I DO, AND I UNDERSTAND

Helping Young Children Discover Science and Mathematics

Robert Louisell

with special guest chapters by

Stephen Hornstein and Peter Frost

I hear, and I forget.
I see, and I remember.
I do, and I understand.

*Ancient Asian Proverb.

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Chapter 3

How Listening to Children Enables Good Teaching

THE RAILWAY CHILDREN

When we climbed the slopes of the cutting
We were eye-level with the white cups
Of the telegraph poles and the sizzling wires.

Like lovely freehand they curved for miles
East and miles west beyond us, sagging
Under their burden of swallows.

We were small and thought we knew nothing
Worth knowing. We thought words travelled the wires
In the shiny pouches of raindrops,

Each one seeded full with the light
Of the sky, the gleam of the lines, and ourselves
So infinitesimally scaled

We could stream through the eye of a needle.

—Seamus Heaney, Station Island
(permission to publish granted by Farrar, Strau, and Giroux, LLC)

Most people think of teaching as something you do. For example, they may think of it as telling things to children. But much of your work as a teacher of young children will actually involve listening to children and observing them. In order to teach children well, you must listen well enough to understand the meanings that they give to the words that they use. For example, what does a child really want to know when she asks you "Do fish die?" Is this a question that requires a simple "Yes or no" answer? What are the concerns of the four year old child who asks this question? What does she really want to know? What personal experience might have motivated her to ask this question?

If a child tells you that the moon is following her, what should you say? If you tell her that the moon doesn't really follow you—that it only looks like it does—will she be likely to confide her private thoughts with you again?

What if a child tells you that shadows come from the leaves on the trees? Or that the trees make the wind move?

What should you say? How should you respond?

It's easy for teachers of young children to think and respond in simple, direct ways. They often do this unconsciously. They may "react" to what children say instead of responding to it. For example, a simple reaction to a child telling you that the moon follows her would be to tell her that it doesn't *really* follow her. But what message do you give the child when you correct her expression of her own ideas? Will she think that you take her ideas seriously? Will she think you respect her as a person? You mean no disrespect, but what does she infer? If you shouldn't correct her, what *should* you do?

One aim of this chapter is for the reader to learn to listen to children in such a way that they may be understood and feel accepted as persons. Another aim is for the reader to learn how to use listening as a method of teaching children. But, if we are to become good listeners with children, we must first learn some things about how young children typically think. We must learn something about how they reason and converse.

How Young Children Reason and Converse

When young children converse, their words are sometimes more or less a "free association" of thoughts rather than something they intend to communicate to another person. Take this "conversation" which was overheard by Piaget's researchers in a classroom of 5–6 year olds. At the time, each child was making her or his own, individual drawing to illustrate the story of Goldilocks and the Three Bears.

> First child (Male): *The daddy bear is dead. Only the daddy was too ill.*
>
> Second child (Female): *I used to live at Saleve. I lived in a little house and you had to take the funicular railway to go and buy things.*
>
> Third child: *I can't do the bear.*
>
> Fourth child: *That's not Goldylocks*.
>
> First child: *I haven't got curls.*

For young children, words are at times more of a "good companion" to whatever they are doing at the time than an attempt to communicate to someone else. Take, for example, these words overheard in a classroom while a child was observing a live tortoise (Piaget, 19291975).

> Child: *Now then, it's coming... It's coming, it's coming, it's coming. Get out of the way... It's coming... Come along, tortoise!*

This child's talk conveys excitement about the tortoise's movement. But it also expresses more than excitement—a sort of entreaty to the tortoise to move along, as if the child's words might influence the tortoise.

A few moments later, the same child is observing the classroom aquarium. He says

> *Oh, isn't it [a salamander] surprised at the great big giant [a fish]...Salamander, you must eat up the fishes!*

Is the child only "wishing" that the salamander will eat the fish? He appears to be telling the salamander what to do! Is this child really attempting to communicate to the salamander and the tortoise? Or, is he only producing words to go along with the actions of these animals? The young child's use of language is about much more than communication. And there is often as much nonverbal communication as verbal. It's likely that nonverbal gestures accompanied the child's words in the case of the tortoise. The child was probably attempting to "coach" the tortoise along.

Piaget once referred to the language and thinking of young children as egocentric. He later said that he was sorry he had ever used this term, because it was so often misinterpreted to mean "self-centered." He did not at all mean to imply that the young child is self-centered! Rather, he meant that the young child doesn't easily consider more than one point of view at the same time. For example, in the conservation of solid substance interview that we described in Chapter 1, the child focuses on how much longer the clay is when it has been rolled into a sausage shape (It was in the shape of a ball when the child began rolling it). Or, he may focus on how much thinner it is. But he won't think about the two perspectives—that the clay is longer and thinner—at the same time. As Piaget put it, the young child doesn't *decenter* and consider both perspectives together. If he did, the child might say that the one result—the clay being longer—compensates for the other one—the clay being thinner.

Characteristics of Egocentric Thought

You have already read about animism and artificialism in Chapter 2. These are two types of thinking that children display during the egocentric period. In addition to these, we would like to explain three more: realism, syncretism, and juxtaposition.

Realism: When we use the term "realism,"we are not referring to our everyday usage of the term; for example, "being realistic." Rather, this word has a specific meaning when used by Piaget. It has to do with the child confusing real, physical things with the mind. The following interview with a young child illustrates one example of realism (Piaget, 1929/1975, p. 39).

Adult: When you think, what do you think with?

Child: *With the mouth.*

The child knows that our words come from our mouth and confuses words with thought. The interview continues.

Adult: ... Now shut your mouth and think of your house. Are you thinking?

Child: *Yes.*

Adult: What did you think with.

Child: *The mouth.*

At a slightly later stage, the child says that thought comes "from the head" (Piaget, 1929/1975, p. 49).

Adult: You know what it means to think?

Child: *You think of things you want to do.*

Adult: What do you think with?

Child: ... *A little voice.*

Adult: Where is it?

Child: *There* (He points to his forehead).

This child confuses thinking with talking; that is, he confuses thinking with words. Piaget concluded that this confusion results because young children don't fully distinguish their experiences in the world from whatever goes on inside their minds. Likewise, they don't completely distinguish words from things; for example, the word "lake" from the actual physical thing—a lake.

Adult: Where is the word "lake"?

Child: *It is inside it [the lake] because of the water.* (Piaget, 1929/1975, p. 73).

And when the same child was asked where the word, "sun" is when we think of the sun, he replied that the name of the sun was "in the sun." (Piaget, 1929/1975, p. 74).

The young child during the egocentric period of development doesn't necessarily distinguish *things* from her *thoughts* about things. But, as the child's intellectual development progresses over a period of years, the child eventually develops an idea that thought is located "in the head" or "in the brain."

Yet, when children who have reached this stage are asked if they can "see" thoughts, they say that they can.

Child: [after being asked about where his memory is located] *Inside there* [pointing to his forehead].

Adult: What is there?

Child: *A little ball.*

Adult: What is inside it?

Child: *Thoughts.*

Adult: What would one see inside it if one looked?

Child: *Smoke.*

...

Adult: Is thought smoke?

Child: *Yes.*

Adult: Where [did it come] from?

Child: *From outside.*

Adult: Where?

Child: *The air outside and the smoke from the chimney*.

...

Adult: What is the smoke?

Child: *Breath.*

Another question children are sometimes asked is about the location of dreams. For example, in response to the question "When you dream, where is the dream?," children often respond that it is "in front of you."

We might say that children during this stage do not make a complete distinction between the internal (their thoughts, or their minds, or their memories) and the external (their mouths, their heads, their brains or their breath); in other words, between themselves and the world that they experience.

This lack of a complete distinction between themselves and their surroundings also results in a belief in magic. For example, children in the U.S. often repeat the "Step on a crack, you break your mother's back" expression before they carefully avoid stepping on cracks. This is a sort of game that is played among children, but the origins of the saying may go back to the young child's confusion of self with his or her physical surroundings. Here are a few more obvious examples of children confusing their own actions with their surroundings. These examples are taken from adult recollections of childhood. [1]

1st Recollection: *Every evening, from about the age of 6 to 8, I was terrified of the idea of "not waking up the morning." I used to feel my heart beating and would try, by placing my hand on the chest, to see if it wasn't stopping. It was undoubtedly in this way that I started counting to assure myself. I counted very quickly between each beat and if I could succeed ... in making the beats correspond with even or uneven numbers, I felt reassured* (Piaget, 1929–1975, p. 136–137).

2nd Recollection: *When I particularly wanted something, I often used to step on every other stone as I walked on the pavement. If I succeeded in doing this as far as the end of the pavement, it was a sign that what I wanted would happen.*

The next reflection dates from ages 9 to 11.

3rd Recollection: *I often accompany my father when he goes to the rifle range. While my father shoots, I sit on a bench. He gives me his cigar to hold. I imagine I can influence the accuracy of his shot by the position of the cigar. According as the cigar is almost vertical (the lighted end downwards), or at the angle of 90 [degrees], 120 [degrees] or 180 [degrees], the shot will be only fairly good, good, or excellent. The shot never entirely misses, because my father is a good shot. However, after two or three good shots have been fired, I lower the cigar with the feeling that he cannot keep this up* (Piaget, 1929–1975, p. 137).

In each of these recollections, the adult recalls believing—at least a bit—in magic. This is important when discussing how to teach young children about science because magic is not what science is about. Rather, science is about understanding the physical causes of things. The magic expressed in these three examples is about trying to cause things to happen by wishing for them to happen (or thinking they will happen); that is, it is the belief, on the part of the child, that she can influence events by performing certain actions. These actions are actually totally unrelated to the physical results, but children sometimes believe they are related. Piaget concluded that the child's realism is the result of the child's confusion of herself with the material world. When egocentrism declines, beliefs in psychological causality are replaced with an interest in more scientific explanations; that is, with a belief in physical causes for physical phenomena.

We don't want to give you the impression that Piaget believed that children had thoroughly thought through their ideas about the questions which he posed to them. He didn't believe this (Piaget, 1929/1975, p. 123). Rather, he concluded that children give the types of responses that they give to his questions because they have not yet fully distinguished their psychological worlds from their physical worlds. In other words, they are not yet fully self-conscious; that is, they're not yet fully aware of themselves as distinct individuals. The quote from Chapter 1 is relevant here.

> Mother: Did you have nice dreams last night?
>
> Child: You should know!
>
> Mother: Why should I know?
>
> Child: You were in them.

Syncretism and Juxtaposition: The talk of young children reflects their developing logic, except that their logic may develop before they are able to articulate it in words (Piaget, 1932/1973). *Syncretism* is one aspect of the young child's logic. It could be defined as "relating everything to everything else." As an example, consider the following response to the question "Why doesn't the moon fall out of the sky?" (Piaget, 1929/1975, p. 147).

> Bea (age 5): *The moon doesn't fall down because it's very high up, because there isn't any sun, because it is very high up.*

These statements ("There isn't any sun," "It's very high up") are not logically related. But, in the mind of the young child, each of these statements is taken together as one piece. Thus, the child explains one thing by referring to another thing that, in her mind, is part of the same "piece." The moon doesn't fall out of the sky because it's very high up in the sky and because there isn't any sun there, etc. All of these things that the child notices when observing the moon in the sky are related to each other in the mind of a young child. This is what we mean when we say that syncretism could be defined as "relating everything to everything else."

A child whose thought is syncretistic doesn't adapt to the person talking; that is, she doesn't try to analyze the individual words or parts of a message. Rather, she assimilates anything said to whatever she already knows—just as the young child, Bea, did in the example we shared above (Piaget, 1929/1975, p. 161–165). This is also true of egocentrism (that the child doesn't adapt to the person talking) since the child cannot be thinking of the speaker's perspective while simultaneously thinking about her own point of view. But, while the process of syncretistic thought results in many misunderstandings for the young child, it also brings the child, eventually, to a more accurate understanding resembling the understandings of adults. In other words, it is the means by which the child eventually develops a more accurate understanding of her world (Piaget, 1929/1975, p. 168).

We've discussed syncretism and defined it as relating everything to everything else. For *juxtaposition*, on the other hand, nothing is related to anything else. It is like the drawings of a bicycle for which none of the parts are connected. Examine the following reproductions of children's drawing of a bicycle.

Notice in Figure 3.1 how Mol's drawings (5 years, 3 months old) show 3 parts—a seat and two wheels, but not any of the connecting items

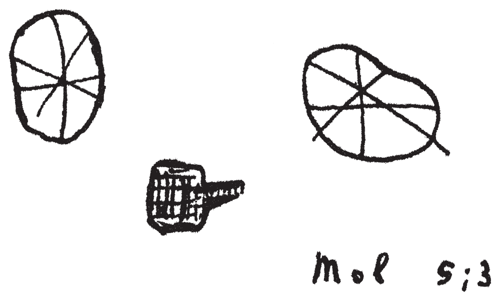

Figure 3.1
Credit to *The Child's Conception of Physical Causality*, by Jean Piaget (London: Routledge and Kegan Paul, 1930).

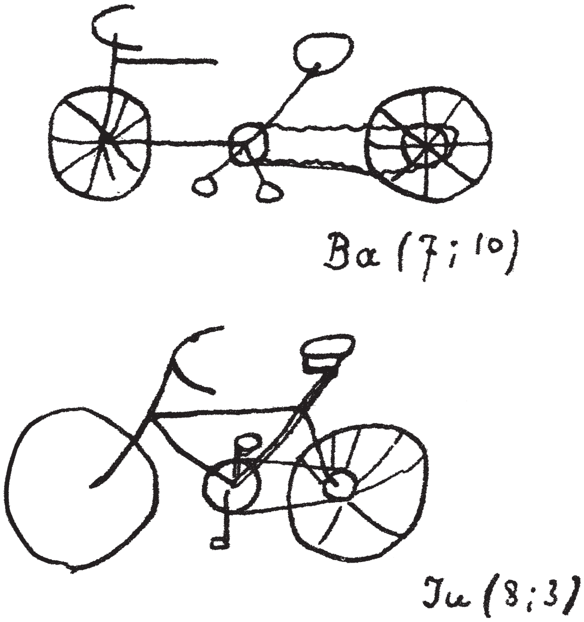

Figure 3.2

Credit to *The Child's Conception of Physical Causality*, by Jean Piaget (London: Routledge and Kegan Paul, 1930).

like the bicycle frame, the chain, or the seat post. This is a good example of juxtaposition. All the parts are juxtaposed without regard to how they connect. The child's explanations for how a bicycle works are along the same lines; that is, they are disconnected.

You might think these two ways of looking at things—syncretism and juxtaposition—are exact opposites. And you would be correct in thinking this, but, despite their dissimilarity, syncretism and juxtaposition "go together;" that is, they occur together during the egocentric period. Piaget has said that the egocentric child's thinking is "pre-logical" (Piaget,1928/1972). Others (for example, Easley and Zwoyer, 1975) have said that the child has a logic but that it is different from that of adults. But, however we look at the child's logic (prelogical or different), the tendency to see everything as related to everything else is a logical contradiction of the tendency to see nothing as related, and this contradiction, along with many others, does not seem to bother the young child at all! As an example, let's look at an interview with a child about why boats float (Piaget, 1930/1972, p. 138).

> Adult: Why does the wood stay on the water? [meaning "Why does it float?"][2]
>
> Child (Age 7:11): *It's light, and the little boats have sails...*
>
> Adult: And the little boats without sails, why do they stay on the water?
>
> Child: *Because they are light.*
>
> Adult: And why do the big boats stay?
>
> Child: *Because they are heavy.*

In this excerpt from an interview, the child contradicts himself. As Piaget put it "one boat will float because it is heavy, another, because it is light. Logical coherence is entirely sacrificed in such cases to fidelity to fact" (Piaget,1928/1972, p. 253). In other words, the child is faithful to the facts—that the heavy boat floats and that a light boat also floats—but the child's logic is not consistent. Another example of a child warping her thoughts to facts can be seen in the following video.

View Video 3-1

When the interviewer asked the child in this video to predict where the two ends of the pencils were located underneath the cardboard screen, she had no difficulty deciding where to point. She pointed as if each pencil would end at the same point underneath the cardboard. The interviewer lifted the cardboard screen to reveal that one pencil ended at a point less close to the end of the cardboard than the other. After showing this to the child, the interviewer asked her if her prediction had been correct. She said it had, even though it clearly had not. This is what Piaget meant when he said that logical coherence is sacrificed to fact. This is a feature of the young child's reasoning which teachers must take into account.

The Child's Logic After Egocentrism: Eventually, over a period of years, the child emerges from this period of egocentrism and develops a more organized, logical reasoning. At this point in time, the child can no longer be considered to be in the preoperational period. Instead, she is now in the period that Piaget called *concrete operations*. What does this term mean? It means, first, that the child has a more organized system of thinking. Piaget called these more organized systems of thought *cognitive structures*,[3] or operations. Second, it means that the child's thinking can be applied to reality. However, even though the child can apply her thinking to real things, she is not yet able to apply this system of reasoning to the more abstract, hypothetical types of propositions that adults can consider such as algebra or sophisticated mystery novels.

A cognitive structure is an organized, logical pattern of thought. For example, when the child is capable of conserving solid substance (as in the interview with clay that we discussed in Chapter 1), she will be able to imagine reversing the action which transformed the clay from the shape of a ball to the shape of a sausage. In other words, she will realize that, just as rolling the ball of clay in between one's hands has changed the shape of the ball to the shape of a sausage, one could also roll the sausage-shaped clay back together into the shape of a ball. The same applies to all of the conservation tasks. For example, for the conservation of liquid quantities task, in which the water has been poured into a taller, more narrow glass than its original container, the child can mentally picture herself pouring the water back into its original container. When a child reaches the point where she can imagine performing an action that negates the original action, her thought is said to be *reversible*. Because she is capable of reversible thinking, she realizes that the amount of clay (in the first task) or the amount of liquid (in the second task) has not been changed. Reversible thought is one of the cognitive structures of concrete operations. The child's thinking has been applied to real, concrete things like the clay or the liquid. And the child's thinking is an organized, logical pattern of reasoning. In Piaget's words, it has become a mental "operation."

What causes the child to move beyond the preoperational period into the period of concrete operations? Physical maturation plays a role as do a variety of sociocultural experiences. Piaget noted that social interaction results in the child becoming aware of his or her self; that is interaction with others makes one aware that others have different points of view than oneself and that insight makes one more aware of one's own point of view (Piaget, 1930/1972, p. 252; Piaget, 1932/1973; Kamii, 2000, Chapter 3).

Interviewing Young Children

How can a teacher find out what the child's ideas really are about any particular topic? One way is to interview the individual child in much the same way as Piaget and his colleagues did. We will explain how to do this but, before we do this, we should first show you some actual interviews. Let's start with Video 3-2. Please view Video 3-2 now.

View Video 3-2

It's important during an interview that the teacher not "put words into the child's mouth." In this interview, a teacher[4] is interviewing one of her first grade students, Jessica. Notice that she begins the interview with very indirect questions; for example, "Have you ever been outside for a walk at night" followed by "Was the moon out?" and then "Can you tell me anything about the moon?" These types of questions help the child to explain *her* experiences with minimal influence from the person doing the interview. Notice that Jessica volunteers information with her response. She says "It's shaped like a circle and like a banana." We don't recommend asking questions like "What was the moon doing?" because that may imply to the child that the moon is alive and *does* things, but Jessica volunteers something that many children her age say—that the moon follows her.

The only mistake this interviewer makes in a nearly flawless interview occurs when she asks this child "If there were only one moon..." It appears that she just doesn't want to believe that the child thinks there are two moons, so she follows with this question. It's difficult for teachers and parents to interview their own students and children because of this problem; that is, teachers and parents typically have difficulty accepting that a child's ideas may be very different from their own and may even seem a bit crazy! They don't want to believe that the children whom they know could believe anything so "crazy." But that is what we, as teachers and parents, must deal with when we interview our students and children. We must take off our "teacher hats" (or parent hats) and become good detectives, examining any evidence we can find about what the child's real beliefs are.

Let's examine one more interview before we discuss recommendations about how to interview—Video 3-3.

View Video 3-3

In this interview, the child changes her counting scheme after the interviewer has spread out the upper, brown row of cubes to be counted. The interviewer is so surprised by this that he asks the child to repeat her counting of each row two more times! He is trying to figure out which items she is actually counting, but he hasn't succeeded in doing this during all the times that he has reviewed this videotape in the more than 30 years that have elapsed since he did this interview! When the child is asked whether or not each row is the same, she responds "You have more and I have less." Yet, when the brown row of cubes is compressed so that it takes up the same amount of space as the white row, she says both rows have the same amount and, when asked if she wants to count them, she says that she knows (and therefore doesn't need to count).

Next, this interviewer introduces a "fan" on which the white and brown cubes are placed at opposite ends of tracks that have been outlined on the fan.[5] Notice that this interviewer made a mistake, which he corrected during the interview, just after he introduced the fan on which the brown and white cubes were placed. In phrasing his question about the number of cubes, he said "Are there more blocks up here where the brown are or down by you where the white are?" The problem with this phrasing is that it implies that one row is more than the other. Thus, it suggests to the child that one row has more. He quickly added "OR are there just the same number?" Through experience, we've learned to phrase this question more simply; for example, "Does one of us have more? Or, do we both have the same amount?" This last phrasing doesn't suggest either answer (one row containing more cubes or both rows having the same amount).

It's interesting that this child changed her mind about one row having more after she had pushed the white blocks about a third of the way up the fan. At that point, she concluded that both rows had the same amount. While the fan was not intended as an instructional tool, it seemed to have that effect.[6] However, the interviewer's purpose in using the fan during the interview was to find out at what point the child would change her mind and decide there was one white cube for every brown cube—not to "teach" her that there were the same number of cubes in each row.

Teachers who have much experience interviewing children can learn to talk with children about these things "on the run" throughout the daily activities of the classroom and on the playground. However, when one is new to interviewing children, it's useful to follow certain guidelines. Those guidelines that we recommend include the following.

✔ **Start with an interview protocol**. A protocol in this context is a list of possible questions about a particular topic. Questions are listed in the order that you anticipate asking them.

✔ **Don't stick to your protocol**. You must be a flexible conversationalist when interviewing children. In a clinical interview, you are trying to find out what the child's *own* ideas are (Otherwise, it's not an interview!). Your protocol is just a "guide" to help you stimulate conversation on the part of the child. If you stick too closely to your protocol, you risk giving children the impression that you are either not really interested in *their* ideas or that you are "fishing" for a correct answer.

- ✔ **Videotape your interview**. A typical teaching day provides teachers with many opportunities to step outside the teacher role in order to interview children. For example, you can interview an individual child while children are playing at recess, lined up for lunch, etcetera. After one has had lots of practice interviewing children, it seems to come naturally. However, beginners usually videotape their interviews so they can review them and try to improve their interviewing skills.

- ✔ **There are no correct answers in a clinical interview**. The purpose of a clinical interview is to find out how the *child* thinks about a particular topic; that is, what the child's ideas about this topic are. This information should provide you with insight into the child's way of looking at things. As Jack Easley said, "The point which Piaget makes so well [is] that children don't give wrong answers. They believe in the answers they give because the answers follow from their way of looking at things" (Easley and Zwoyer,1975, p. 24)

- ✔ **Skilled interviewers get kids talking! It's difficult for teachers to resist the urge to talk**. We often monopolize a conversation as we attempt to teach our students. But the purpose of a clinical interview is to find out the *child's* ideas—not ours. It is important that we take off our "teacher hat" and step outside of the teacher role when we interview children. A workable strategy for getting kids to talk is to "play dumb"; for example, you might say "What can you tell me about the moon?" as if you mean to say "Teach me about the moon. I don't know much about it."

- ✔ **When a child says something, follow up on it with another question or a statement acknowledging that you understand what the child has said**. The child's comment may or may not have anything to do with your interview protocol. If it's not related to your protocol, don't worry about it. At least the child is honestly sharing his or her ideas with you. Go with the flow! After the child has shared the ideas that don't relate to your protocol with you, try to lead the child back to the topic you have in mind.

- ✔ **Be careful not to influence the child's responses**. Too often, adults interview children like a judge giving instructions to a jury. For example, a judge may say "If you think the defendant is innocent, then .... HOWEVER, if you think the defendant is GUILTY, then ..." Don't put words in the mouths of those children whom you interview. Try not to act surprised when a child tells you something that sounds incorrect or strange. Never imply that he or she should "know better." Never try to convince a child to change his or her answer.

- ✔ **When deciding what questions to include in your interview protocol, include questions which children pose to adults and other children**. Piaget found many of his best questions for use in interviews by listening to the questions which children asked during natural conversation.

- ✔ **Don't assume that the child is telling you his or her true feelings**. Also, don't assume that the child is *not* telling you his or her true feelings. Children have many reasons for telling you things in an interview. They may think that you want them to give a particular answer. They may, for example, be "reading" your body language or voice inflections. They also may become tired and give answers just to "get you off their backs." There is no sure way to determine whether a child really believes what is said during an interview. However, Piaget (1929/1975, pages 1–32) has shared some questions to consider when an interviewer is trying to determine whether the child is sharing one's true beliefs during an interview. These are:

  - Do the child's ideas appear to be roughly similar to the ideas of other children in the same developmental range? Note that we say range—not age. Mentally handicapped children may express ideas similar to children who are younger than them, but they may still reflect the ideas of a particular developmental stage. If they do, then it is more likely that the child really does hold these beliefs.

- Is there a continuous evolution to the child's thought? For example, are the ideas a child expresses in January related to the ideas he or she expresses in March? Put another way, do the child's ideas disappear gradually? If they do, you will often find one idea being only partially abandoned while another idea is emerging. This is considered to be evidence that the child really does believe those things he or she tells you.
- Do the child's ideas resist suggestion? For example, if you tell a child that, previously that morning, her best friend told you the opposite answer, will the child "stick to her guns" or switch to the answer that her friend gave?

Activity for Future Teachers 3.1

Now that you have reviewed some interviews with children and read our pointers for doing clinical interviews, it's time for you to do one yourself. You will learn far more by doing your own interviews than you can possibly learn from reading about them or by viewing interviews done by others. Find a child whose parent(s) will permit you to interview her or him. Develop an interview protocol that is likely to be a good match for this particular child in terms of age and developmental stage. You can consult child development texts or other books about teaching children math and science for ideas concerning interview topics (We have also provided some interview protocols in the online course materials). Get an appropriate camera for recording the video and sound of an interview. Interview the child and then review it to answer the following questions: 1. What are this child's ideas related to this topic? How do you know? 2. What could you have done differently during the interview to learn more about this child's ideas?

- Do the child's ideas show up in many of the ideas which the child expresses on this topic? If a child expresses the same idea in many ways, she is probably sharing her sincere beliefs. For example, if many of the child's answers are animistic, then the child probably does think along animistic lines.

Interviewing Throughout the Classroom Day: Sometimes a teacher may conduct a brief interview with an individual child "on the spot" while working with a group of children. Consider, for example, the following classroom experience with a bright, 7 year old child named Chrissy. While learning about the algorithm for 2-digit addition (which was called "carrying" when Chrissy's teacher was in primary school), Chrissy completes the following math problem on a blackboard where her group of students are working.

$$\begin{array}{r} 4\ \ 7 \\ +\,3\ \ 5 \\ \hline 7\ 12 \end{array}$$

Her teacher asks her "What's your answer?"

Chrissy replies "seven-hundred twelve?" She says it as if she is asking a question. Chrissy has added 5 to 7 and written her result, 12, below, in the ones column. Next, she added 3 to 4 and wrote her result, 7, in the tens column. Her teacher then explains that "there's a rule" that you can only put one digit in the ones place. Chrissy quickly erases and changes her answer to look like this:

$$\begin{array}{r} 47 \\ +\,35 \\ \hline 712 \end{array}$$

Again, she says that her answer is 712. Now, her teacher realizes that Chrissy has not yet grasped the exchange of ones for tens, and she reteaches this procedure to Chrissy, using base ten blocks (To see how this is done, see Chapter 5).

Using Interviews While Working With the Whole Class: Interviewing individual children is the best way to find out what individual children think about a particular topic, but, since teacher's schedules so often require them to work with an entire group of children, it's not always practical for classroom teachers to do this. However, the approach of interviewing children in order to inform your teaching can also be adapted for use with small groups and even an entire class of children.

For example, one might introduce children to a science activity such as making clay boats. As they reshape the clay while trying to form boats that will float and as they test their boats by placing them in containers of water, they will be confronted with some basic science concepts such as density and specific gravity. No one will expect that they should be able to articulate their ideas about these concepts at this stage in their development, but the children will still encounter some of these concepts in a rudimentary way because of their experiences trying to make the boats float. After a certain amount of time to explore their success at making floatable boats (25–40 minutes, initially), the teacher will gather the entire group that has been participating in this activity together for discussion.

"What makes a boat a good boat?" she might ask the children. Different children will have different ideas about this topic. Some may say that the sides must be high enough so the water doesn't get in and sink the boat. Others might emphasize that you can't make the sides too high or they might become so thin that the water gets in through the cracks and holes in the sides. Perhaps another child will say that it's best if you close the walls together at the top of the boat so no air can escape. There will be a variety of ideas expressed by the children. This process of "interviewing" a class makes for excellent discussions that help children to consider ideas that are different from their own ideas. Another way of saying this is that this type of discussion may help some children to decenter to the point where they will consider other points of view.[7]

Karen Gallas (1994) is a teacher of grade 1 and 2 children who has attempted to create a classroom learning environment that facilitates learning by embracing all aspects of the child's self-expression; for example, the child's drawings, conversations, stories, songs, dances and writings. As she says

> It seems important that children have a place where seminal experiences, which occur both in an out of school, move from silent expression into speech. I am reminded of my observations of my own young children as they encountered new experiences in the world: their isolated wanderings, for example, on a remote island off the coast of Maine. They would return home silent, but filled with deep thought. What might they have realized if their school had been one where they could have shared their observations and thinking with others, where their silent narratives would have been made manifest and filled with recognition? Children's narratives, if uncovered and honored in the context of the classroom, can become powerful vehicles for thinking and learning. (p. xiv).

If you want to listen to children, your first step will need to be establishing a classroom environment that children can trust. They must feel welcome to express their ideas to you, their teacher, and to the other children in their class through every media imaginable; that is, through drawings, talk, stories, songs, dances and writings. They must feel welcome to share their own experiences and backgrounds—whether they just arrived from Laos last week or have parents and grandparents who were born in this country. They must feel welcome to share their own experiences whether they are poor or wealthy.

One approach that Karen Gallas has used to interview her grade 1 and 2 children about their ideas is to let them conduct the daily "share time" sessions. She doesn't sit in the teacher's chair for the sharing time. Instead, she sits in the back of her group of students and selects a child to conduct the share time while she listens and observes. All topics are accepted. All questions, thoughts, and stories are allowed. The child who conducts Share Time talks for a while and then asks for, and responds to, questions. A teacher can gain a lot of insight into how children think about particular topics by listening to this more open type of classroom participation.

Other Ways to "Listen" to Children's Ideas: Within their own minds, young children don't necessarily separate "science" from the other topics about which they have questions (Dewey, 1933). "Math" has a special connotation for them because of the numbers and operations that they associate with it (for example, addition and subtraction). For both subjects (science and math), it's helpful to have students keep a journal. Journals may include drawings, invented spellings, and writing. As the children become more skilled, they may even include songs, audiotapes, and videotapes. But even younger children who cannot yet write or invent their own spellings can put drawings in their journals. These journals may not neatly distinguish science topics from other topics about which the children are curious. They may include questions about thunderstorms, weather, and people. The child's drawings and, later, his or her writings, are expressions of the child's ideas about topics that he or she is interested in. Good teachers learn to observe these drawings and read these writings thoughtfully in order that they may gain insight into the thinking of the children with whom they work. It's also important to invite children to tell you about their drawings—especially when they cannot yet write or read.

As the child's teacher, you should be careful not to think about science too narrowly. Sometimes a child has ideas about science that he can't articulate clearly. Gallas tells the story of John, a first-grade child, who wrote about rap music in his science journal. Gallas' student-teacher told John that rap wasn't science and therefore he couldn't write about it in his science journal. But Karen Gallas persisted in asking John why he thought that rap music was science. After several attempts to explain his idea, John finally said

> *'Cause microphones are electric, and some microphones, they have wires hooked up to the radio... they have it hooked up to... the pianos and stuff and they got it plugged in, and those are electric. 'Cause that's how you write about it...So can I?*
> Gallas replied "Sure." (p. 93)

It's best to allow children to enter anything in their science journals. Some children's questions may be about social behavior. Others may be about nature. Some children even pose the big questions of science; for example, "How did the earth begin?" and "Does the universe have an end?" or "How did people evolve?" Children's questions reflect diverse interests!

Gallas also advises teachers that they should not worry about students staying on the topic during share time or in their journals because "staying on the topic" really means staying on the topic that the *teacher* has in mind and, to find out how the child thinks about any topic, you must listen to the things that *the child* says about it (p. 84). Likewise, the teacher should not worry about whether or not the children's discussions or journals express the correct answer to specific questions (p. 87). Again, it's more important that the teacher gain some insight into how the child is thinking about any topic. As Eleanor Duckworth said

> Wrong ideas...can only be productive. Any wrong idea that is corrected provides far more depth than if one never had a wrong idea to begin with. (p. 71).

We're not saying that teachers should never teach or explain correct answers to children. They should, for example, teach their students about the life cycles of insects (and the names of each stage of these life cycles). But the emphasis should be more on the ideas that children express about the life cycles than on the correct terms.

The student who wrote about rap music in his science journal also included many comments in his journal about how "exciting" it is. Upon receiving the Nobel Prize for her work in maize genetics, the scientist Barbara McClintock said "Every plant in the field, I know them intimately" (Witz, 1995).[8] It was her love for her plants that drove her research. Gallas believes that the young child's excitement about science is more important than that she or he correctly use science terms or apply science concepts correctly to her world. At this stage of childhood, we agree. As she puts it

> Excitement, wonder, and awe characterize their [children's] interactions with hands-on science... [Instead of correct usage of science terms, we must][9] engage as many children as possible in observing, experimenting, talking, and writing about the world. That process must begin with deep emotional attachment and focus, as children naturally do, on the surprises in nature.... For children, a feeling [for science topics] is ever-present... That awareness can be a starting point from which conversations about science begin. I believe those conversations must be on the child's terms (p. 98).

Gallas quotes Hillman as saying that the classroom activities must be shifted from one that explains to one that helps children to understand, from one that emphasizes the names of things to one that nurtures imagination, and from the "head" to the "heart" (p. 102). We agree.

It's important that teachers allow students to explain their ideas often and as fully as they can. Otherwise, they may miss important clues into the workings of the child's mind—clues that will help teachers to facilitate the development of children's ideas. It's important that teachers develop insight into how children make sense of their worlds. As Gallas says

> ... in order to follow the [science] talks [of children] I must bring to them the child's mind and I must watch and listen carefully for clues as to when an idea is making sense. That can be done, as I learned early on, only if I am quiet. Silence has enabled me to hear the sense that children are making, and that sense is much more complex than I first realized. (p. 100).

In past generations, it was sometimes said of children that "silence is golden." Our point about listening to children is that we could apply the same adage to teachers of young children!

Teaching by Listening: Easley and Zwoyer (1975) coined the term "teaching by listening" to describe an approach to teaching that is based on thoughtfully listening to children's ideas (p. 20). As they point out, teachers can be unaware that teachers and children have different interpretations for the things being said during classroom activities (Easley and Zwoyer, p. 19). They say that master teachers must become "mind readers" (Easley and Zwoyer, p. 21). Easley recalls an innovative mathematics education leader, Max Beberman, who demonstrated a "natural and spontaneous inquisitiveness about the form the subject matter was taking in the minds of his students" (Easley and Zwoyer, p. 21). In other words, teachers of students of all ages must be actively curious about what is going on in the minds of their students. They must listen and observe for the purpose of finding out the child's ideas about whatever topics are being discussed.

This kind of teaching must not focus on correct answers. Instead, it must focus on the child's *ideas*. Asking children to explain their way of thinking about a topic can lead to further insight on the part of the teacher. You might think that it is part of your duty as a teacher to be a disseminator of information. However, telling children that a particular answer is "correct" closes off further explanation on the part of the child. These explanations of the child provide teachers with information about the child's ideas on the topic (p. 25).

As Easley and Zwoyer have said,

> If you can both listen to children and accept their answers not as things to just be judged right or wrong but as pieces of information which may reveal what the child is thinking, you will have taken a giant step toward becoming a master teacher rather than merely a disseminator of information (p. 25).

Glossary

cognitive structures: organized patterns of thought; mental actions that occur in a logical, organized pattern.

concrete operations: cognitive structures that are organized in logical, reversible ways.

decenter: to consider multiple points of view simultaneously.

juxtaposition: perceiving or thinking of parts without regard to how they are related; considering parts but not the whole which is made up of its parts; focusing on the parts of objects while ignoring how they are related mechanically.

realism: confusing physical reality with things of the mind; for example, confusing the sun with its name, dreams with reality, or ideas with actual things.

reversible thought: the ability to imagine the negation of an action that has already occurred. In other words, imagining the reversal of a previous action.

spontaneous conviction: changing one's mind about a topic while discussing, or thinking about, a topic; for example, during an interview.

syncretism: relating everything to everything else. Thinking and talking as if everything relates to everything else.

Endnotes

[1] These are direct quotes from these adults, so we have italicized them.
[2] Brackets inserted by the author.
[3] A cognitive structure is an organized, logical pattern of thought.
[4] Thanks to Penny Shenk and her former student, Jessica, for permission to use this interview.
[5] The video of the fan doesn't look like what the child and I saw while completing this interview. I carried the fan, folded, in my backpack while bicycling to the interview and I didn't realize that the creases of the folds in the fan would show up on the video as black lines (like the lines on which we had drawn the tracks with black magic marker). However, all we actually saw during the interview were the fold creases, with no color whatsoever, so we were not distracted or confused (as you might be while viewing it).
[6] When a child changed her or his mind during the interview, Piaget called this a *spontaneous conviction.* By using this term, he meant to imply that the process of thinking about the topic resulted in a deeper understanding on the part of the child. He has also used the term "liberated conviction" for those times when the child changes her or his belief after being influenced by interaction with the interviewer. This does not necessarily mean, however, that the interviewer has explained the concept to the child (Piaget, 1929/1975, Introduction).
[7] For more on this approach, see *The Clinical Methods In Education* by Marianne Denis-Prinzhorn and Jean-Blaiz Grise, as translated from French by Marie Louisell and Robert Easley (posted with the online resources for this chapter).
[8] As quoted (Witz, p. 11) from *A feeling for the organism: The life and work of Barbara McClintock,* by E. F. Keller (1983)
[9] Brackets added by the author.

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I DO, AND I UNDERSTAND

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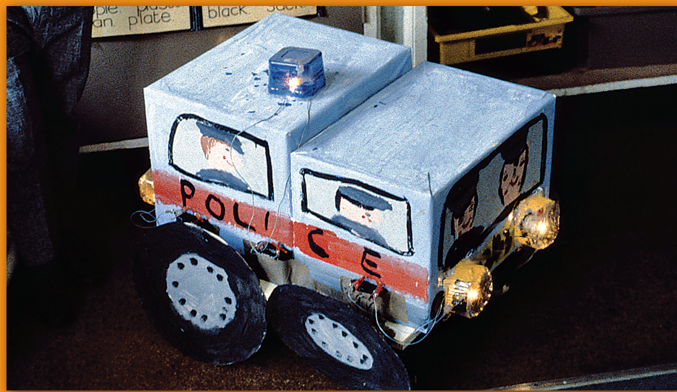
"A merit of his liberalized Piagetian approach is to help educators to take a subject's perspective about children as learners. These analyses of Dr. Louisell's yield wise advice on educational strategies, which might help to refine interventions in elementary science education."
— Juan Pascual-Leone

(About science activities)
"If we provide hands-on situations for children—for example, exploring density by testing out which objects sink and float or learning about electricity by experimenting with batteries, bulbs, and wires—they will reflect on the science phenomena that they observe and develop their own ideas about them."



Facsimile of a Police Car Built By Children

Paintings by 1st Grade Children After Trip to Zoo

(About constructivism)
"When we help children to develop their *own* ideas about the world around them... we are helping them develop *their* knowledge of the world. This is far more important than trying to pass on our own knowledge — a knowledge most young children will be unable to understand at this stage."

"Previous texts on the subject … neglected … grade levels one through three. This book … comprehensively deals with preschool/kindergarten *and* grades 1–3 and it contains over a hundred tested early childhood activities for mathematics and science."

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