# Play and Concept Development in Science

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"You can teach any child any subject at any age or stage of development in an intellectually honest way (Bruner, 1960)." What an incredibly bold and perplexing statement! Is it possible to teach Boyle's Law to a 4-year-old child? Can a 6-year-old child understand the concept of Bernoulli's Principle? Surely, a kindergarten child can separate objects into piles that will either float or sink, and they can reason within themselves that some things sink because they are "heavy," or that they float because they are "light." But is it remotely possible, that through "intellectually responsible" instruction, you can teach the five-year-old child to understand Archimedes' Principle -- that an object will displace a volume of water equal to its own mass, and if the mass of the object is greater than the volume of water it displaces, the object will sink? Can a kindergarten child gain such conceptual understanding that if an object displaces a volume of water that is less than the mass of the object, it will float?

Bruner's statement is one that has caused considerable turmoil in the mind of this author. As a university professor of science education, it is my responsibility to prepare education students to become effective elementary-school teachers. In most self-contained elementary-school classrooms, these educators will teach all subjects to the children, including science.

Perhaps there are two – or three – questions that need to be asked: 1) Would a young child have the desire or motivation to learn such involved concepts? 2) If Bruner's statement is correct, then is it important for educators to spend time teaching (in and "intellectually honest" manner, of course) such concepts to children?

In most classrooms in the United States, conceptual understanding in science is not expected until a child reaches 5th or 6th grade (ages 10-12). Younger students are taught simpler skills such as observation, sorting, classifying, comparing and contrasting, etc., and are provided with opportunities to explore their environment, and to perform simple experiments, such as which ice cube will melt the fastest: the one in the sun, or the one in the shade?

Is it possible that a teacher does not even *need* to teach deeper science concepts to the younger child, much less having to worry about doing so in an "intellectually honest" manner? Is it possible that young children can begin to gain such conceptual understanding on his or her own, simply through playing with science?

In a 2001 study, Restak looked at numerous biochemicals in the brain that contribute to emotional states. The biochemicals enable the brain to communicate with the body via the bloodstream. In addition, they affect the neurons that are associated with learning and memory formation. "Most of this activity occurs beyond our conscious awareness. Our thoughts and emotions usually work together, but sometimes, powerful emotions can drive our actions without us consciously understanding why" (p. 112). Is it possible that children's play can elicit such powerful emotions that can affect the way that a child is able to understand concepts, even though he or she may not be able to verbalize such a concept?

As children learn, information is encoded in different parts of the brain. Schacter (1996) relates how these pieces of information, which are stored in separate parts of the brain, are linked together to form "more enduring memory systems deeper in the brain," and becomes, therefore, easier to remember. What is it that links together those separate bits of information? Does play pay a part in such functions of the brain? Play allows young children the chance to test and apply science ideas imaginatively. Memory is enhanced when concepts are acted upon by the learner using recall strategies, such as mental imagery and other retrieval cues.

In 1979, Barbara Biber wrote of the tremendous value of play as a valid form of learning. "It was seen as a means of deepening insights, integrating knowledge, and finding identification on a personal level." Wolfe, Cummins, & Meyers (1998) stated, "science gives structure to activities, while play encourages creative behaviors and positive attitudes toward solving problems." However, we need to be reminded that play loses its value as relaxed, pleasurable activity if adults are too quick to intervene, even to ask questions or capitalize on the "teachable moments." Children's play, if it is to remain a valuable learning experience, must be voluntary and intrinsically motivated. Play is active, and play is pleasurable (Bredderman, 1982). So many people, including teachers and parents, still have the antiquated belief that "telling" is equal to "teaching." Instead, children's minds are constantly engaged in sense-making. The constructivist view is that children build knowledge internally by interacting with the environment, making sense of the world around them through that interaction.

Friedrich Froebel (1904) wrote that "young children need to learn the language of forms before they learn the language of words. Even without explicit instruction, young children are acquiring elementary and adaptive knowledge and skills in . . . science . . .." As young children may not possess the language skills necessary to verbalize conceptual understanding, the teacher or researcher must ask questions of the child, but only after the play is finished, so as not to interrupt the play setting. Questions, such as, "What did you find out about . . .?" "Can you show me what happened when . . .?"

And yet, according to Elkind (1999), there are three major obstacles in creating an "intellectually honest" form of science instruction for young children: a) adults are incapable of discovering how children acquire science concepts; b) "young children think differently than we do and do not organize their world" the same way we do; and c) "young children have their own curriculum priorities and construct their own . . . science . . . concepts." He states that, while children have their own way of constructing science concepts, " they may seem wrong from an adult perspective."

Jerome Bruner argues that "schools have wasted a great deal of time by postponing the teaching of important areas because they are deemed "too difficult' (Smith, 2002). In the case of the young child, one might agree with Bruner's assessment that interest is the best stimulus to learning. He states that "motives for learning must be kept from going passive . . . they must be based as much as possible upon the arousal of interest in what there is to be learned, and they must be kept broad and diverse in expression" (Bruner, 1960). What better way to stimulate a young child's interest in science than through play?

Elkind (1999) differs from Bruner, in that, while Bruner promotes the idea of inductive thinking in young children, Elkind sees children as experiencing transductive thinking. Whereas science has concepts requiring different levels of abstraction, Elkind writes that young children are unable to deal with second symbol systems. This represents the fundamental error in Jerome Bruner's assumption that "you can teach any child any subject at any age in an intellectually honest way."

In conclusion, in order to overcome the limitations of children's transductive thinking, it is imperative that educators need to encourage their unlimited imagination and curiosity. We need to watch for, and take advantage of children's spontaneous motivation. And finally, we need to adapt our instruction to the individual needs, interests, and abilities of young children.

Is it possible to "teach any child any subject at any age in an intellectually responsible way?" Perhaps so. But when we can capitalize on the opportunities to provide children with concrete experiences with which to play, and knowing that, according to Erikson, through play, individuals continue to add new understandings about the world, the bigger question arises, "Is it really important to do so?"

Pleading for further research, the debate continues . . .

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