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AUTHOR	Kamii, Constance
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ABSTRACT

A Piagetian preschool emphasizes the child's active construction of mental images rather than passive association of words and pictures with real objects. The role of the teacher is neither to dictate good behavior nor to transmit ready-made predigested knowledge. Her role is to help the child to control his own behavior and to find things out as a result of his own curiosity and exploration. The child builds knowledge through his own actions on objects, using object feedback and his own reasoning processes. To accomplish this task, the teacher selects a variety of objects to give a range of possible activities from which the child can choose. The teacher diagnostically picks up on the child's interests by making suggestions and asking questions. Piaget's distinction among physical, social, and logico-mathematical knowledge and representation guides the teacher in deciding when to answer a child's specific questions and when to leave the question open for the child to find the answer. The basic principle to keep in mind is that play is the most powerful ally on the teacher's side. A curriculum which reflects an understanding of the nature of intelligence from Piaget's biological perspective will define its long-term goals first and then proceed to conceptualize its short-term goals. (Author/WY)

An Application of Piaget's Theory to the Conceptualization of a Preschool Curriculum*

Constance Kamii
Ypsilanti Public Schools
Ypsilanti, Michigan 48197

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As I go on with my sixth year of studying Piaget's theory, I keep finding in my own publications statements that reflect a misunderstanding of the theory. These errors can perhaps be viewed as evidence of how different Piaget's theory is from any other theory that is studied in American universities. The differences are too basic, too numerous, and too complex to discuss in an hour. Piaget's notions of "perception", "memory", "thinking", "intelligence", "learning", etc., are fundamentally different from the way in which we usually think about these terms. As I cannot possibly deal with any one of these topics today, I am forced to be selective and superficial in sketching the conceptualization of a preschool curriculum based on Piaget's theory. The conceptualization is by no means complete, as this paper reflects my views after less than three years of experimentation.

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In order to give the rationale for the objectives of the preschool curriculum and the methods of teaching that will follow, I would like to highlight a few of the basic Piagetian notions concerning the nature of "intelligence", "knowledge", and "learning", and the relationship between cognition and affectivity. The theoretical underpinnings of the curriculum will be shown in a biological theory of intelligence that encompasses the intelligence of all the animals in the evolutionary scale at the lower end, and the intelligence of the human adolescent at the higher end of the continuum. We can better understand the nature of intelligence itself by taking a biological perspective, and we can conceptualize our short-term goals better once we have defined our long-term goals.

Piaget looked for laws of cognitive development in nature, rather than in the laboratory. His reason was that laboratories may provide "scientific" data, but they artificially limit what the organism is allowed to show to the experimenter. The laws of learning derived from the laboratory may, therefore, not be valid for education, and they may not even be valid for rats.

In Biologie et Connaissance (1967), Piaget points out two methods which must not be used in studying behavior. They are

1. Methods that project into less complex animals structures or phenomena that characterize more complex animals. For example, we may look at the bobbing head movements of a parrot and think that it is bowing to us, when, in reality, these movements are the stereotyped remnants of the parrot's desperate attempts to escape from its cage (Lorenz, 1952).
2. Methods that overlook the characteristics of more complex animals and reduce the analysis of their behavior to a level that is appropriate for less complex animals. An example is the approach to human intelligence in terms of what has been found with rats. In other words, human beings may learn certain things by association and reinforcement, but there may be a lot more to human learning than what can be found with animals.

Views of cognitive development may also be limited by our epistemological perspective. In psychology, we usually start studying cognition by looking at perception. In this approach, stimuli are thought to come through the senses and interpreted by the brain. Internal traces of perception are then assumed to remain in the organism in the form of images, and more "abstract" knowledge is believed to be constructed from perceptual knowledge according to principles of association and generalization. In this view, association and generalization are thought to be enhanced through language and various forms of reinforcement. I think education is generally limited by this perspective.

Piaget started his inquiry into the nature of knowledge not by looking at perception but by looking at all organisms, both extant and extinct. His starting point was the observation that all living organisms have the characteristic that they act and adapt to their environment. The very fact that an amoeba lives, or a crab or a lion or a human baby lives, indicates that it is acting and adapting to its environment. Otherwise, it would simply die.

Biological adaptation itself implies a degree of intelligence and knowledge. For example, fishes "know" enough not to jump out of water. Crabs run away from people. Some birds can travel to a specific place across a continent and return precisely to the original place the following year. Bees adapt not only to their physical environment but also to an elaborate social system. Babies know how to cry to announce their discomfort. Whether the mechanisms of adaptation are called "instinct", "reflex", or "intelligence", the fact remains that all living organisms have some kind of mechanisms that enable them to act in such a way that they adapt to their environment by meeting their biological needs. The basic biological needs of all animals are for nutrition, protection from physical harm, and reproduction. If adaptive mechanisms were not present, either the individual organism or the entire species would die off.

When Piaget talks about intelligence, he is talking about intelligence in this broad, biological sense. To be sure, some organisms are more complex and more intelligent than others. If there are genetic potentials, the organism develops far beyond mere biological survival. In the case of human beings, the baby's reflexes adapt to external objects and develop into the construction of the object, representation, reversibility of thought, and all the way up to formal operations. I think Piaget showed convincingly that there is a complete continuity between the newborn baby's reflexes and his later ability to think.

Before discussing this continuity in more detail, I would like to give a specific example. Let's take the example of the knowledge that Washington is the capital of the United States. If we tried to teach this knowledge to our preschool children, the most we would get would be rote recitation. The children would not even understand the statement because they do not have the general framework of knowledge into which they need to fit the statement in order to understand it. They need a framework of geography and political organization to understand this sentence. To have this framework, they have to have a general cognitive structure. Even the four-year-olds living in Washington would not understand that they live in Washington, or that they live in a city and a country at the same time. To them, "capital" may mean a person, or a building, or a fountain, or nothing at all. Classification is thus involved in understanding each of these words, as well as the relationship among the three main words. In addition, space has to be structured to understand the spatial relationship between Washington and the United States. If the child really understands this simple statement, we can conclude that he has a general cognitive structure that can coordinate all these abilities, and a lot more.

A sixth grader can more or less understand that Washington is the capital of the United States. However, after six additional years of living, reading the newspaper, studying history and civics, and taking a senior trip to Washington, the same child will be able to derive much richer meanings from the same statement. If asked to free associate to the word "Washington", he might say, "Peace demonstrations, the White House. . ., Jefferson, Lincoln, . . , a square piece of land ten miles by ten miles, etc." If I asked you to free associate, you would probably put Jefferson and Lincoln at the end of the list and begin with things like "the Office of Child Development, OE, OEO. . ." Notice that, even in free association, few people would say, "The price of eggs in China. . ., Napoleon. . ., Charlie Brown. . ., and Marilyn Monroe!" These examples illustrate Piaget's view that since knowledge is organized in a coherent, whole structure, no concept can exist in isolation. Each concept is supported and colored by an entire network of other concepts.

The above example was given in order to lead up to the point Furth (1969) makes that, for Piaget, "knowledge" and "intelligence" in a broad sense are exactly the same thing. Furth says that to understand this statement, it is necessary to make the distinction between "knowledge" in a narrow sense and "knowledge" in a broad sense. Knowing that Washington is the capital of the U. S. is an example of knowledge in a narrow sense. The general framework that enables the child to understand the specific statement about Washington, on the other hand, is an example of knowledge in a broad sense. Knowledge in a broad sense is not a collection of specific facts, but, rather, an organized structure that is qualitatively different. General knowledge is what makes it possible for the child to understand specific information. Piaget is not particularly interested in how the child acquires specific knowledge, but he is concerned with the development of the broad cognitive framework. This framework is what he calls "intelligence". The child understands and learns new things through this framework. "Knowledge" in a broad sense and "intelligence" are, therefore, exactly the same thing for Piaget.

"Learning", too, can be specific or general. The child can learn that something is called "a cup" or "the moon" or "a dinosaur", or that plants need water to grow. These are specific learnings. But the child can also learn to structure his space from his crib to his entire house, and then to the block he lives on, his city, his country, and all the way to outer space. He can also learn to structure his time from the present to infinity or to prehistoric times. He can learn to structure all the objects in the universe into hierarchical systems of classification. These are examples of learning in a broad sense. They comprise the basic elements of "knowledge", or "intelligence", in the broadest sense.

In formulating the objectives of a preschool curriculum, I think we need to put the accent on developing the general framework. But how to develop the framework is r . to which I have only partial answers. This is the question of ou research. I am not even sure that a year of preschool makes any difference. These are empirical questions worth trying to answer. One thing I do know is that no amount of specific learning will result in greater general intelligence. Intelligence simply does not develop in an additive way. Another thing that I know is that schools generally function in ways that do not foster the development of intelligence.

The important question, now, is where this framework comes from and how it is built. According to Piaget, it is rooted in the baby's sensory-motor adaptive actions and is built as these actions are internally coordinated. Piaget saw cognitive structures in the baby's motor activities where others saw only preintellectual actions like motor coordination. One of his unique contributions is that he views intelligence as actions,[1] and sees a complete continuity between action and thought.

For the newborn baby, there are no objects. The reason for this phenomenon is that the baby has not differentiated himself from objects, and no discrete object can exist in the baby's mind until he has become able to impose a structure on the mass of incoming sensations. In The Origins of Intelligence (1952) and The Construction of Reality in the Child (1954), Piaget describes in great detail how the newborn baby's reflexes adapt to external objects and become sensory-motor schemes, or action patterns, through which the baby comes to recognize objects. He describes precisely how sensory-motor adaptive actions are repeated as long as the situation is similar, but are differentiated or combined in new ways if either the organism's needs or the external situation changes. The baby thus constructs objects and gradually comes to know each object by grasping it, putting it in his mouth, dropping it, picking it up, shaking it, transferring it from one hand to another, etc.

[1]The significance of "actions" in this context is not the external behavior, but the internal processes that accompany the motoric actions. In early sensory-motor intelligence, the two are not differentiated. They become gradually differentiated, and the child becomes able to think about actions without actually engaging in them and to predict the results of his actions.

If there were no action, therefore, there could be no object for the baby. If there were no object, time and space could not be structured, the notion of causality would never come into being, and there could certainly not be any representation, logic, physics, or history. In short, if there were no action, there would be no knowledge for the organism. There would be only sensations.

By acting on objects, babies gradually structure their space and time. Piaget gives the example of an experiment in which he placed an attractive toy on a pillow in such a way that the baby could reach the pillow but not the toy. (The toy was on the side of the pillow away from the baby.) Until a certain stage, it does not occur to the baby to pull the pillow to get the toy. However, once he has structured the spatial relationship between the two objects, the baby immediately pulls the pillow and never forgets this learning. This is an example of Piaget's theory that sensory-motor intelligence <u>is</u> coordinated actions.

Babies also find out about the physical nature of objects by acting on them. For example, by putting a cookie in the mouth and then a rattle and everything else in sight in the mouth, they find out that certain things can be eaten and others cannot. The foundation for classification, the notion of negation ("can<u>not</u> be eaten"), and the notions of size, shape, weight, and texture can all be seen in this familiar scene. If there were no action, therefore, there would be no physical knowledge.

Intentions come into being as the baby acts on objects. For example, he may fortuitously notice when he drops a rattle that it makes a noise. If he has reached a certain level of development, he will make use of this fortuitous discovery and repeat the same action intentionally to produce the same sound. Means-ends relationships, or problem solving, thus grow out of coordinated actions.

The action of walking greatly expands the baby's structuring of space and time. When he accidentally loses a ball by rolling it under a sofa, for example, the baby first looks for the ball where it disappeared. Later, however, under similar circumstances and even with a different sofa, he is likely to go around to the back of the sofa to look for the ball. This change demonstrates the baby's ability to structure space sufficiently to extend the movement of the ball into an area that he cannot see. There is a lot of elementary geometry and physics involved in these coordinated actions.

The baby who is just beginning to walk is likely to go down a step as if it were a flat surface. After one or two falls, however, he will anticipate the descent and adjust his actions accordingly. Anticipation is thus part of adaptation, and it is part of coordinated actions. Anticipation gives rise to new coordinations, and new coordinations in turn generate further anticipations. For example, the baby who has structured one step can go on to anticipate the structure of two steps. Before long, he will be able to anticipate running up and down the entire stairway. Eventually, he will become able to think about the stairway without actually engaging in the external action of running. In other words, knowledge is progressively created out of adaptive actions, and it has the function of facilitating the organism's greater adaptation to the environment.

I belabored the point that the child's cognitive framework is rooted in his adaptive actions, and that thinking is coordinated actions. This point was belabored because it has important implications for preschool education. If we believe that intelligence is rooted in the depth of biological adaptation, and if we believe that development is continuous and uninterrupted, and if we believe that intelligence is one coherent, integrated structure through which the child learns, then we will build a curriculum that extends these actions. If, on the other hand, we believe that intelligence develops through perception, association, and language, we are not likely to stress the coordination of actions.

In the remainder of this introductory section, I would like to discuss the relationship between the socioemotional and cognitive aspects of human behavior from a phylogenetic perspective, and substantiate Piaget's assertion that, in reality, the two are inseparable. To do this, I would like to compare the various species first on the receptor side and then on the efferent side, and finally from the standpoint of social organizations.

Speaking of receptor organs, Piaget (1967) says that the degree of differentiation of receptor organs makes a difference in the organism's tendency to approach things that are desirable (food and sex) and avoid things that are undesirable (danger). He states that as long as the organism does not have differentiated sensory organs, external events are of concern to it only at the time of direct physical contact. Biological needs disappear as soon as they are satisfied, and reappear in periodic cycles.

On the other hand, when olfactory, visual, and auditory organs are differentiated, the organism's biological needs change because it becomes capable of sensing the presence of food, sex objects, and danger that are not in direct contact with it. More complex animals have organs with which to perceive food, for example, and they become capable of anxiety when there is no food in sight. In other words, the capacity for anxiety emerges as a result of the capacity to perceive things that are not in direct physical contact. A need to increase the probability of finding food thus emerges, and a new need for exploration is created. The ability to perceive distant enemies likewise generates anxiety and vigilance. Since more complex animals can perceive things with which they are not in direct physical contact, their cognitive milieu is larger. An animal's capacity for emotions thus goes hand in hand with its capacity for cognition.

According to Furth (1969, p. 188)

> "Concerning the locus where modifiability occurs, Lorenz mentions a significant difference between the evolutionarily highest branches and lower ones. In lower animals it is predominantly on the receptor side that learning takes place. Animals learn to distinguish relevant cues, learn to aim better at objects which they approach, or acquire necessary information to complete an inbuilt behavior pattern. . . However, freedom to acquire new motor patterns is characteristic of the highest mammals, as is witnessed by the development of that part of the brain which controls voluntary movements.
>
> "The direction of this development seems of importance for a basic understanding of human intelligence. One notices that lower down on the scale of evolution animal behavior is rigidly fixed in its adaptation. Above this level there is increased modifiability in the form of greater responsiveness towards the environment on the receptor side, and finally there emerges the capacity to move freely and to act on and manipulate things of the environment."

In other words, amoebas do not explore their environment, but dogs, rats, and human babies certainly do. Primates and humans have hands which immeasurably increase the organism's capacity to manipulate and explore objects.

The educational implication of the above passage is that from the standpoint of cognitive development, any training in perceptual discrimination is likely to produce little cognitive growth. It seems more fruitful to put the emphasis on developing the efferent side, i.e., "the capacity to move freely and to act on and manipulate things of the environment." The importance of developing children's curiosity and eagerness to explore and experiment becomes clear. The more curious the child is, the more he will explore, and the more knowledge he will gain. The more knowledge he has, the more advanced the nature of his curiosity will be, and the more systematic his exploration will be.

A corollary of the higher animals' capacity to act on its own initiative, rather than merely reacting to stimuli coming from the outside, is the capacity for play. Play can be broadly defined as activities that the organism engages in for no reason except that the activity itself is pleasurable. In Play, Dreams, and Imitation in Childhood, Piaget (1962) classifies play into the three types of practice games, symbolic games, and games with rules. All organs have a biological need to be used; otherwise they atrophy from disuse. Likewise, the capacity of higher animals to act on their own initiative has a biological need to be used. Play is, therefore, a characteristic of higher animals. Millar (1968, pp. 61-62) states,

> "No one, to my knowledge, has ever suggested that the single cell animals, the protozoa, play. . . It is not until we get to the arthropods[2], jointed-limbed animals who have their skeleton on the outside of the body, that some observers have spoken of 'play'."

In other words, higher animals not only have the capacity to behave on their own initiative in a variety of ways, but also the need to actively use this capacity.

Piaget amply demonstrates in Play, Dreams, and Imitation in Childhood (1962), The Origins of Intelligence (1952), and The Construction of Reality in the Child (1954) that babies and children learn by playing. Play is one of the most powerful allies on the teacher's side. Unfortunately, we have not learned how to use play very well in our classrooms. This is the essence of what we are trying to do in our classrooms.

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[2]The lobster, crayfish and other crustacea, and insects such as ants, bees, and wasps are the examples she gives.

Adults, especially educators, have a tendency to classify human activities into "work" and "play", as if the two were mutually exclusive. We know that some play is hard work (e.g., skiing and playing the piano), and some work is fun (e.g., playing with ideas and hypotheses). The following matrix may clarify the relationship between work and play:

		Work	
		Not enjoyed	Enjoyed
Play	Exploring Making sense out of things Games with rules Symbolic games	?	X
	Practice games (repeating and exercising)	?	X

The ideal situation for learning falls in the cells marked "X". When education falls in the cells marked "?", as if learning were an unpleasant job the child has to be paid to perform, then it has to resort to motivational devices. There is something wrong somewhere when we have to use gimmicks to motivate preschool children to learn.

Another characteristic of more complex animals is that they create, and exist in, social systems. Amoebas do not have a social system, but more complex animals like ants, fishes, birds, bees, and humans do. The young of these species must adapt not only to their physical environment but also to their social environment. Social systems facilitate and regulate the species' biological needs for food, sex, and safety. Morality, values, attitudes, roles, interpersonal relationships, language, etc., are, therefore, an extension of our biological needs, and are part of our very nature. Even when he is alone, therefore, the child is, and always will be, a social being.

When Piaget discusses the importance of social collaboration in cognitive development, we can see that, in his thinking, he usually takes normal socioemotional adaptation for granted. The desirability of teamwork among children is one of the few pedagogical principles he has explicitly stated (Piaget, 1969). He argues that by exchanging views and trying to resolve differences of opinions in social collaboration, children learn to coordinate different points of view. This coordination requires the child to get out of his egocentricity because his reality is not necessarily the same as other people's reality. The modifiability of human adaptation is thus enormous. We create a social system which in turn greatly modifies how we conceive of our environment.

Because human beings are so modifiable, they can also be modified into ways that are very maladaptive. In Play, Dreams and Imitation in Childhood (1962), Piaget described the complete continuity between the baby's reflex and his entrance into the symbolic world. This continuity is the topic of another paper. The only point I would like to make today is that because we have the biological capacity to create symbols, and to make anything into a symbol of anything we want, we are capable of the kind of neuroses, irrationality, and mass hysteria that rats and dogs are not capable of.

By way of a summary, I would like to highlight the following conclusions from Piaget's biological theory of intelligence because of their relevance to preschool education:

1. Intelligence is rooted in the depth of biological adaptation, and there is a complete, unbroken continuity between the baby's reflexes and his higher mental processes.
2. Intelligence grows as an integrated whole structure, and not additively as a collection of skills. Neither perceptual skills nor specific information will result in developing the general framework that Piaget calls "intelligence". It is through this general framework that the child learns new things.
3. The child's socioemotional life and cognitive life are inseparable.
4. Intelligence is coordinated actions, either external or internalized. Therefore, the way to develop intelligence is to extend the child's coordinated actions.

5. Higher animals have the following characteristics: (a) They have the capacity for voluntary actions and exploration, and use this capacity in the form of play. Human beings have both the capacity and the need to know and to make sense out of their environment. (b) They create social systems which regulate and modify their biological nature.

How to apply these principles to preschool education is a matter of opinion. I would like to present my May, 1970, version below under the following headings: The formulation of objectives, teaching methods, and the evaluation of the curriculum.

I. The Formulation of Objectives

A. Long-range goals

The objectives of preschool education can best be conceptualized in light of long-range goals. I think one of the long-range goals of education should be formal operations and the socioemotional maturity to use them in all kinds of situations in the world outside the classroom.

The objectives of our preschool curriculum include physical knowledge, social knowledge, the structuring of space and time, classification, seriation, and number. By discussing the longitudinal outcome of these short-term objectives, I hope to show why we emphasize cognitive processes rather than external behavior. I hope to show that if we help the child to develop his cognitive processes, we may increase his chances of attaining formal operations. If, on the other hand, we teach to the external behavior, or the final answer, we may end up decreasing his chances for later learning.

For example, seriation in preschool takes the form of arranging objects of graduated sizes (e.g., five dolls having heights of 6, 7, 8, 9, and 10 cm). We are happy when children arrange the dolls in the right order, say, from the tallest to the shortest one. However, our real goal is not children's ability to arrange objects. In a sense we don't even care whether or not they can arrange little dolls and sticks because, as adults, we never need to arrange dolls and sticks. Our real goal is to enable children to generate the cognitive structure of seriation when the necessity presents itself. After all, real problems in the world come with all kinds of ambiguities and shades of gray, and it is we who have to generate and impose the logical structure to even begin to isolate the relevant variables we want to think about. I would like to give two examples to illustrate what I mean, one in science and the other in history.

Inhelder and Piaget (1958, Ch. 3) describe an experiment dealing with the flexibility of metal rods. In this experiment the child is given a number of metal rods, a number of dolls that can be screwed onto the end of the rod to make it bend when it is held horizontally, and the apparatus shown in Figure 1. The child is asked (a) to find out what kind

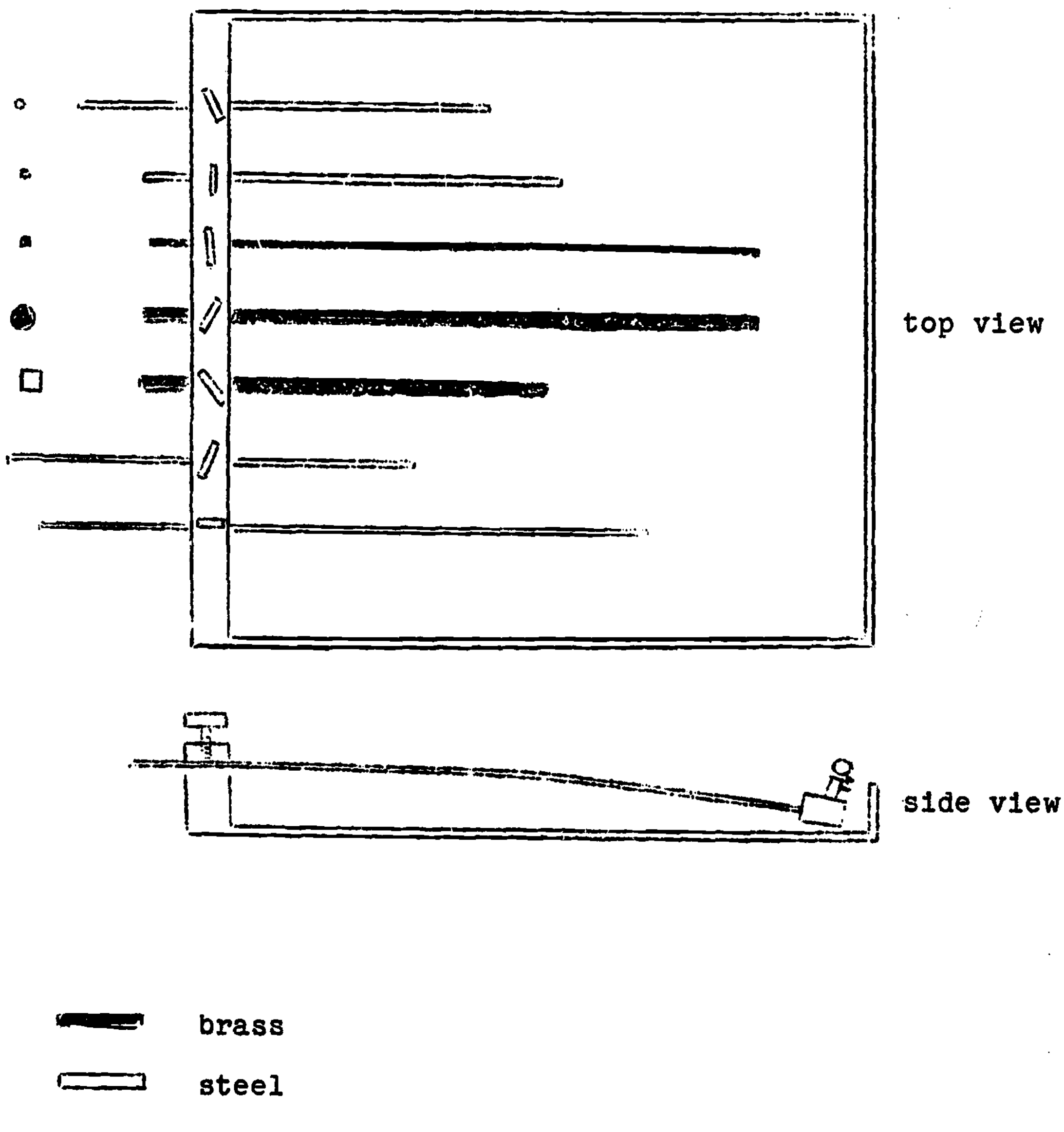


Fig. 1. Apparatus Used by the Child to Test the Flexibility of the Rods

of rods are flexible enough to bend and reach the "water", and (b) to prove his conclusion. The rods vary along four dimensions--thickness (thin and thick rods), length (the child can adjust the length of the rod), cross-sectional shape (round and square rods), and material (brass and steel rods). The dolls are made of the same material but vary in size and, consequently, in weight (100, 200, and 300 grams). The child is encouraged to experiment freely with the objects to find out when the rod bends and when it does not. He is given help whenever he has any difficulty in manual dexterity.

The child in the period of concrete operations (from about 7 to 11 years of age) can easily classify the rods by any of the attributes. However, in trying to figure out the factors that determine their flexibility, he is likely to put 100 grams on a long, thin, square, steel rod, and 200 grams on a long, thick, round, brass rod. In other words, he holds only one or two factors (e.g., length) constant and varies all the other factors! The child who has reached formal operations,on the other hand, compares rods that are identical in every way except for one variable, such as length. Formal operations thus enable the child to incorporate into one single system all the variables that may be relevant, and to vary only one factor at a time. This systematic process of formulating and verifying hypotheses is a characteristic of hypothetico-deductive thinking.

The proof that the child considers to be necessary and conclusive also reveals whether or not he has attained formal operations. Below are examples of the ways in which a 9-year-old, an 11-year-old, and a 16-year-old responded to the request, "Could you show me that a thin one bends more than a thick one."

A 9-year-old (in the period of concrete operations)

> Places 200 grams each on a long thin rod, and a short thick rod. No amount of help enables him to see that his proof is not a proof.

An 11-year-old (not quite in the period of formal operations)

Places 100 grams on a round, steel, long, thick rod, and 200 grams on a rod identical with the first except for its thickness. The experimenter then says, "I would like you to show me only that the thin one bends more than the wide one. Is that way right?" The child replaces the 100-gram weight with a 200-gram weight.

A 16-year-old (in the period of formal operations)

Immediately picks up two rods that are identical except in thickness and gives the logical proof.

Classification and seriation schemes are generated in the above experiments. Without varying the lengths of the rods (i.e., establishing the serial correspondence between the length of the rod and the degree of bending), children cannot isolate the relevance of length. Without varying the thickness (establishing the correspondence between thickness and degree of bending), they cannot conclude that thickness indeed affects the flexibility of a rod.

In a study of formal operations in history, Hallam (1967) and Lovell (in press) gave to pupils of 11 to 16 years of age short passages to read on various historical topics such as the Norman Conquest and Queen Mary Tudor. After the children had read the passages and had any word explained that they did not understand, they were asked a number of questions. One of them related to the passage on Queen Mary Tudor was "Do you think it sensible to have conformity in religion in a country?" The children were allowed to re-read the passages as many times as they wanted to. In this research, Lovell and his collaborators found repeatedly that the pupils' answers could be classified as pre-operational, concrete operational, and formal operational, with many answers falling at intermediate points.

At the concrete-operational level, the children showed the following characteristics: Ability to predict a result from the evidence, but inability to generate a hypothesis dealing with the possible; and ability to move from one point of view to another, but without being able to coordinate the two or more points of view into a single system.

The formal operational adolescents, in contrast, were found to go beyond the given, to reason systematically by implication, and to attempt to relate a multiplicity of possible links and points of view. The following is an example given by an adolescent of 14 years and 8 months:

> "This is a very difficult question to answer because there are basically two ideas in the present day. On the one hand you have the idea that all should be subservient to the state and, on the other hand, you have the idea that choice is a good thing. There's a lot to be said for both sides. But religion, being essentially a private thing between man and God, should be divorced from politics whenever possible. However, where a situation arises where there are two conflicting religions or ideologies, I think that in such a case it is probably permissible to attempt to enforce a uniform front to hold together the country in time of stress. Two bitterly opposed religious parties is a thing that should be discouraged because neither thinks anything of the other and is prepared to go to any lengths because religious fanaticism, when entering into politics, is often a more evil thing and more dangerous than politics, although politics in its own way is often both."

I would be happy to see some of today's young adults think like this at the formal operational level. Rather than grappling with different points of view to attempt a resolution, or a higher-order synthesis, some of them see social problems only from their point of view. They even resort to violence and consider their morality as the only "right" morality. It is not that these young adults are incapable of formal logical operations. They are capable, but emotions often render us stupid. As educators, we cannot claim success if we produce young adults who are capable of formal operations, but do not use them in their daily life.

By using classification and seriation, the formal-operational scientist above constructed at least the following 32 combinations in trying to isolate the factors that are relevant to the flexibility of the rods:

2	x	2	x	2	x	2	x	2	= 32
(thick-thin)		(long-short)		(circle-square)		(steel-brass)		(bends-does not bend)	

In reality, he was dealing with more than 32 combinations because each variable was not a dichotomy, but, rather, a continuum. The concrete-operational child can manage only two or three variables and mentally constructs matrices such as the following, which produces only four combinations:

	bends	does not bend
long		
short		

The formal-operational historian quoted above seems to have constructed the following six variables (There may be more, but six is all that I am able to isolate. Maybe you can find more.):

Religious freedom (vs. no religious freedom)
Political freedom (vs. no political freedom)
Physical danger (vs. safety)
The welfare of the individual (vs. the welfare of the group)
Fanaticism (vs. rationality)
What is permissible (vs. what is mandatory or forbidden)

The six variables yield at leat $2^6 = 64$ combinations (assuming that each variable is dichotomous. In reality, there are more than 64 combinations because each variable is not a dichotomy but, rather, a continuum).

I apologize for the detail I went into in the above discussion. The point I tried to make is that the long-term goals in classification and seriation are not to enable children to make little matrices and arrange little graduated sticks, but to use the process of classification and seriation to isolate relevant variables and to generate and test hypotheses in dealing with the real world.

B. Short-term objectives

We have discussed the origins of intelligence on the one hand and some long-range goals of education on the other. The short-term goals of preschool education must be placed in this context to make sure that whatever children learn is firmly rooted in sensory-motor intelligence, and learned in such a way that the probability of future learning increases. Although the socioemotional and cognitive objectives are discussed separately below, it must be remembered that, in reality, the two are inseparable.

1. Socioemotional objectives

Our objectives are internal processes rather than external behavior. For example, one of our objectives is the development of curiosity. Whether curiosity manifests itself in constant experiments or questions, or both, is not of particular concern to us. We feel that each child has different ways of being curious, and the teacher's job is to encourage each child to be curious in ways that are comfortable for him. Some of the most important objectives are listed below.

a. Intrinsic motivation to derive pleasure from using previously learned schemes

(1) Children's busily doing things, many things, anything from rolling barrels to playing with a flashlight, with initiative, enthusiasm, and excitement.[3]

Intelligence develops by being used. If children keep acting on things on their initiative, their intelligence is likely to develop by the very fact that it is being constantly used. As long as they have the initiative to keep doing something, each solution is likely to lead to a new challenge.

(2) Curiosity

Curiosity is more focused than the above objective. Examples are

(a) Exploring things (e.g., magnifying glass, hair brush) to figure out how they are made and how they work.

3* I would like to acknowledge the assistance of Eleanor Duckworth, of the University of Montreal, in conceptualizing this objective.

(b) Experimenting with means-ends relationships with scales, balances, etc.

(c) Asking questions

(3) Confidence

We want children to have the confidence that they <u>can</u> figure things out on their own (rather than depending on the teacher to provide the answer). Even when their answer is "wrong" from the standpoint of adult logic, we want children to speak their minds with confidence. Confidence seems to lead to the two objectives listed above.

(4) Creativity

We want children not to come up with only one response, but to take pride in coming up with many different responses. Even with simple things like going down the slide, for example, we want children to come up with many different ways of doing the same thing (e.g., coming down on stomach, backward, with hands up, etc.).

I think the above objectives are likely to give more educational mileage than any of the specific cognitive objectives. If children are excited, curious, confident, and creative, they are bound to go on learning, particularly after they go home and after the preschool year.

b. Controlling one's own behavior

(1) Ability to make decisions and plans, to carry them out, and to evaluate one's own activities

(2) Ability to respect rules and authority when necessary

c. Relationship with peers

(1) Playing with other children

(2) Discussing things with other children

(3) Respecting the rights and feeling of other children

d. Relationship with adults

2. Cognitive objectives

Piaget delineated three areas of knowledge according to the different ways in which knowledge is structured. The three are physical knowledge, social knowledge, and logico-mathematical knowledge. These pens will be used to illustrate the differences among them.

Physical knowledge is structured from the feedback children receive from the objects when they do something to them. For example, by letting go of a pen, the child finds out that it does not break like a crayon when it hits the floor, and that it usually bounces once. If the child acts on the pen in a certain way, it reacts by making marks on paper, on skin, on cloth, and on walls.

Social knowledge comes not from feedback from objects, but from feedback from people. The fact that a pen makes a mark on the wall is physical knowledge, but the fact that Mommy gets angry when she sees the mark is social knowledge.

If I show you five pens, the fiveness is an example of logico-mathematical knowledge. If I show you five red pens and two blue pens, the fact that there are more pens than red pens is also an example of logico-mathematical knowledge. Each of these objectives, plus representation, will be discussed below in further detail.

a. Physical knowledge

As stated before, physical knowledge concerns physical phenomena and the physical nature of objects. Time and space are also aspects of physical knowledge. The child finds out about the physical nature of a pen, for example, by doing things to it, e.g., dropping it, trying to bend it, squeezing it, and trying to make marks with one end of the stick or the other. The object always reacts to the same action with regularity, and the child builds his physical knowledge by structuring the regularity of this feedback from the object.

The child can find out that while a pen does not bend, a metal rod does. In a similar way, he finds out that paper tears but cloth does not. He also finds out that fishes are happier in the water than out of it, and that no matter how hard he tries to make a block stay underwater by itself, it always comes back up with regularity.

There are three main objectives in teaching physical knowledge. One is enlarging the child's repertoire of actions he can apply to objects to explore their nature. The second is the process of experimentation when a problem is given. The third is the initiative to come up with a problem of one's own and to wonder about things.

For example, with a balance, the child first plays with the object and figures out how it works by thinking up different things to do to it. We might then put 8 washers on one side and 3 on the other, and ask the child to make the two sides balance. We are interested in the process of reasoning rather than the final answer. At the beginning of the year, some children put 2 on the side that is up, and then 2 on the other side that is already down! We want children to/become able to reason more logically in an intuitive way, i.e., to better coordinate their actions.

After solving the problem that the teacher suggests, some children decide to play the same game with some other objects, e.g., marbles. This is an example of the initiative to come up with a problem of one's own. I think it is better that a child comes up with one question of his own than that he answers ten questions that he doesn't care anything about.

b. Social knowledge

Social knowledge comes from people, e.g., the mother who gets angry at a mark on the wall, Other examples are

The names of all objects, both in spoken and written forms

The fact that neckties are for men, and not for women

The fact that dogs and plants can be brought into the house, but not worms and rabbits

The fact that we have to pay money to take home a bottle of pop

The fact that at certain times people insist that it's time to go to bed

The fact that firemen put out fires, maids clean rooms, and milkmen deliver milk

The notions of religion, laws, and politics

The ultimate source of this kind of "truth" is people, and the child can acquire social knowledge only from people.

Our objectives in social knowledge are usually not deliberately planned. Some content comes up incidentally (e.g., one child telling another child in sociodramatic play, "Daddies don't do that!"), and at other times children come up with questions (e.g., "What's this?" "A filing cabinet."). The reason for this unplanned approach will be given in the next section on teaching methods.

c. Logico-mathematical knowledge

Logico-mathematical knowledge includes three major categories: (a) classification, (b) seriation, and (c) the construction of elementary number concepts. Logico-mathematical knowledge is the hardest to explain because people usually think that logic is socially derived. There is also a strong tendency to believe that logic is a matter of using language correctly.

Preoperational children think very differently from adults, and, particularly in the logico-mathematical realm, care must be taken to develop their cognitive processes according to the way they think. Since logico-mathematical knowledge is built from feedback from the cognitive structure that already exists, we will defeat our purposes in the long run if we push preoperational children into concrete operations. Therefore, our objectives remain well within the preoperational period.

(1) Classification

According to Piaget's theory of classification, any criterion the child "invents" for grouping is correct, provided he uses it consistently. The objectives in teaching classification are the processes (not the final product) of (a) inventing one's own criteria and using them consistently, (b) shifting the criteria to group and regroup the objects in many different ways, and (c) thinking independently rather than depending on others to judge the correctness of the conclusion.

<u>Example of objects to be sorted</u>

3 red pens
2 blue pens
2 red caps
8 blue caps (one is different from the other 7)
2 pencils (yellow).

With the objects listed above, for example, when asked to put together the things that are "the same in some way", the preoperational child may put a cap on each pen and pencil. We consider this response to be correct. Our objective in classification is not to have the child figure out how the teacher wants things grouped. We want him to come up with his own reason for grouping things and re-grouping them. A separate paper (Kamii & Peper, 1969) gives a fuller description of how Piaget's theory of classification differs from other theorists'.

After putting a cap on every pen and pencil, a high-level preoperational child may shift criteria and make the following four groupings:

Grouping 1:
- 2 pencils and the 2 pens which have ink left in them
- all the blue caps
- all the red caps
- all the pens without any ink left inside
- (Then, he removes the one blue cap that is different.)

Grouping 2:
- all the pens
- all the caps
- all the pencils

Grouping 3:
- all the pens (He puts caps on all the pens)
- all the pencils

Grouping 4:
- all the blue things
- all the red things
- all the yellow things

If the long-range goal of classification were to group things by color, by shape, by size, or by genus, it would make sense to teach these classificatory schemes from the beginning. However, our long-range goal is formal operations. Therefore, the important thing for children to learn is the <u>process of generating and imposing a logical structure</u> onto all the ambiguities of the real world. Whether the logical structure he "invents" is based on color or shape is not the important thing.

(2) <u>Seriation</u>

Our goal in seriation is to have children become able to arrange series of graduated cups, dolls, blocks, etc., from the biggest to the smallest, or vice versa, by using the perceptual configuration (preoperational seriation). While this is our behavioral objective, in a sense we don't care whether or not children can arrange cups and dolls. It is more important to have the child seriously think about how to arrange the items than to have him mechanically apply a rule (e.g., "pick up the biggest one first, then the next biggest one, . . .").

The important thing is that the child become able to <u>generate the logical structure</u> when faced with real problems.

One day in water play, for example, a child was surprised to find out that a fairly heavy block floated. She got up to get a larger block, thinking that a larger one would sink. Upon finding out that the larger one also floated, she went to get another still larger one in an attempt to find one that would be heavy enough to sink in water. This spirit of generating a graduated order in a question raised by the child himself seems much more important than memorizing the generalization that wooden objects float regardless of size.

In an intuitive way, this child learned that the phenomenon of sinking depends on something other than absolute weight and size.

(3) Construction of elementary number concepts

Here, too, we would like the children to establish the numerical equivalence of two sets with about 8 objects having a relationship of "provoked correspondence", and conserve the equivalence. However, the behavior of making one-to-one correspondence or giving conserving answers is not our objective. The structuring of the underlying process is our real objective. Since I wrote a separate paper on number (Kamii, 1969, in press) elaborating this statement, I will not say more about this area.

d. Representation

Since Piaget's theory of the relationship among "thinking", "knowing", and representation is too unique and too complex to go into, I would simply like to refer you to Furth (1969, 1970). The only point I would like to make before delineating the curriculum objectives in representation is that it is not with pictures and words that children think. Therefore, the acquisition of knowledge is one thing, and the ability to represent this knowledge is quite another thing. Representation is taught in a Piagetian preschool in order to help the child to structure his knowledge and to communicate it to other people.

Piaget distinguishes three types of representation. They are (a) indices, (b) symbols, and (c) signs. They are elaborated below in outline form.

(1) Indices

(a) Part of the object (e.g., part of a duck sticking out from behind a boat)

(b) Marks causally related to the object (e.g., footmarks in the sand)

(2) Symbols

(a) Imitation (the use of the body to represent objects, e.g., walking like a duck)

(b) Make-believe (the use of objects to represent other objects, e.g., using a box to represent a duck)

(c) Onomatopoeia (e.g., uttering "Quack, quack!")

(d) Pictures and models (e.g., drawing a duck and making a duck with playdough)

(3) Signs

Words and other signs, e.g., algebraic signs

The index differs from symbols and signs in that it is part of the object that is being represented. Symbols and signs, in contrast, are differentiated from the objects. The difference between symbols and signs is that only the former bear a resemblance to the object represented. Signs do not resemble the real object at all.

Basic to Piaget's theory of representation is the notion that representation is an active process rather than a passive association. His biological theory states that the organism begins to represent objects as part of biological adaptation. As stated earlier, the child can walk down a stairway more easily, for example, when he can represent to himself the spatial structure on which he is walking. Later, he internalizes this action and becomes capable of evoking the object by only imagining the action. The result of this internalization is called the mental image, which has a visual, tactile, kinesthetic, and auditory reality for the child. The mental image is what makes it possible for the child to derive meaning from such external representations as pictures and words.

A Piagetian preschool, therefore, emphasizes the child's active construction of mental images (rather than the passive association of words and pictures with real objects). Sociodramatic play and making symbols with playdough, blocks, paint, and pipe cleaners are examples of this active construction.

If the process of creating symbols is strengthened, the resultant mental image is bound to be vivid, and the words the child uses are bound to have a solid sensory-motor foundation. Representation at the level of symbols (in the sense in which the term is used in the above outline) is an objective that we particularly stress, although language and the use of indices are also emphasized.

In concluding this section on objectives, I would like to stress that although Piaget divides knowledge into physical, social, and logico-mathematical knowledge for purposes of analysis, he believes that, in reality, the three are inseparable. Intelligence for Piaget is one coherent framework. Therefore, there cannot be any physical or social knowledge without a logico-mathematical structure.

II. Teaching Methods

By "teaching methods", I mean what the teacher does and uses to achieve the objectives of the instructional program. In this section, therefore, will be included the selection and organization of learning activities, and the selection and organization of the content. Since teaching methods differ according to our different notions of how the learner learns, I would like to discuss a few Piagetian principles of learning first in order to give the rationale for the principles of teaching that will be discussed later.

A. Piagetian principles of learning

I will not deal today with the general relationship between "learning" and "development" that Piaget discussed in 1964 (Piaget, 1964). Instead, I would like to select three principles of learning that are particularly relevant to preschool education. The first one is that learning takes place from inside the organism by an active process of "construction", rather than by a passive process of absorption. The second principle is that if each cognitive structure is developmentally integrated with the previous structure, the developmental stages are longitudinally coherent, and the learning achieved in each stage is permanent. The third principle is that learning takes place within the general framework that Piaget calls "intelligence". Each of these principles is elaborated below.

1. Learning is an active process of "construction" from inside the organism.

Fundamental to Piaget's theory is the notion that knowledge is not passively received from the environment but actively constructed by the organism. Piaget rejects the $S \rightarrow O \rightarrow R$ model because it assumes that the organism perceives and receives the stimulus from the outside in a passive way. As Piaget puts it, there is nothing stimulating about the stimulus itself, and stimuli as such do not stimulate the organism. It is the organism that acts on the stimulus, and not the other way around.

Figure 2 shows how Piaget views the relationship between the stimulus and the organism.

S ←. . . .→ O

Fig. 2

Many examples can be cited from Piaget's writing to illustrate the above view of the stimulus. For example, the baby may be exposed to his bottle hundreds of times, but he does not *know* it well enough to recognize it until he has "constructed" the object in his mind. When the bottle is given to a hungry baby in such a way that only its bottom can be seen and the nipple is hidden, a six-month-old baby will not even recognize his own bottle. At about nine months of age, however, when he has "constructed" the object, he will immediately show recognition by grasping the bottle, turning it around, and starting to drink out of it. In other words, stimuli do not stimulate, and it is the organism that constructs even highly meaningful objects to which it has been exposed hundreds of times.

Let's take an example from a more advanced stage. Babies grasp and let go of the same object many times to study the regularity of the object's reaction. They then pick up and let go of other objects and find out whether or not they react in the same way. They also vary the position from which the object is dropped, and the trajectory by throwing things instead of just letting go of them. These endless, tireless activities can be interpreted as the baby's process of constructing an elementary notion of the force of gravity. It is thus not the object that stimulates the baby to react. It is the baby that acts on the stimuli that were around him all along. Objects which were not previously of interest can thus become interesting when the organism has developed enough ideas to perceive them differently.

2. <u>Learning takes place in such a way that the developmental stages are longitudinally coherent.</u>

Piaget believes that no stage can be skipped if cognitive development is to have a solid foundation for future growth. This statement is obvious enough to any programmer. What is not obvious to adults is the fact that the cognitive structures of preoperational children are very different from those of adults, and that the sequence of development is not what adult logic leads us to expect.

Let's take the concept of weight as an example of the longitudinal evolution of stages. Between seven and eight years of age, most children believe that a clay ball and another identical clay ball flattened into a "pancake" do not have the same weight. Many of these children believe, however, that the clay ball and pancake have "the same amount" of clay. For these children, there is no <u>logical necessity</u> that "the same amount" necessarily implies "the same weight".

Six months to a year later, these children acquire the conservation of weight. In other words, the knowledge that did not lead them to the conservation of weight before (i.e., the knowledge that the two clay objects have "the same amount") now leads them to conclude that the two objects <u>must</u> weigh the same. Although these children now have the conservation of weight, their notion of weight is still not completely differentiated from their notion of volume. Faced with two balls of exactly the same dimensions (Figure 3), but one made of clay and the other of heavy steel, these children believe that the one made of steel will make the water come up higher than the one made of clay. The reason for this belief is that the heavier ball is believed to push the water more than the lighter ball, thereby making the water rise more. As long as weight and volume are thus not dissociated in the child's mind, the notion of specific gravity is impossible to construct. Specific gravity, after all, is the relationship between the weight of an object and its volume, each of which can vary independently.

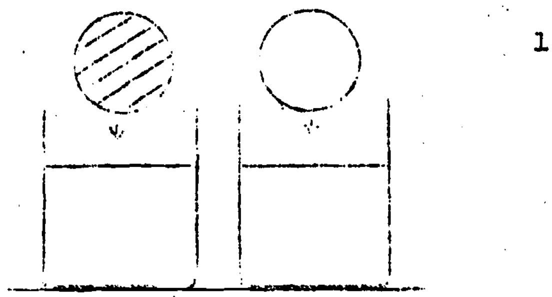


Fig. 3

At about 11 years of age, the child dissociates volume from weight, and he soon becomes able to construct the notion of specific gravity.

The evolution of the concept of weight is only one of the many examples that can be cited to show that later concepts develop out of earlier concepts, and that the child has to go through one stage after another of being "wrong" before he becomes able to think logically like adults. Piaget views children's "wrong" notions as intermediary stages that are necessary for the ultimate construction of adult concepts.

The child who cannot conserve weight may be "wrong" from the adult's point of view. However, there is a certain amount of intuitive correctness in the belief that the "pancake" weighs less "because it is flat". From the standpoint of the pressure one feels in holding a clay ball on the palm of one hand, and a flattened clay ball on the other, the child is absolutely correct in thinking that if weight is distributed over a large surface, the pressure on each spot will be less than when it is applied only at one spot. In a sensory-motor way, ever since infancy the child understands weight in terms of the downward pressure he kinesthetically feels when he picks up an object. The seven-year-old's concept of weight may thus be "wrong", but pressure is a factor that is relevant to the concept of weight. Therefore, pressure has to be part of his construction of the concept of weight rather than being cued out if it is to develop eventually into the dissociation of weight and volume.

Each concept is thus rooted in the baby's sensory-motor intelligence and takes a long time to evolve into an adult form. Therefore, concepts can be taught neither in a month nor in a year or two. Any attempt to skip an intermediary stage or to cue out the "wrong" notions is likely to result in hindering later learning. When earlier concepts are shaky, they will not serve as the foundation that generates higher-order concepts. Therefore, rather than cuing out and suppressing "wrong" notions, the teacher must bring them out to the fore to be integrated with other notions.

When new concepts are integrated with previously acquired ones, the learning is solid and not likely to be forgotten. Each new stage then increases the probability that the next stage will be achieved.

3. Learning takes place within the general framework that Piaget calls "intelligence".

Let us go back to the example of the concept of weight to illustrate the theory that each concept is part of a general cognitive framework, and that each concept is related to all the other concepts that the child has constructed. I would like to discuss below the evolution of the concept of weight in the periods of sensory-motor intelligence, concrete operations, and formal operations.

In the infant's early sensory-motor intelligence, there is no differentiation between the self and the object, and the baby's concept of weight is limited to what he feels in his body. We can infer from his behavior that he can tell the difference between being held securely and being held uncomfortably. One of the accomplishments of the sensory-motor period is the differentiation between the self and the object. The concept of the weight of objects emerges as part of this development. The sensory-motor adjustments the baby makes between holding a heavy bottle and holding a light rattle illustrate both his notion of the objects' weight and the gradual differentiation between the self and the object.

Intelligence which has reached the stage of concrete operations (around seven or eight years of age) is characterized by reversibility of thought. By this time, the object has become clearly differentiated from the self, and it can exist in the child's mind regardless of whether or not it is in sight. In contrast to sensory-motor intelligence, which functions only as the organism acts directly on the object, concrete-operational intelligence involves actions which are internalized. Thought at this stage can take place without external actions and in two opposite directions at the same time, e.g., pouring and pouring back,[4] separating and reuniting subgroups,[5] pushing an object to the right and pushing it back to the left,[6] and viewing an object as being at the same time bigger than certain objects and smaller than certain other objects.[7]

The conservation of weight is part of the general framework of intelligence which has become able to function internally without external actions, and without being limited to actions going only in one direction. The child can now mentally transform the piece of clay back and forth into a ball and into a "pancake". Other concepts that are involved in the conservation-of-weight task are the physical knowledge about the nature of clay and how scales work. The concept of weight as being independent of the kinesthetic feeling of pressure, and the concepts of "same", "more", and "less" are also involved in the conservation-of-weight task. When we thus compare the seven-year-old's concept of weight with that of the infant, it becomes clear that each concept is part of a general cognitive framework which consists of a network of more concepts than we can imagine.

While concrete operations are operations on concrete objects, (such as clay, water, and beads), formal operations are operations on operations (such as classification and seriation). When the child is about 12 years old, his cognitive framework becomes able

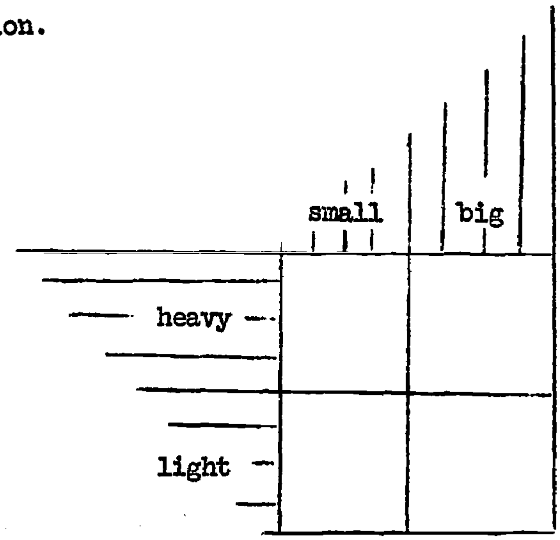
[4]Manifested in the conservation of liquid.

[5]Manifested in class inclusion.

[6]Manifested in mental images.

[7]Manifested in seriation.

to operate on operations. In the specific-gravity experiment, for example, the concrete-operational child's concept of weight is limited to absolute weight. As can be seen in the matrix below, concrete operations are inadequate to explain why things sink or float. Big things are usually heavy, and heavy things usually sink, but not always. Small things are usually light, but they don't always float. When a needle is found to sink (a small and light object) and a unit block is found to float (a big and heavy object), the child needs to operate on classes and series to generate the concept of specific gravity. This is precisely what the child cannot do at seven years of age because he is just becoming able to engage in operational classification and seriation.



I am not sure that I am being clear about the evolution of the concept of weight. All the details were given as an example to illustrate the point that each concept is made possible in the context of the general framework that Piaget calls "intelligence". Because concepts exist as part of this framework, every concept is related to every other concept in a network. The educational implication of this statement is that if we work through this framework, we are likely to maximize our educational mileage. If, on the other hand, we overlook this framework, we may well continue to make things hard and artificial both for disadvantaged children and for ourselves.

B. Piagetian principles of teaching

The question at hand now is how to achieve the objectives discussed at the beginning of this paper in ways that apply the above Piagetian principles of learning. The objectives of the preschool were said to be to maximize the child's chances of attaining the long-range goals of formal operations and adaptation to society by developing in the following areas:

1. Socioemotional development
    a. Intrinsic motivation to derive pleasure from using previously learned schemes.
    b. Controlling one's own behavior
    c. Relationship with peers
    d. Relationship with adults
2. Cognitive development
    a. Physical knowledge
    b. Social knowledge
    c. Logico-mathematical knowledge
        (1) Classification
        (2) Seriation
        (3) Construction of elementary number concepts
    d. Representation

The basic principles of learning were said to be

1. Learning is an active process of construction from inside the organism.
2. Learning takes place in a longitudinally coherent way.
3. Learning takes place within the general framework called "intelligence".

I would like to discuss now some principles of teaching under the following headings: (a) The role of the teacher in a Piagetian preschool, (b) the selection and organization of learning activities, and (c) the selection and organization of the content.

1. The role of the teacher in a Piagetian preschool

According to Piaget, as it was stated above, there are three sources of knowledge--feedback from objects, feedback from people, and feedback from the cognitive structure that the child has already built. The role of the teacher in a Piagetian preschool, therefore, cannot be one of simply transmitting all types of knowledge to children. Her function is to help the child construct his own knowledge directly from feedback from objects and through his own reasoning with objects.

In physical knowledge, for example, if the child believes that a block will sink, she encourages him to prove the correctness of his statement. If he predicts that chocolate pudding will turn into chocolate, she says, "Let's leave it here until tomorrow and find out what happens." Most four-year-olds predict, before a marble is placed in one pan of a balance, that that side will go down, and the other side will go up. When this prediction is given, the teacher does not say, "You are right," but, instead, says, "Let's find out." She lets the object give the feedback from the child's own action on objects. This is how she indirectly builds the child's initiative, curiosity, and confidence in his own ability to figure things out.

In the teaching of social knowledge, teaching in a Piagetian preschool is not different from traditional teaching, i.e., the teacher simply tells the answer and reinforces the correct responses.[8] Since social knowledge is man-made and can come only from feedback from people, the teacher feels quite free to tell the child, for example, that something is called a "pendulum" or a "tape recorder", that we have to pay pretend money to buy things from the play store, that clean-up time is not just for a few people but for everybody to clean up, and that we have different attitudes towards accidents and willful destruction. Social knowledge is the only area in the cognitive framework in which the teacher in a Piagetian preschool freely transmits ready-made knowledge. If the child believes that he can have two birthdays two days in a row, for example, she becomes the direct source of feedback.

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[8] This statement refers to the teaching of social knowledge, which is not to be confused with socialization. Social knowledge refers to factual information, while socialization refers to the child's behavior and feelings. An example of social knowledge is the child's knowing that willful destruction of property results in people's anger. Whether or not he respects other people's feelings and belongings in his behavior is an example of socialization.

The teacher's role in logico-mathematical knowledge is harder to explain because logico-mathematical knowledge is usually believed to be a kind of social knowledge. Classification, for instance, is often considered in terms of the "correct", or "more advanced", form of classification. An example of this point was given earlier in connection with the cognitive objectives of classification. In classification, the teacher should accept the child's way of thinking and proceed from there because, in the final analysis in classification, there is no "right" or "wrong" criterion for grouping things.

The role of the teacher in the logico-mathematical realm is thus not to reinforce the "correct" answer but to encourage the child's process of reasoning from his point of view. Young children have their own way of reasoning, and if we prematurely impose our ways, we only confuse them because they have no way of understanding why our classification is "better" than theirs. If we prematurely impose adult logic on young children, the lesson they will end up learning is that the correct answers always come from the teacher's head. Learning will then become a matter of guessing the desired response while scrutinizing the teacher's face for social approval.

The preceding statement is an example of the close relationship between cognitive development and socioemotional development. If logico-mathematical processes are taught by social approval, we could end up making the child uncertain and lacking in confidence about his ability to figure things out. If the child feels that his own way of classifying things usually turns out to be considered wrong, he will end up having less and less confidence in his own resourcefulness, and more and more confidence in what is in the teacher's head.

I cannot overemphasize the importance of developing disadvantaged children's confidence in their own ability to figure things out. We find in our project that when children do not have this confidence, they will not experiment to find out the different effects of different actions. In fact, they will prefer to say, "I don't know" than to venture a response.

Chittenden (1969) emphasizes the difference between instruction and the child's construction of knowledge. We find in our project that when the teacher minimizes her instructional role and does whatever she can to facilitate the child's construction of knowledge through his own actions on objects, his initiative and curiosity increase. In fact, it seems to be in the nature of young children to have an insatiable amount of curiosity about everything. The Piagetian teacher's role, in summary, is not to transmit knowledge, but to enable the child to create his own knowledge.

2. The selection and organization of learning activities

When I first came to the field of preschool education, I rejected the traditional nursery-school curriculum because its goals seemed too vague and sentimental. I found out, for example, that dramatic play was used for self-expression, for the development of children's imagination, for learning about the roles of fathers and mothers, and for a chance to feel like big people. I had no particular objection to these goals, but felt that for children in danger of failing in school later on, education had to do a lot more than what was good for middle-class nursery schools.

Later, I found in Piaget's theory many reasons why dramatic play, painting, block building, paper folding, Jell-O making, etc., were so relevant to education. The more I studied Piaget's theory, the more I came to respect the intuitive wisdom of the traditional nursery school. For example, Piaget (1962) showed that dramatic play provides an important entrance into the symbolic world. In other symbol-making activities like painting and making clay models, the child cannot directly externalize his mental image because he has to express it indirectly through paint and clay. In dramatic play, in contrast, he can externalize his mental image directly with his own body. If he wants to symbolize the idea of "father" in dramatic play, for example, he does not have to make the drawing or a clay model of a man. He can use his body directly to symbolize his ideas. Sociodramatic play, therefore, provides the unique situation in which the child can be both the symbol and the symbolizer at the same time. (In other symbol-making activities, the child is a symbolizer, but not a symbol.)

Sociodramatic play has the added advantage of movement, interaction, and continuity over time. The painting of a man cannot move and interact with other people, but the self as a symbol can. In sociodramatic play, the child thus has a dynamic symbol rather than a static one. As the symbolizer, he has to maintain a coherent sequence of interactions over time, and also decenter from his own perspective to that of a father, brother, or policeman in order to interact with other children who are in complementary roles.

The significance of the above cognitive processes for the ability to read became clear. Reading in a mechanical sense cannot take the child very far because if the child's symbolic world is not a vivid, dynamic reality, the written and spoken word cannot have much meaning. Reading then becomes an empty, mechanical, meaningless chore. I think sociodramatic play can help the child to make his symbolic world more real, more vivid, and more exact, but this hypothesis still remains to be tested empirically.

Since a complete Piagetian analysis of the traditional curriculum is beyond the scope of this paper, I would simply like to say that our general approach to preschool education is similar to the child-development philosophy. However, the way in which we use the traditional activities is different. In this section on how learning activities are selected, and the next section on how the content is selected, I hope to sketch a few examples of the way in which our curriculum differs from the traditional practices.

We have a daily schedule to give variety as well as a framework for the children to be able to anticipate the daily sequence of activities. This schedule includes individual activity time, group time, playground time, juice time, and bathroom time.

Occasionally, there are field trips to the zoo, to the store to find out more precisely how to play "store", and to the neighborhood streets to collect leaves, sticks, and stones for use in physical knowledge, classification, seriation, and number.

The individual activity time is the longest and most important block of time. During this period, the children choose what they want to do from the range of possibilities that the teacher provides. The materials she selects to put in the classroom are, therefore, crucial. If she puts some paint and brushes, a number of blocks, house-keeping toys, puzzles, etc., in the classroom, there is a high probability that these things will be chosen by the children.

The teacher may make a pendulum, for example, by suspending a weight from the ceiling in hopes that the children will notice it and start playing with it. (Slides) (By "playing", I mean the child's acting on the object to find out how it reacts.) After allowing a sufficient amount of time for the children to find out about the object, the teacher can introduce a game of knocking down a rubber doll which is standing on the floor. The rule of this game is to hold the weight at a particular spot and let go of it, rather than giving it a push. Either the teacher or the children can vary the position of the doll. The important thing in the selection of activities is that the teacher have several possibilities in mind as to which way she wants to take the child, but she does not force things in which the child is not intrinsically interested at a given moment.

There are times when children are not given a choice. For example, at playground time, everybody has to clean up and go outside. Most of the time, however, the children are told what the choices are, e.g., painting, sociodramatic play, block building, table games, and playing with sand. We feel that it is desirable to let the child select his learning activity for several reasons. Among them are the following:

a. An activity that the child himself selects is likely to be at the right level of difficulty for him. Children seldom select things that are either too easy and boring, or too hard and meaningless.

b. Voluntary activities are those in which the child is maximally involved. Both the socioemotional forces and the child's entire framework of intelligence are then likely to be active in the learning activity.

c. Asking children to make decisions is likely to enhance their initiative. We want children to take the initiative to learn both at school and after school hours, rather than waiting to be told what to do.

d. Children need to learn how to make decisions, rather than simply obeying orders all day. Selecting an activity and having to live with a decision for a brief period of time is in itself educational.

Matrix 1

The Content of a Piagetian Preschool Curriculum

Processes / Materials	Socioemotional Objectives				Cognitive Objectives					
							Logico-mathematical Knowledge			
	Intrinsic motivation	Controlling one's own behavior	Relationship with peers	Relationship with adults	Physical knowledge	Social knowledge	Classification	Seriation	Numerical construction	Representation
The self										
Food										
Kitchen utensils										
Art materials										
Tools										
Animals										
Plants										
Rocks										
Colors										
etc.										

42a

Fig. 4. Classification of Beads:
A Child between Stages I and II

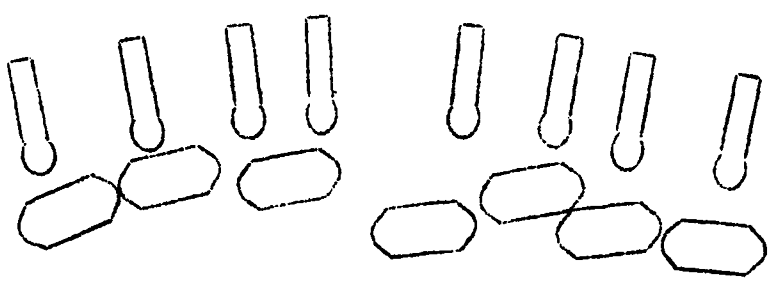


Fig. 5. Establishing Numerical Equivalence:
A Child in Stage I

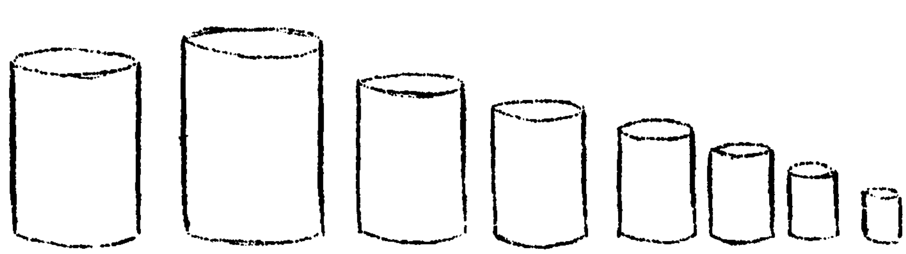


Fig. 6. Seriation: A Child in Stage I

3. The selection and organization of the content

The content can be conceptualized roughly in a matrix form as shown in Matrix 1. In the columns of this matrix are the various socioemotional and cognitive objectives. In the rows are the objects we want children to know and use, e.g., the self, items of food, kitchen utensils, etc. The traditional nursery school has done well in finding out what objects appeal to young children; so we select mostly from these objects things that are likely to enhance certain cognitive processes.

At the beginning of the year, for example, we put in the classroom two sizes of many things, such as plates, pans, wooden and metal spoons, forks, rectangular and cylindrical blocks, paint brushes and containers, paper for painting, etc. We select these objects because we want children to become aware of size differences and classify things according to size as they play with the objects. At this point, classification and seriation are still undifferentiated, and we don't worry about number as such, yet. Making groups of things is an elementary activity in the construction of numbers, and this is all that we aim for at the beginning of the year.

Our philosophy in selecting and organizing the content is to (a) select the materials as suggested above to give a variety of appropriate choices to the child, (b) make a diagnostic evaluation of the child's level of functioning and train of thought once he has chosen an activity, and (c) follow up on his interests in the light of this diagnostic evaluation. In other words, the teacher constantly engages in diagnostic evaluation by keeping the theoretical framework in mind and locating the child's level of functioning in this framework. She has several possible objectives in mind for each child, but in her moment-to-moment interaction with him, she picks up on his interests rather than imposing hers. She constantly works on the socioemotional objectives as she works on the cognitive objectives.

As stated above, the selection of objects to put in the classroom is crucial. The kind of objects and their variety and quantity are important considerations in determining what the children will select.

Another consideration is the versatility of each object as can be seen in the following examples of how blocks might be used for the development of the child's physical, social, and logico-methematical knowledge as well as representation:

a. For representation

If the child is building a gas station, the teacher can help him to elaborate the streets around it or to introduce cars and customers to extend the play into a dynamic, symbolic experience.

b. For spatial reasoning

If the child does not seem to know what to do with the blocks, toy stove, sink, and dresser that he has collected, the teacher can arrange them into a room and ask him if he would like to make a room just like hers (slide). If the child has a passion for trains, she would make a train station instead. (Spatial reasoning is similar to representation, but it involves making an exact copy or a precise modification of a spatial arrangement, rather than the externalization of a general idea.)

c. For pre-seriation

If the child is building a ramp, the teacher might make a bigger ramp and see how the idea strikes the child.

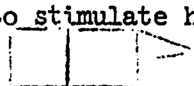
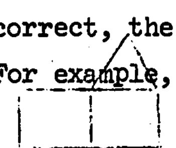
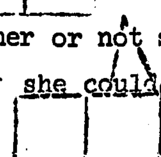
d. For physical knowledge

Blocks can be placed in a collection of objects for sinking-and-floating experiments.[9] Another game the teacher can introduce uses the sounds objects make when they are dropped on the floor. She can ask a group of children to close their eyes and to guess what she dropped on the floor.

[9]In physical-knowledge experiments, we do not ask children to explain any phenomena. We limit ourselves to having them predict the outcome of an action on objects, to verify the prediction, to recall what happened, and to figure out means of producing certain results.

> Blocks make sounds that are different from the sounds made by scissors, empty cans, and old magazines. The children can soon play this game without the teacher and add other actions on objects, such as hitting a block with a block, or a block with a pencil.

Piaget's theory makes it possible for the teacher to get a kind of X-ray picture into the child's cognitive processes. When the child does this in classification (Figure 4), the teacher knows that, with these objects, he is functioning not quite at the stage-II level. In number, with these particular objects (Figure 5), the child proves to be in stage I. In seriation, too, (Figure 6) the child is clearly still in stage I.

Our method of teaching applies Piaget's exploratory method of testing. If the child's answer is incorrect, the teacher asks another question to stimulate his thinking. For example, when the child makes this copy  of this model  (slide), the teacher can ask whether or not she (the child) could walk on her roof in the same way that she could walk on the teacher's roof. The child's response was this  (slide), which was still not quite right but good enough for the time being. (By the way, copying shapes with sticks is one of our reading-readiness activities, and I am sorry that there is not enough time to discuss these activities.)

The specific items selected are of particular importance in the teaching of physical and social knowledge. If we want children to know how a swing works in the sense of physical and social knowledge, for example, it is imperative that there be a swing in the environment. For logico-mathematical knowledge, in contrast, the particular objects used do not matter as much. For example, numbers can be learned with dolls and hats just as well as with cups and saucers, as long as the two sets of objects involved have a qualitative one-to-one relationship that Piaget calls "provoked correspondence".[10]

[10] Four-year-olds who don't understand the terms "just as many" and "the same number" understand much more easily the idea of "just enough hats for everybody" when the two sets have a relationship of provoked correspondence. They understand from the nature of the objects that there can be only one hat that each doll can wear at a time, and only one cup that can go on each saucer.

Classification, too, can be learned just as well with cars and blocks as with balls and toy shoes.

The approach advocated in this paper is not easy for the teacher to use in the classroom. It is much easier to take children through a preplanned set of activities. However, if each child's knowledge is a construction from within, and if this construction is a continuous process of integrating the new with the old structure, and if no concept exists in isolation, learning cannot proceed in the same way and same sequence for all children. Therefore, the teacher must follow the learner's own way of learning and guide it, rather than imposing her sequence of objectives. Before concluding this section on teaching methods, I would like to make a few comments about the importance of children's expressing themselves. The importance of clear and open communication, as well as the importance of respecting other people's feelings and opinions, goes without saying. From the point of view of children's cognitive development, too, we must encourage children to say exactly what they mean rather than pressuring them into giving the "right" answer.

In the first place, unless children tell us how they think, we cannot get the diagnostic insights that are essential for diagnostic teaching. In the second place, I would like children to have enough confidence in their own process of reasoning, rather than "learning" through social conformity. For example, in the situation shown below, if the child feels that 8 objects in the top row are "more" than 8 objects in the bottom row, I would like him to say so with confidence, rather than being shaped into reciting the "right" answer. The space occupied, after all, is an important consideration

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oooooooo

in the construction of number concepts, and any attempt to teach numbers must let the child himself work out the relationship between space and number through his own process of reasoning. If the process becomes well structured, the correct conclusion is bound to emerge. It is, therefore, on the underlying processes that we must work, not the answer, or the surface behavior. There are two papers (Ezell, Hammerman, & Morse, 1969; Kamii, 1969, in press) in which we describe how we work on the underlying processes for the construction of elementary number concepts.

There is another paper (Kamii & Derman, in press) giving the findings from an experiment which contributed to my belief that we must allow children to be honest with themselves. The six-year-old children who took part in this experiment were taught, among other things, to conserve weight and volume. They were found, for the most part, to give the correct answers, but usually in a sing-song fashion, as if they did not mean what they were saying. Their responses were not coming from the depth of their convictions. It occurred to me afterwards that teaching methods that attempt to excite the child's entire cognitive framework and enthusiasm must encourage him to say exactly what he means and exactly what he believes.

The teaching methods proposed on the basis of what I understand of Piaget's theory promise not to produce quick and spectacular results. However, changes that come from within an organism always come slowly. There is a phenomenon in embryology that Piaget points out, i.e., the fact that the more complex the organism's structure, the longer it takes the embryo to develop into a structured whole. There is no step that can be skipped in this process, and no way to force the rate of development. The only thing we can do to enhance biological development is to optimize the conditions under which the organism develops.

Disadvantaged children do not live under optimal conditions, both in a physical-biological sense and in a cognitive-biological sense. If I am wrong in the specifics of the curriculum conceptualized so far, I may still be right in saying that the best way to educate disadvantaged children should be sought in the laws of cognitive development in nature, and not in the laboratory.

In summary, the role of the teacher is neither to dictate "good" behavior nor to transmit ready-made predigested knowledge. Her role is to help the child to control his own behavior and to build his own knowledge through his own actions on objects, his own reasoning processes and his own curiosity and excitement. To accomplish this task, the teacher selects a variety of objects to give a range of possibilities for the child to choose from. When the child has chosen his activity, the teacher diagnostically picks up on the child's interests by making suggestions and asking questions. Piaget's distinction among physical, social, and logico-mathematical knowledge and representation guides the teacher in deciding when to answer a question, when to let objects give the answer, and when to leave the question open. As stated earlier in this paper, the basic principle to keep in mind is that play is the most powerful ally on the teacher's side.

III. The Evaluation of the Curriculum

In a nutshell, I don't know how to evaluate this curriculum. It has taken almost four years to conceptualize the objectives presented above, and in some areas (i.e., physical knowledge and the structuring of time and space) the objectives and teaching activities are yet to be developed. While studying the theory, the children in the classroom, and education in general, I changed my mind many times about what the objectives of a Piagetian preschool should be. Since I am not sure about the objectives, I am even less sure about how to evaluate the curriculum.

I used to think that intelligence or achievement tests could be used to evaluate a preschool curriculum based on Piaget's theory. I later came to see, however, that it made no sense at all to use these tests. Some of the reasons for this statement can be found in Kohlberg (1968) and Kamii (in press).

By definition, a Piagetian approach can only be a long-term approach. However, long-term evaluation is not possible at this time because schools function in ways that are very anti-Piagetian. For example, we advocate children's voluntary activity and curiosity, but schools encourage passive receptivity. We believe in children's constant exchange of views, but schools prefer quiet passivity. We think that the process of arriving at the answer is more important than the answer itself, but schools put the accent on specific facts and the "right" answer. In fact, we even believe in the importance of the child's going through many stages of being "wrong" before he becomes able to reason logically like an adult. We think that children learn to make decisions by making decisions, but schools emphasize obedience.

It may be worth sketching a few ideas about how the curriculum might be evaluated. I think the most important variables are the socioemotional ones because if the children achieve our socioemotional objectives, their chances for future learning are maximized. I think these data should be collected by observing the children in their real-life milieu, rather than in artificial test situations. The important thing in the evaluation of an educational program is not whether or not the child is able to do something under certain circumstances, but whether or not he actually uses his abilities from day to day under normal circumstances. Incidentally, I think it would be good to institute a system of exchanging evaluators among the various projects that are in existence. For the cognitive areas, the Piagetian tasks described in Kamii (in press) might be used, with the modifications that were found to be necessary after the chapter was written.

Before concluding this paper, I would like to make a few points about the use of psychometric tests, "accountability", and the long-range solution of social and educational problems. The scores obtained on psychometric tests like the Peabody Picture Vocabulary Test, the Stanford-Binet Intelligence Scale, and the Preschool Inventory may predict later achievement test scores, which indeed predict the pupils' survival in school. However, I would like to raise the question as to how much theoretical and practical validity these correlations have. They can perhaps be explained simply in terms of the peculiar way in which all psychometric tests are constructed and administered, and the way in which schools are run to teach specific facts and the "right" answer. When we think about what is happening on college campuses today, we wonder what psychometric test scores tell us about the nation's advantaged, "intelligent" younsters who made it to college. Our perspective should be broader than payoff and "accountability".

I am well aware of the social crisis that we are facing today. Any quick method that can be found to increase disadvantaged children's chances of getting through public schools is an enormous accomplishment. However, I am also of the opinion that any effort that perpetuates the present educational system will not result in the long-range solution of our social and educational problems. Atkin (1969) points out that the federal perspective of "accountability" is almost by definition a short-term perspective related to political payoff.[11] He argues convincingly that "to gear all of our new

[11] Atkin goes on to say, "The term 'political payoff' is not used in a pejorative sense. It is becoming a requirement, however, for a federal administration to show in a reasonably short period of time that large amounts of monies spent for social improvement result in significant changes. The short-term nature of the perspective brought to our tasks by federal officials represents one major issue that should be in the forefront of educational thinking as we examine new sources of funds from the federal government for novel programs."

educational effort to attempt solve deep (social) problems on a short-term basis may in the long run turn out to be a major misapplication of scarce resources." It is absurd to think that we can institute 500 - 750 hours of preschool education without changing the 10,000 hours of compulsory education that follow preschool and kindergarten.

The more I study Piaget's theory and the children in our project, the more I become convinced that Piaget's theory can make a contribution to education. However, the theory still needs to be digested, developed into a curriculum, implemented, and evaluated in longitudinal experiments. What difference this theory can make to the education of disadvantaged children is a question that remains to be answered empirically, not only to my satisfaction but also to the satisfaction of people like this audience and the teachers who actually teach the children from day to day. There is a long and thorny road ahead before this question can be answered.

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Some Reactions to the Discussants

Constance Kamii

June, 1970

Helen Robison rightly pointed out that my paper did not adequately treat the teaching of language. I would like to make the following remarks in response. I feel that the teaching of concepts is too often equated with the teaching of words, and that at the four-year-old level, we should be able to talk about cognitive development without necessarily talking about language development at the same time. One of my reasons for not discussing the teaching of language was to stress the point that, according to Piaget, thinking does not grow out of language.

As for the teaching of language *per se*, we help our children to develop it in two ways: (a) Through imitation without communication and (b) through the use of language for communication. According to Piaget, language is learned first by imitation, e.g., French babies imitate French sounds. In our curriculum, we extend this imitation into chants and nursery rhymes that are taught particularly on the school bus. In chanting nursery rhymes, the children do not concern themselves with communication, and simply have fun uttering sounds and word patterns.

In the second approach, in contrast, language is used for representation and communication. Therefore, for example, if we want children to name objects, colors, and numbers, we set up situations in which the statement "I want some red paint (or two cookies)" serves a useful purpose for the child. This approach is in contrast with the situation in which the child is asked to say, "This paint is red," when both the speaker and the listener can see the object. The function of language is for the communication of ideas and representation of things that are not present. Some examples of the use of language for representation and communication in our curriculum are making predictions in physical knowledge, exchanging opinions in social and logico-mathematical knowledge, and verbally interacting in sociodramatic play.

I would like to react to only one of the points made by Frank Hooper, i.e., his question as to where the infralogical operations concerning space and time fit into the trichotomy of physical, social, and logico-mathematical knowledge. I mentioned space and time only in passing under physical knowledge because they seemed too complicated to fit into the trichotomy.

Spatio-temporal structures belong halfway between physical knowledge and logico-mathematical knowledge. Space and time are like physical objects in that they have properties of their own that cannot be changed at will by the action of the subject. On the other hand, spatio-temporal structures are like logico-mathematical knowledge in that they have to be constructed by the subject himself rather than being discovered empirically. Geometry is closer to logico-mathematical knowledge than to physical knowledge, while other activities involving space, e.g., billiards, pendulums, balances, and shadows are closer to physical knowledge. These activities can be used to help the child to structure temporal sequences, too, i.e., predicting the results of an action, verifying the prediction, recalling what happened, and figuring out means-ends relationships.