science activities in which young children can make objects move or change in observable ways. When teachers encourage experimentation with objects such as ramps and marbles, children get opportunities to test their ideas, observe the results, and draw conclusions from their observations. For example, in the introduction, when Erica uses her teacher's shovel to dump gravel on her own somewhat inclined gutter, she can clearly observe how the gravel moves (or does not move, in that instance). She is able to compare her expectation ("Changing shovels will make my gravel go faster") with what actually happens.

When children's expectations are not met, teachers can usually observe surprise, puzzlement, or disappointment in their faces or body language or can hear it in their vocalizations. These feelings can spur children to experiment and try to figure out how to succeed. When objects react in unexpected ways (e.g., when Erica's gravel does not skitter noisily or quickly down her gutter), such feedback offers children the basis for further experimentation.

In fact, a constructivist teacher explicitly encourages children to try out what she as an adult knows to be incorrect ideas. Why? So children will experience contradictions between their wrong ideas about objects and the observable results of their experiments. Observable feedback from the objects is what convinces children eventually to discard a misconception and try out other ideas. This is why Erica's teacher does not correct her idea about shovels. Rather, Sharon cooperates with Erica's initiative in testing what Sharon knows to be an incorrect hypothesis. When a teacher respects young children's unique thinking by giving them the chance to test and refine their incorrect ideas for themselves, they are more likely to go on to correct their misconceptions.

Conventional vs. physical knowledge

Many (nonconstructivist) educators assume that when children have misconceptions, the responsible teacher should show or tell them what is correct. From a constructivist perspective, however, that approach is necessary and productive only when the child's misconception involves knowledge that is "conventional." The term *conventional knowledge* refers to information that is arbitrary—that is, the society has simply agreed that something is so (e.g., "We call that a *block*" . . . "New Year's Day is January 1" . . . "Red means *stop*!"). Remember young Matthew in the introduction? His misconception was that the word *hike* always means "to snap a football through the legs"; his parents supplied the conventional knowledge that it can also mean "walking distances outdoors."

Piaget (1964; 1969/1970; 1971/1974) also talked about *physical knowledge*—that is, knowledge of the physical world that can be gained *only* by active experimentation with objects. Thus, simply showing or telling children about the physical world often results in confused thinking or memorization without understanding. One constructivist first grade teacher, Beth Van Meeteren, encountered this when she taught a summer program for children identified as "talented and gifted": Some children had memorized definitions for words such as *inertia* . . . but then built inclines leading to zigzagged pathways and were surprised when marbles flew straight off the path at the first corner (see Photograph 4).