CHAPTER - II
CONVERSATION AND CONCEPTUAL UNDERSTANDING

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2.1 Piaget Background to the Problem

The late Prof. Jean Piaget, is now being ranked the greatest psychologist of this century. Having been trained as zoologist, he tried to move his thought in every possible direction. In the context of his own vast epistemological abstract frame of reference, he was ultimately seen of value who did talk something, relevant to the education of children, outweighing, in the process not only the present educational thinkers but also all those who had preceded him. He founded the world famous Geneva school where with his vigorous brain power and long hours of sitting at his desk for about fifteen hours a day for over sixty years, he began to solve the problems of how children, adolescent develop their cognitive abilities. He has expounded a new concept of biological intelligence where conservation plays an important role. He worked vigorously on the genesis of conservation ability and has also proved that it is the precursor of intelligence. Thus conservation is the central theme of cognitive ability in human being, and knowledge revolves round the cognitive abilities of man. How could one best highlight the intelligence revolution which constitutes Piaget's work? One can point out to three modern revolutions that have changed the
outlook of modern man. They are associated with the names of Copernicus, Darwin and Freud respectively. The first placed the earth and the sun within the greater totality of the universe and the second did the same with respect to men and the greater biological totality. Freud finally took away the unquestioned variables.

Maturation of the nervous system.

Experiences with physical reality, and

Interaction with the social milieu.

Assuming the first of these, transactions with the physical and social environment will be assimilated in so far as they can be fitted into the existing cognitive organization. In this process, however, the organization is changed, and thus becomes capable of a new level of assimilation at the next encounter. The tension created by the imbalance between assimilation and accommodation provides the motivating force for intellectual growth and expansion resulting in the attainment of new levels of equilibrium or understanding. The need to explore and learn initiates within the organism and becomes self-perpetuating like R.W. White’s drive for “Competence”.

3. Intellectual development is continuous but results in qualitative difference.

According to Piaget, operations such as identity, negation, implication etc. are the ones that characterize adult thought, Operational thought, in explor-
ing the possible as opposed to real, performs a number of logical steps such as combination, reversal, disjunction etc. on the prepositional content and in addition can reason about its own processes. By contrast, the pre-operational thought of the child is tied to the world of physical objects, governed by perception rather than reason, and is unable to comprehend such concepts as conservation or reversibility, transitivity and classification.

The butterfly does not resemble the caterpillar from which it evolved, although its development from one to the other may be traced at very step. Adult logical thinking is qualitatively different from the sensorimotor adaptation of the infant, or the preoperational and concrete operational through of older children, but it is founded on these earlier stages, and depends for the elaborateness of its functioning on the richness of experience at each stage along the route.

4. Development is uneven both across and between stages

Piaget uses the terms 'horizontal' and 'vertical' declages to conceptualized two observed phenomena of cognitive development.

Horizontal declage refers to the fact that, even when a level of thought is attained, it need not be uniformly applied in all areas. Hence a child may attain the concept of conversation of mass before it is applied to weight or volume.

Vertical declage refers to the fact that a
problem with similar content is approached at different stages with a completely different level of functioning. In the social-emotional realm, Erikson has drawn attention to the different levels of approach at different ages to life long problems such as maintaining a balance between trust and mistrust or establishing one's autonomy with respect to others. The difference in these levels is undoubtedly related to the development of cognitive functioning.

2.2 Cognitive Development: Operations and Structures

Piaget is now classified as a genetic epistemologist, since he is concerned with the nature of knowledge and the structures and processes by which it is acquired. This is in contrast to his not being a child psychologist in the practical sense concerned primarily with child growth and development. His main concern is to show that in all discussions of the development of knowledge, the roles of maturation and experience are not sufficient but must include also a mental logical structure called “equilibration”. Piaget argues that much of our knowledge comes not from without but from within by the force of our own logic, a fact often forgotten in education.

Piaget's work is crucial for educational philosophy as well as psychology because it shares with progressive education on approach to the child in terms of action, process and growth, Educational philosophy,
for which true education is growth, finds in Piaget's psychology the foundation and framework.

Piaget discussed four basic factors that contribute to intellectual development. They are: (1) physiological development (2) direct experience with physical world (3) social transmission (communication, teaching etc.) (4) equilibration or auto regulation.

It is the last of those four factors that Piaget studies in depth, because it has been given little attention and is yet of fundamental importance. The first three factors involve the individual as passive or a receiver. As his physiological system matures, he is confronted with many experiences; he is presented with much information. But intellectual development is not passive, it involves acts or operations by the learner. These acts, or mental operations, on objects in the physical world involve revising partial understanding broadening concepts and relating one idea to another.

For example, the child is confronted with a problem involving two balls of clay of the same size. One ball is made into two smaller balls and the child is asked which will make the water (in a glass) rise higher, the large ball or the two smaller balls. The child answers that the two smaller balls will. Why? Because there is more. The experiment is conducted and the water is found to rise the same amount in both cases. Some children are unable to reconcile the apparent contra-
diction. Others are able to assimilate his new information and generalize a correct answer for similar experiments. Piaget would say that the second group has achieved a mental "equilibrium" or equilibration. Their mental processes have accommodated this new information, generalized it, and it is now a part of their mental structures.

For this equilibrium to occur, the child must act or "Operate" himself on objects. It is not sufficient to explain why if ideas are to become a part of his own mental structures. Piaget would agree with Dewy that child must experience things for himself.

To know an object or event, according to Piaget, is not simply to look at it, or hear about it and make a mental copy or image of it. Knowledge is not a copy of reality. To know an object, is to act on it, to modify it or transform it and, in the process, to understand the way the object is constructed. Such an act is called an "Operation". An operation is the essence of knowledge. It is an interiorized (mental) action that modifies the object.

The basic processes of arithmetic are operations. Children will usually need to perform the concrete operation of joining a MM, set of 3 objects and a set of 2 objects and noting the result, in order to begin to understand the number idea involved. Similarly, an operation on a ball of clay could consist of dividing it into two smaller balls. The two balls of
clay can be put back together to produce the original larger ball. Hence there is the same amount of clay in the two smaller balls as in the large one. This idea of reversibility is important in logical thought and it escapes children until a certain stage of development. A child may recite at the verbal level that $3 + 2$ is 5 but then not be able to reverse the procedure by retaining 5 as $3 + 2$.

An operation is never isolated. It is always linked to some other operations and is a part of a total structure. A number does not exist in isolation but in relation to other numbers, that is, 5 is $3 + 2$, $2 + 3$, $1 + 4$, $4 + 1$, 1 more than 4, 2 less than 7 etc.

Similarly, in logic, a logical class does not exist in isolation but is a part of the total structure of classification. To classify using the "inclusion relation" for example, consider a city such as Ahmedabad, Gujarat. Ahmedabad is in or included in Gujarat. Gujarat is included in India. India is "included" in South Asia. South Asia is "included" in the Northern Hemisphere, Northern Hemisphere is included in the sphere or earth, which is included in the solar system etc. Thus, a hierarchy of classification is built. It is these operational structures of classification that are the natural psychological reality and basis for the development of human knowledge.

From the above discussion, it seems that Piaget
argues that there is functional relationship between a child's physical and mental actions and the development of logical thought. He asserts that "actions" lead to the development of "Operations" and operations in turn lead to the development of "structures".

It is necessary to know operations and structures in greater detail.

2.2.1 Operations

Operations are mental acts, such as various types of conversation. Operations have four main characteristics;

1. Operations are actions that are internalized; that is, operations can be carried out in thought as well as in action. Internalized actions begin to emerge around the age of two years, the end of the sensorimotor period, when the child becomes capable of internal representation.

2. Operations are reversible. It has been shown earlier that addition and subtraction are the same operation carried out in opposite direction $2 + 1 = 3$ or $3 - 1 = 2$.

3. The third characteristic of operation is that it always maintains some invariant although a transformation or change always occurs. In the process of addition, pairs of numbers can be grouped in different way ($2+1, 1+2, 1+1+1$), but the sum remains invariant. Similarly, in all conservation problems, quantities are conserved during change
in irrelevant dimensions.

4. The fourth characteristic of an operation is that no single operation exists alone. An operation is always related to a structure or network of operations. For example, addition-subtraction operation is related to the operation of classifying, ordering and conserving number. Each of these particular operations emerges in development at about the same time and has common core of cognitive pre-requisites. Each operation is necessary for the other operations to emerge fully.

An operation differs in specific ways from an action.

An action can be an isolated event, such as a child manipulating an object. Actions can lead to the development of physical and logical mathematical knowledge. Logical mathematical knowledge eventually results in operations. So operations are mental activities that are internalized, reversible, conserved and integrated with higher organizations (structures) and other operations. Thus the child who discovers through manipulation of objects that a particular collection of stones arranged, has or is constructing a mathematical operation of commulativity. The raw materials for operation are the child’s actions.
2.2.2 Structures

Structures (schemata) are the highest order mental organization one step higher than operations. Like operations, structures have certain characteristics. A structure is a totality that certain laws apply to all the parts of the structure. To quote Piaget (1952).

The system of whole numbers is an example of a structure, since there are laws that apply to the series as such. Many different mathematical structures can be discovered in the series of whole numbers. One, for instance in the additive group. The rule of associativity, commutativity, transitivity and closure for addition are all held within the series of whole numbers. (Child's conception of Numbers. p.22).

The laws that govern a structure are also laws of transformation, so that in the case of addition of whole numbers, a number can be transformed into another by adding something to it.

Also, structures are self-regulating in the sense that one need not go outside the structure to find elements for transformation, and the result of the transformation stays within the system.

Again to quote Piaget further
Referring to the additive group once again; when we add one whole number to another, we do
not have to go outside the series of whole numbers in search of any element that is not within the series. And, once we have added the two whole numbers together, our result still remains within the series. (Child's Conception of Numbers. p.23)

While structures are the highest-order mental organizations, according to Piaget, it should be noted that structures are always related to other structures and that many structures are sub-structures of larger structures. For example, the structure of whole numbers is a part of the larger structure (all numbers), which includes fractional numbers, rational numbers, etc.

There are various types of structures, which are as under:

(1) Classification of Structure

An example of a structure is the classification structure. Elements of the classification structures emerge before the structure is complete. For example, children of 4 or 5 years of age can place objects of similar shape or color into collections based on their characteristics. This is simple classification. Children of this age typically do not comprehend the inclusion principle, i.e. that a total class must be as big or bigger than one of its sub-classes. To quote Piaget:
A child of this age will agree that all ducks are birds and that not all birds are ducks. But then, if he is asked whether out in the woods there are more birds or more ducks, he will say, "I don't know; I have never counted them. It is the relationship of class inclusion that gives rise to the operational structure of classification. (Judgment and Reasoning pp.27.28)

Thus, classification does not have characteristics of a structure before the inclusion principle is grasped.

(2) Ordering or Seriation Structure

Similar in development to the classification structure is the ordering or seriation structure, which children typically develop around age seven. A child of 4 or 5 years is presented with a series of sticks varying in length by perceptually small differences. The child is asked to order the sticks from the smallest to the largest. Preoperational children perform this structural framework.

Around the end of the preoperational period, children typically manage with trial and error to arrange all the sticks in a series. Their approach is still not systematic. After age 7 or so, children develop a systematic coordinated method, that reflects a
completely developed seriation structure. They seek out and select the smallest stick (or they begin with the largest), then the next smallest, and so on. The arrangement is made without trial and error.

The relationship between a child's actions on objects and the child's mental or intellectual development is made clear by Piaget. Actions lead to the development of operations; mental operations lead to the development of mental structures.

Mathematical Structures and Structures of Logical Thoughts

Throughout his writings, Piaget suggests a relationship or similarity between the logical structure of the mind and the logical structures of mathematics. Piaget outlines the relationship between the "mother" structures of mathematics and the structures of thought in children. Here, Piaget refers to the work of Bourbaki, a mathematician who derived three basic or "mother" structures of mathematics that were not reducible and that independently or in combination could generate all other mathematical structures. The three structures are the "algebraic structure", the "order structure" and the "topological structure". Piaget observes that young children have cognitive structures resembling these mother structures of mathematics. Now these three types of mathematical structures are highly abstract. Nonetheless, in the thinking of children as young as 6 or 7 years of age, the structures resembling each of these
three types can be found.

The prototype of the "Algebraic Structure" is the mathematical concept of a group. Algebraic structures are characterized by their form of reversibility. In children's thinking algebraic structures are to be found quite generally, but most readily in the logic of classes - in the logic of classification. Children as young as 4 or 5 years can classify geometric shapes. It is the relationship of class inclusion that given rise to the operational structure of classification, which is in fact analogous to the algebraic structures of the mathematicians.

Thus, in thought of even very young children are structures analogous to the algebraic structures of mathematicians.

Of the second mother structure, "Order Structure", Piaget says;

"This structure applies to relationships, whereas the algebraic structures applies essentially to classes and numbers .......... the form of reversibility characteristics of order structures is reciprocity."
Piaget uses the structure of seriation as an example of an order structure in children’s thinking. (Child’s conception of Number p.25)

Bourbaki’s third mother structure, topological structure, includes ideas such as proximity, inclusion, and exclusion, and applies to geometry as well as other areas of mathematics. The typical four-year-old understands and can represent topological relationships. When asked to copy drawings with topological properties, such as the parts of the drawings are usually placed in proper relationship to one another, demonstrating a comprehension of topological space. The same age child typically can distinguish simple Euclidian shapes - circles, squares, etc., but has difficulty drawing Euclidian shapes. This inability to represent Euclidian shapes does not seem to be the result of a lack of drawing skills. It is clear that children develop topological concepts and that they are developed prior to the development of Euclidian concepts.

Piaget has attempted to demonstrate that three mother structures of mathematics appear spontaneously in the development of young children. Bourbaki has suggested that these structures can be combined to generate all the other structures of mathematics. Piaget says, similarly, that in children’s thought additional structures evolve from a combination of two or more of the basic structures that have their natural roots in children’s thinking. To quote, Piaget again says:
When we study the development of the notion of number in children's thinking, we find that it is not based on classifying operation alone but it is a synthesis of two different structures. We find that along with the classifying structures, which are an instance of the Bourbaki algebraic structure, number is also based on ordering structures, that is, a synthesis of these two different types of structures. It is certainly true that classification is involved in the notion of number. (Child's Conception of Number p.38)

Thus, number, a synthesis of class inclusion and relationships of order, depends on two mother structures, the algebraic and the order, at the same time. Either structure alone is not adequate. All this evidence persuades Piaget and his co-workers that the logical aspects of the structures of thought are similar to the logical aspects of mathematics.

Now, these details of the genesis of the formation of operations and structures would be classified in the stage theory propounded by Piaget.
2.3 Stages of Development: A Stage Theory

Piaget distinguishes four main stages in the development of these mental structures.

1. Sensori-motor stage:

The first is a sensori-motor preverbal stage lasting approximately for the first two years of life.

2. Pre-operational stage:

The second stage is that of pre-operational representation. It marks the beginning of language in the form of words. Words are symbols of representations of reality. The word 'tree', for example, is not a tree but a symbolic representation of one. The child may be shown a picture of a bird and asked why it does not fly away. This use of symbols or "representation" marks the beginning of thought. At this stage there is a reconstruction or representation of experiences at the pre-representation "operations".

In the sensorimotor stage, the child is restricted to direct interaction with his environment, but in the pre-operational stage he begins to manipulate symbols of representations of physical world in which he lives. The pre-operational period is often described as lasting from 2 to 7 years of ages. However, this is only a rough guide. For some mathematical concepts children do not leave the pre-operational stage until
30

9 or 10 years of age.

3. concrete operations stage:

The third stage is that of concrete operations, which is particularly important to the elementary school teacher because most of the time that children are in the elementary school they are in this stage of development. For many mathematical ideas children reach the concrete operational stage at around 7 years of age. Some mathematical ideas, however, do not become operational or meaningful until 10 or 11 years of age and yet many teachers try to teach these ideas earlier.

Piaget studied the concrete operational stage using the concept of conservation or invariance, which is a basic characteristic of conversation or invariance, which is a basic characteristic of this stage. For example, a child is shown two glasses containing the same amount of water.

The water in one glass is then poured into a taller glass with smaller diameter.

When the child understands that the amount of water is still the same and rejects what perception tells him (one looks like more), he is using logic and has arrived at the concrete operational thought level for the concept. That the amount of water is conserved or remains invariant after the pouring operation is referred to as the concept of conservation or invariance. To arrive at this stage the
child must realize that the process can be reversed that if the liquid is poured back into the original container, the amount should be the same. The psychological criteria for a reversible operation are that of conservation.

This is concrete operational stage because the child is obtaining ideas from operations on such concrete objects as water, clay etc. At the beginning of the concrete operational level the ideas of the child are still based on observation and experience with objects in the physical world, but he is beginning to generalize or break away from manipulation of objects as a way of 'knowing' when these generalization are correct and complete the child is at the concrete operational level.

This level is important mathematically and psychologically because many of the operations are mathematical in nature.

4. Formal operation stage:

The last or fourth stage is the formal operation stage of the hypothetic-deductive operational level. This does not usually occur until eleven or twelve years of age. The child now reasons of hypotheses or ideas rather than on needing objects in the physical world as a basis for his thinking. He constructs new operations, those of prepositional logic, and he attains new mental structures. He is now able to consider all possibilities or combina-
tions rather than those based only on experience of experiment. He begins to classify, order and enumerate in the verbal proposition form of deductive logic. He can operate with the form of an argument and ignore its imperial content. He can use the procedures of the logician or scientist - a hypothetic - deductive procedure that no longer lies his thoughts to existing reality. Piaget maintains that these logical mathematical neural structures produce thought rather than the reverse of thought producing logic.

After considering the above background and theoretical aspects of Piaget's work, the investigator in the subsequent paragraphs, deals with the theoretical aspect which bears relationship with his problem of research i.e. conservation and conceptual understanding in mathematics.

2.4 Conservation or Invariance of Number

The idea of relation is important in the world of mathematics. It furnishes a basis of comparison of ideas both in logic and in mathematics. Some of the first experience in mathematics for children involve the comparison or relation of two quantities - 'the same as' or 'equal' or 'greater than' or 'less than' or 'the same as'. These are the quantitative relations as contrasted to the qualitative relations.

After considering the relations "greater than", "less than" and "equal" or "the same", the child is
faced with the extent to which one set may be "greater" than another. To answer this question, counting is the usual procedure. This counting, as learned by the child may very well be a rote activity. Before entering school, his parents may have thought they taught him to count. He has memorized a sequence of sounds - "one, two; three, four." and therefore says that he can "count". However, if he is asked how many objects you hold in your hand, he may be guessing an answer. His counting is purely a rote-type learning. He has not yet learned to establish a one-to one correspondence by matching number names to the objects being counted.

One-to-one correspondence or matching is fundamental to determining the number of a set, and children need many readiness activities of a matching sort, such as dresses to dolls, milk cartons to straws, children may be shown to sets and asked to compare them by placing an object in one set by an object in the other set to see if there is more in one set.

Such activities are appropriate at the concrete operational level. Children can see and handle objects. These activities in three-dimensional space are followed by worksheets or books in which there are pictures of sets and the children draw lines between pairs of objects in the two sets. This, of course, is moving toward the abstract since pictures are two-dimensional representations of three-dimensional objects.

After matching object to objects in pictures,
children learn to match the number names or numerals objects.

They may then be shown several sets, each containing a different number of objects, and asked to write the number or objects below each set.

When they can place the number names in one-to-one correspondence with objects in a set and tell you, for example, in which of the above sets there are "four" objects, they are then beginning to count rationally. The teacher may think they then understand the idea of number four. However, the idea of number is so subtle that if she says in different fashion such as spread out more,

"I THINK SOMETHING MISSING"

the children say there is "more" in the spread out set. A child may if less than six and a half to seven years of age "count" if asked the objects in each set and answer "four in each case but still maintain there is more in the spread out set. The spatial configuration of what he sees (perception) triumphs over the intellectual idea of the conservation of the number, four.

It is the conservation concept that he does not yet have and which is necessary for a real understanding of number. Number by its very nature is invariant. This the child does not understand.

The learning of the one-to-one correspondence number concept is also a spontaneous process according to Piaget. It is largely independently and self-deter-
mined. For example, a child of five or six may be "taught" to count objects laid out in a raw but if the objects are rearranged in a more complex pattern such as a circle or zigzag, he can no longer count them. Thus, the child counts but may not be able to count.

Children can, without being taught, determine the number of a set by matching its elements with those of another set. More important, the child knows the number of each set is the same regardless of the arrangement of the elements in the two sets. He has developed the concept of conservation or invariance of quantity, which he must have understood the concept of number. Conservation is a developmental process and not taught at any stage of development.

To understand number, the child must first develop its basic characteristic of invariance or conservation.

Piaget contends that conservation is a necessary condition for all rational (reasoning) activity. The teacher cannot accelerate to any great extent the development of the conservation concept, but she can provide an environment for it to develop. And when the conservation concept has developed in a child, counting based on one-to-one correspondence develops almost automatically since it is according to Piaget, a spontaneous process largely self-determined rather than taught.

Recent development in Piaget's theory and work in America and other European countries demonstrated
that conservation could be induced if proper method of training in conservation be given. This aspect is inconclusive and contradictory to the thesis and research evidence showed by the Geneva School. Hence, the investigation was more interested in the research topic selected by him in as much as he wanted to see whether in Indian environment and culture the same or contradictory evidences were coming from his research work.

But before coming to the problem of conservation, the important factors affecting cognitive development would be briefly dealt with.

2.5 Factors Affecting Cognitive Development

There are four factors involved in the transition through these stages of development which are discussed below;

1. Maturation Factor:

The first of these factors, maturation of the nervous system, is commonly thought to be an internal process, but the various stages occur at different ages in different cultures and different countries.

2. Experience Factor:

With reference to the experience factor, there are two types of experience that are very different from a psychological standpoint and very important from a pedagogical standpoint. First there is a physical experience, and second there is a logical mathematical experience. The act of weighing two objects to determine if they have the same weight
would be a physical experience. The logical mathematical experience in contrast comes not from the object or objects themselves but from the action of the learners on the objects. For example, a child under 7 is given a set of pebbles and asked to place them in a row. He is asked to count them in one direction and then in the other. He then places the pebbles in a circle and counts them in one direction and then one other. He then tries another arrangement. He discovers that the sum is always the same and is independent of the order. He discovers a property of the action of ordering, not a property of pebbles. This is quite another form of experience and marks the beginning of mathematical deduction. The subsequent deduction is "interioring" the action carried out of the pebbles so that pebbles will no longer be necessary.

3. Social Transmission Factor:
The third factor that of social transmission or educational transmission, involves the imparting of knowledge by language. This factor is important, but only when the child has a "structure" that allows him to understand the language being used. And it is at this point that a child often becomes lost, the teacher not realizing that he does not yet have the necessary structure. The relation "brother of" or "sister of" may mean something different to the young child. For example, he sees
the other children as his brothers and sisters but does not see himself as a "brother of" the other children in the family. The reversibility of the "brother of" or "sister of" relation is not yet understood. The child can think in only one direction.

4. Equilibration Factor:
The fourth factor equilibration or self-regulation, is fundamental one, according to Piaget. One form of equilibration is the co-ordination of the first three factors. But there is another form. The child having passed through the necessary stages of maturation is shown two balls of clay the same size, with the verbal guidance of the teacher, the child is asked to flatten one ball and is then asked which is more, the flat piece of clay or the ball of clay. He is not sure and compensates for the action of flattening by restoring the flat clay to its original form. He sees that they are the same. It is this compensation type action or reversibility that leads him eventually to a stage of equilibrium where he knows that transformations in shape do not change the amount. This process of equilibration is an active process involving a change in one direction, being compensated for by a change in the opposite direction. The term equilibration or self-regulation is used in the sense that it is used in cybernetics processes with feed back and
feed forward, of processes that regulate themselves by progressive compensation of systems, in a sense like an electronic computer.

2.6 Conservation : Stages of Development

Piaget concluded from many experience of children that there are three stages of development. The first is the absence of conservation. Children at this stage think that the quantity gets larger or smaller as its configuration or shape is changed. Many five and six year olds would say the first set at the top in the illustration contains "more" because it occupies more space or because beads at the extremities are further away.

The extent of this lack of understanding of conservation of numbers can also be demonstrated by having a 5 or 6 year old take beads from a pile with both hands, placing one bead at a time in each of the two jars, a jar for each hand.

Even though he has placed a bead in jar for each bead placed in jar B, he thinks there is more in jar b. Even if the child can count and says there are, for example, "30" in each container, he still says there are more in B because the beads are higher in B.

Thus, there are three stages of the development of conservation which are as under:

i  No conservation - NC

ii  Semi conservation - SC
iii Complete conservation - CC

For measuring conservation in children Piaget has developed some standard tasks which were known popularly as Piagetian Standard Tasks. They are thirteen in number which are described briefly in next paragraphs.

2.7 Piagetian Tasks for Measuring Conservation

Piaget Battery:

A set of 13 tasks was selected, representing a wide range of concepts, which according to Piaget's writing, and the studies by Lovell, Hyde, Coodnow and others, show a clear progression in stages of response between about 6 and 11 years.

They were also chosen for clarity and for ease in evaluating the response without extensive 'clinical' inquiry; that is, they were given with sufficient questioning only to ensure that the subject had or had not grasped the concept.

(Detailed questions are given in Vernon's Environmental Handicaps and intellectual development. Brit J. Edc. Psy; 35.9-20, 117-126)

1. Time Concepts:
   including day after tomorrow, day and time in another town, why a watch has two hands.

2. Left and right:
   Pointing to tester's seating position and stating whether each of 3 objects is to the L or R of another.
3. Equidistant Counters:
   Placing a number of green counters equidistant from
   the tester's and the subject's red counters.

4. Logical Inclusion:
   White and blue squares and blue circle; several
   question such as — Are there more circle or more
   blue things? why?

5. Tilted Bottle:
   A half filled bottle is seen up right, then half
   hidden in titled, or on its side. S draws the water
   surface on an outline picture.

6. Conservation of Liquid:
   Water is poured from one of two half-filled beakers
   into a tall glass or a flat dish. Which has more? why?

7. Conservation of Plastic in:
   T: Two equal balls S rolls his _____ into a
   sausage. who has more? In addition one ball is
   ______ flattened into a plate ans S is asked, if
   both were _______ dropped into the water beakers,
   what would happen to the _____ level of water?

8. Insect Problem:
   The tester draws an insect on top of a circle
   representing the edge of a jar. S is asked to draw
   what it would look like if it walked round the rim
   to the bottom.
9. Number Concept:
Cards are presented with the numbers 3, 2 and 5, what is the biggest numbers you could make with these? Also with the numbers 2, 4, 4, 9 & 3.

10. Conservation of Lengths:
Two equal-sized rode; does alteration of their relative position affect the length?

11. Dot Problem:
S is asked to make a dot in the same position on a sheet of paper as one drawn on the tester's sheet. Scored for left-right reversal, and for use of ruler _______ or other means of fixing the correct position.

12. Shadow:
S inserts the shadow on a drawing of a lamp and a man; scored for correctness of position, and length.

13. Conservation of Area:
Two fields (Green blotting paper), 2 cows and 12 horses (white blocks); houses are scattered ____ on one field, along the edge of the other. Which cow has more grass to eat, and why?

References
2. Ibid., p.13
3. Irene J. Athey et al (Ed.) : Educational Implications of Piaget's Theory. Xerox College Publish-
7. Ibid., pp 11-14.