CHAPTER NO 11

THEORETICAL BASIS FOR INTRA-CULTURAL STUDIES
Theoretical Basis for Intra-cultural studies.

This chapter discusses the theoretical framework which forms the basis for the development of instructional material to be used in the present study.

This chapter deals with Bruner’s theory of instrumental conceptualization which is the rationale for this research work. It also discusses Soman’s research work which is a guideline for the present study.

Thus this chapter discusses

2.1. - Theoretical Framework -

This part includes:

2.1.1. Research strategy and Research technique for intra-cultural studies.

2.1.2. Piaget’s theory of cognitive development.

2.1.3. Bruner’s theory of instrumental conceptualization.

2.2. - Review of related researches.

2.1. - Theoretical Framework:

The present study is an intra-cultural study between three sectors of Indian community viz urban, rural and adivasi, and tries to investigate the effects of three instructional materials on the achievements of the students in the above mentioned sub-cultural groups.
Intra-cultural study is in a way a microscopic inter-cultural study. Hence all the principles and rationale of cross-cultural research studies as given by Berry (1974) will be useful for the present study. They are elaborated in the following paragraphs —

2.1.1. Research strategy and Research Technique for intra-cultural studies.

2.1.1.1. Main goals of cross-cultural studies.

1. Comparative cognitive psychology attempts to understand the range, the variability and the differences in cognitive processes as a function of cultural (including ecological and social) variables.

2. It also attempts to understand the uniformities the pan-human or cross-cultural consistency in cognitive processes so that valid generalizations may be made about human cognitive functioning.

Psychology is the science mostly developed in the western culture. It is the outcome of intensive study of the minority less than one percent of the world’s population. Knowledge of the cognitive operations derived from the source must be tested in order to judge its applicability or generalizability to other populations. Most useful distinct aims given by Berry (1974) are as follows —
1) To transport the present hypotheses and laws of cognitive operations to other cultural settings (other than western cultures) to test their applicability and generalizability.

2) To explore the new cultural system and to discover cognitive variations & differences that are not explained within the western cultural context.

3) To compare our prior understanding with our newer knowledge within diverse cultures to generate more universal descriptions, hypothesis and laws of human cognitive functioning.

2.1.1.2. Basic Requirements -

1) Two behaviors to be compared should fall on a single dimension. There should be dimensional identity. Cognitive functioning across different cultures involves a common baseline inherent in the stimulus, in the organism and in their interaction. The origin of this baseline can be sought both in biologically based ‘physhc unity of mankind’ and the demonstration of cultural universals.

2) Number of entities of elements involved should be at least three. Thus at least three observations are necessary to test a hypothesized relationship. In order to achieve second and third goals, we should include many more observations which are truly representative of all known cultural variations in the comparative framework.
3) For behavior comparison we should take into account the three criteria of conceptual equivalence, functional equivalence and metric equivalence.

Intra-cultural study is just like cross cultural study. For cross-cultural research we take into account different countries where culture is completely different. But within the country cultures differ. There are so many factors that affect the culture. Thus we find different cultures of different people staying in the same country. More so in India because of the diversity in different factors such as religion, tradition, geography and ecology. For intra-cultural study we compare different subcultural groups of the people staying under one culture but under different circumstances. They differ in environment, geographical conditions, tradition so on and so forth. Hence the goals of this intra-cultural studies are the same as they are for cross-cultural studies. Hence the same strategy can be used for intra-cultural studies.

The strategy discussed above is also applicable for the present research work as it is intra-cultural comparison between the three different sub-cultural groups found all over the country.
Criteria for successful Implementation of the strategy -

There are qualitative differences in cognitive processes among different cultural groups:

Study of culture involves the discovery of native principles of classification and conceptualization and that the use of a prior definitions and conceptual models of cultural content to be avoided.

2.1.1.3. According to Berry (1974) three criteria for successful implementation of strategy.

They are -

1. Conceptual Equivalence
2. Functional Equivalence

2.1.1.3.1. Conceptual Equivalence

It refers to the comparison of the tools. It was proposed by Sears (1961). According to him the research instruments (concepts, tests and apparatus) should have similar meaning in both the cultures. This implies a thorough exploration of the most frequent associative meanings of a particular term.

In order to establish conceptual equivalence, it is necessary to discover that the content selected will be the same for field trials. In Maharashtra state, they have centralized syllabus in the schools. All the schools use same text-books in the same language. The topics selected for the research study has been included in the seventh class in all the schools. Even the methods
of teaching and evaluation will be the same for all the schools. Hence criterion of conceptual equivalence is duly satisfied.

2.1.1.3.2. Functional Equivalence

The aspects of cultures are comparable when they are related to functionally similar problems. Two institutions in the socio-cultural systems may be compared only when both the institutions are trying to cope with similar recurrent problems facing each cultural group. This involves the dimensional and goal similarity. So the dimensions and the goals should be similar with reference to the two institutions. This criteria refers to the basis of comparison which should be similar.

For this purpose psychic unity of the students coming from different areas was assumed. Mental functions, of the different students such as memory, imagination, reasoning; are assumed to be the same. All the schools in Maharashtra State follow the same routine. They have same type of time-table for the same pattern of classes. In this study same mode of teaching and test programmes will be followed in all the schools in three areas. Hence the criteria of functional equivalence will be satisfied.

Same teaching and testing programmes will be administered in these schools.
2.1.1.3.3. Metric Equivalence -

The final criterion is that of metric equivalence which refers to the results. To satisfy this criterion of metric equivalence ANOVA technique will be used for all the results from all the areas, using the same levels of significance. Hence this criterion of metric equivalence will be used for this study to bring about factorial validation.

Thus using these criteria the samples will be selected for intra-cultural comparison.

The Second Theoretical Base

2.1.2. Piaget's Theory of Cognitive Development:

This part of the chapter contains the following points -

1. Piaget's interaction model
2. Stages of development
3. Factors of cognitive development.

2.1.2.1. Piaget's Interaction model.

Piaget, as an interactionist, gives an interaction model. According to him the development of intelligence is the result of interaction between an individual's maturation and his social and physical environment. The interaction functions outwardly as adaptive coping and inwardly as organization. This adaptive interaction involves two complementary and interrelated processes of assimilation and accommodation.
Assimilation operates whenever the organism sees something new in terms of something familiar. Piaget (1957) speaks of assimilation as the action of the organism on surrounding objects in so far as this section depends on previous behavior involving the same or similar object.

Accommodation operates as the variations in environmental circumstances demand coping which modifies existing schemata. Thus in the course of duel adaptive process psychological structures are modified in the course of interaction with the environment and cognitive development takes place.

2.1.2.2. Stages of Cognitive development.

According to Piaget, three types of logical structures are progressively evolved in the cognitive development of the child. Each one characterises the attainment of a major stage of development. Accordingly he gives the following three stages of cognitive development:

I) The pre-operational or sensory motor stage.

II) The concrete operational stage.

III) The formal operational stage.
The present study is concerned with concrete operational and formal operational stages.

2.1.2.2.1 The pre-operational or sensory motor stage.

It lasts from birth until the child is about 2 years old. The only organization available at birth are sensory motor schemata, inborn instincts. These instinctive sensory motor schemata are generalized, coordinated with each other and differentiated to become elementary operations of intelligence.

During the higher stage, i.e. after about two years, symbols are constructed. The assimilation takes place whenever the child repeats the play activity. Accommodation is at work whenever he imitates the various activities of others. At this stage he starts using the language.

At the next stage, i.e. up to seven years, in the course of his manipulation and social communications, he extends, differentiates and combines his action images. At this stage his conclusions are still dominated by perceptions.

2.1.2.2.2 Concrete operational stage.

This period starts from seventh year and lasts up to eleven years. Operations are nothing but internalized responses. They grow out of a certain overt actions in exactly the same way as images grow out of imitations. Piaget conceives the three fundamental operations i.e. Classes, relations & numbers develop as
internalization of overt activities. Piaget calls these operations 'Concrete Operations'.

Thus children start thinking in concrete terms as related to the outward objects in the environment. The appearance of conservation concept at the age 7+ years according to Piaget is a landmark in the development of intelligence as it is the first logical group formed and which is the starting point of other logical operations to follow.

2.1.2.3. The stage of Formal operations.

The third stage of cognitive development begins on an average of about 11 or 12 years of age and is characterized by the development of formal abstract thought operations. In a rich cultural environment these operations come to form a stable system of thought structures at about 14 to 15 years of age.

The main characteristics of formal operation is that it leads to scientific thinking. The child can think in abstract terms without the presence of any concrete object. He can perform at this stage, 16 binary operations. He exhibits INRC group.

2.1.2.3. Factors of cognitive development:

Piaget has explained four causative factors that lead to cognitive development. They are, 1) heredity, 2) environment, 3) culture and 4) equilibrium.
2.1.2.3.1. Heredity:

Heredity factors are structural and are connected with the constitution of our nervous system and our sensory organs. These structural factors influence the building up of our most fundamental concepts. Effects of heredity are not modifiable and are not to be rectified totally.

2.1.2.3.2. Environment:

According to Piaget, factor of environment affects the course of cognitive development. By environment factor, we mean ecological factors which include geographical conditions, family surroundings etc. According to Piaget, logical operations and structures are formed due to these ecological and biological factors.

2.1.2.3.3. Culture:

Culture is a man made part of human environment. This includes not only the material conceptual features of human environment but also its features, belief, sciences, myths, religion and laws etc. Cultural influence affects the thought patterns creating profound differences in modes of thinking.
2.1.2.3.4. Equilibrium:

Piaget strongly advocates that besides these factors the factor of equilibrium must be taken into consideration and he makes this factor the central theme of his theory of cognitive development. This factor of the equilibrium dominates on the other three factors and establishes equilibrium between organism and environment.

Considering the above factors of Piaget's theory of cognitive development, some of his points were taken as the base of this study.

To select the age group the stages of operation given by Piaget were thought of. Hence age 11 which is the transitory phase of the development was selected. This is the stage when the child goes from concrete operational stage to formal operational stage. At this stage the changes are taking place. They start thinking in abstract terms. So it was decided to select this age group belonging to different areas for the comparison in their achievements.

Out of the four factors given by Piaget, Bruner selected culture and conducted researches regarding this factor in Mid-west of Africa. He has produced evidences regarding the cultural factor and it's role played in the cognitive development.
On the basis of the evidences of his researches, Bruner has developed his theory of Instrumental Conceptualism. Bruner’s theory is explained in the following paragraphs.

2.1.3. Bruner’s theory of Instrumental Conceptualism:

Bruner works on conservation concepts as proposed by Piaget, but he uses culture as a causative factor in the cognitive development of the individual.

His theory of Instrumental conceptualism is organized around two central tenets concerning the nature of knowing.

1. Man has ubiquitous tendency to categorise. This tendency is generic and leads to the development of the model of outward reality. Our knowledge of world is based on this outward reality. This model can only be tested partially and intermittently against the input. A large part of the structure of this cognitive model is quite remote from any direct test. It has an axiomatic base of our ideas of cause and effect of the continuity of space and time of invariances in experience and so on.

2. These models are evolved as the function of the uses to which they have been put by the culture for over a period of time and then by its members who use them for their own purposes.
Thus these models are first adopted by the culture and then are used by individuals - thus one cannot distinguish (except analytically) between cultural instrumentalism and individual instrumentalism.

Instrumental conceptualism holds that, what is known is constrained and determined by the characteristics of the organism from within i.e. biological heritage and by the characteristics of environment from without i.e. cultural heritage. Thus this theory acknowledges the existence of innate propensities which account for construction of the models of reality. The organism builds its reality on the basis of relatively less information and such building involves the modification of inherent capacities. The occasion for and the possible forms of modifications are both provided and limited by the environment.

The notion of representation is the center of his theory of cognitive development. The extent and the content of the developed reality is constrained inwardly by the objectives of representation and outwardly by the nature of the media of representation.

The organism encodes and stores the experience of the outer world in different ways, through actions, through images and through symbols or words. These ways determine the nature of representation. Thus there are three modes of representation: enactive mode - referring
to actions, ikonic mode referring to images and symbolic mode referring to words. According to Bruner each of the modes could be used in the service of the objectives of symbolic manipulation, image organization and motor action. These three modes are the landmarks of development. They have an invariant sequence of the development of the cognitive activities of child, enactive mode emerges first, then comes ikonic mode and symbolic mode is the last one to develop when the child starts to learns symbols and language. Each mode has its unique way of representing events. Each places a powerful impression on the mental life of human beings at different ages and their interplay persists as one of the major features of adult intellectual life. This developmental sequence of the three modes is constant across cultures.

When a child is trying to adopt to the cultural environment all the three modes of representation are developed. At the beginning the child tries to cope with the environment and meet its demand through actions (enactive mode) later on through images which are relatively free from actions (ikonic mode) and lastly through the words and language (symbolic mode). The emergence of the modes depends upon the active adoption of the organism, which in turn depends upon the demands put on organism by virtue of his living in that culture.
Thus the forms and the contents of the modes of individuals will be similar within the cultures and vary across the cultures. Cultural environment is given importance in instrumental conceptualism especially as regards to the determination of the nature of cognitive processes and structures. If the culture does not require in some sense the emergence of some forms of a mode of representation, especially in the case of symbolic mode these forms are not likely to develop. If the culture does not make available certain conceptual tools, they will not be required.

2.1.3.1. Development of Modes:

There are three main factors affecting the development of modes:

a) The first is the supply of amplifiers that a culture has in stock - images, skills, conceptions and the rest.

b) The second is the nature of life led by an individual and the demands placed on him.

c) The third is the extent to which the individual is required to explore the sources of concordance or disconcordance among his three modes of knowledge.

Our knowledge is limited as regards to the first two factors i.e. culture's intellectual amplification
skills and demands that are placed on the individual. Cultures vary with respect to the manner in which they transmit the skills, images and values to their members, but it is not clear how this transmission takes place.

There is a difference in set of cognitive demands made on members of a subsistence culture and on members of a technical culture dominated by market economy. In a highly technical society which is consisted of many institutions giving rise to complexity of demands, there is an urgent need for conformation between the three modes of knowing. In such societies much of the learning occurs outside the context, outside the range of events that are directly supportive in a perceptual way (ikonic mode) or indirectly available for pointing. Then language becomes the means of conveying the content of experience and action. Under such circumstances there is a need for developing correspondence between what we do, what we see and what we say. This correspondence is involved strikingly in reading and writing i.e. in "school learning".

The phenomenon of "growth errors" is precisely the first unsuccessful stage of trying to achieve correspondence between systems of representation. Here the child becomes more mistaken about same matter as he grows old before he finally comes to understand it.
2.1.3.2. Interaction of three modes:-

There are three basis in which two systems can relate to each other -

i) By matching

ii) By mismatching

iii) By independence of each other.

When the two systems match the organism goes on with its ordinary operations without problem solving. When the two systems mismatch, one or the other is suppressed or some sort of connection is made in the schema which coordinates the two. Problem situation which requires "handling" is created by mismatching. When the attempt is made to remove this mismatch and to establish equilibrium between the representations by two media schema is organized and modified. This leads to the development of different "devices" and "preparations" to deal with the mismatch and cognitive growth takes place. Thus a kind of equilibrium - disequilibrium mechanism in a novel form is the source of developmental propulsion.

According to Bruner, symbolic representation is the most powerful mode which integrates and reorganizes the two other systems. Independence between the two systems vanishes as soon as there develops an organization of experience that in some sense is capable of 'matching' the properties inherent in language. Thus language as a
symbol system is a crucial factor in organising the experience and integrating the experience achieved by other systems.

Use of language enables us to scale higher levels of cognitive development. Once we have coded the experience in language, we are able to read "surplus meanings" into the experience by pursuing the built-in implications of the rules of language. If one wants to guide action by language (symbolic representation), the success of effort will depend upon the extent to which the sphere of experience or action has been prepared to bring it into some conformance with the requirement of the language. In essence, if action itself could be organised first in the way that conformed the instruction to be followed the instruction could be effective.

The development of syntax of the language depends upon cultural amplifiers and on the study of written language. Hence, according to Bruner schooling is a crucial variable in cognitive development. The development of the cognitive growth depends upon language which in turn is dependent on schooling and culture at large.
2.1.3.3. Researches on Instrumental Conceptualism:

Bruner and his associates carried out a series of research studies in Senegal, the western most tip of former French Africa, America and Mexico. (Bruner, at al 1966)

These studies investigated two main areas of cognitive development.

i) Conservation in the classic Piagetian sense.

ii) Concept formation or equivalence.

The two areas complement each other nicely, for much of intellectual growth can be summarised as the development of equivalence or conservation, the equivalence rule of concepts being more 'internal' than that of a conservation more 'external' in orientation.

1. On conservation:

The experimental subjects were all Wolof children belonging to the dominant ethnic group. They were classified in nine groups, along two dimensions pertaining to cultural differences i.e. three degrees of urbanisation and education and to three age levels.
i) Neither schooling nor urban influence.

The cultural milieu of the first group, rural unschooled children and adults, had neither school or urban influence. The age groups were six and seven year old, 8 and 9 year old and 11 to 13 years old. The last group was of adults.

ii) The same traditional rural milieu plus schooling:

The second major group - Bush school children - attended the school in the same village or in nearby village. The group was classified among first graders, third graders and sixth graders, corresponding as closely as possible to the three age levels of unschooled groups.

iii) Schooling plus urban influence:

The third major group consisted of city school children. These children lived in Dakar, Senegal’s cosmopolitan capital and like the second group included first, third and sixth graders. The curricula were identical with those followed in Bush schools. All the children were asked questions in Wolof although French was the official language of instruction.

The traditional jar experiment on conservation of liquids was tried with Piagetian style. Perceptual 'screening' and 'pouring' techniques were manipulated to discover the line of thinking of the subjects.
Conclusions:

The following conclusions were found out:

1) There is more difference between unschooled Wolof children and schooled Wolof children from the same rural village than between rural and urban children. By the eleventh or twelfth year, virtually all the school children have achieved conservation. Only half of unschooled children have done so.

2) The school children moreover show the typical early reliance on perceptual cues in formulating their judgments and later decline in such judgments. Contrary to this unschooled children in the Bush showed gradual rise in perceptual reasons over the same age range. They were dominated by the perceptual cues only.

3) Screening the children from perceptible cues has a very little effect on children who have not yet started to fluctuate. It gave fluctuations a chance to practice. In general 'screening' has not accelerated the conservation in case of Wolof children but has done so in case of American children.

4) Unschooled Wolof children showed the tendency to explain the changed amount of water in terms of action - magic. It was different because the experimenter has poured it. When they poured themselves, it helped the unschooled children and not to the school children who were much less given to such reasoning.
5) In case of unschooled children action is crucial to their representation of the world. Even the symbolic representation is, for them, a sequential account of a train of actions. The African child exposed to western education rapidly becomes perceptualised, almost over-perceptualised. The inter position of the screen between him and the misleading beakers of liquid, do not free him to carry on symbolic equation of the liquid, but only tempts him to look behind the screen to see how it looks.

6) Greenfield thinks that conservation for its development depends on the presence of a sense of identity -- the idea of a potential return to an initial state, in this case, state of equality. The child should use this identity to integrate other cues provided by the situation. The American child does so through cross-classification. The identity schema enables him to think simultaneously of 'appearance of level' and 'reality of identical substance'. When the definition of equal quality shifts from the former to the latter conservation is achieved. Therefore American children using identity as a base for an equality judgment often say 'It is the same water' or 'It looks like more but really it is the same'. They consider identity as a present phenomena. On the other hand Wolof children cannot use the idea of identity to integrate conflicting cues relating to appearance and reality.
To him differentiation between them doesn't exist. Wolof child says "This one and this one (the two standard beakers) are (or were) "equal". Note that one of them is now empty. So his idea of identity is based on the past state, rather than a present one. This is identity by recapitulation. Conflict for Wolof children is between the initial and later appearance of water. The use of two standard beakers is a crucial one as it provides the most effective single type of perceptual cues with respect to conservation. It is the standard beaker which provides a link with the 'past' equality of the initial situation. Similarly 'action' experiments integrate the conflicting cues by providing conformity of action between the past and the present.

These experiments bring to our notice how different modes of thought can lead to the same results. We have seen that an identity schema is as crucial to conservation in Senegal as in the United States, but it can develop by different modes. American children use the language of identity (same) or the cross-classification of the situation according to appearance and reality to express identity and make the equality of the past, simultaneous with the present inequality of appearance. That is they employ primarily symbolic mode e.g. use of word 'the same', contrary to this the Wolof children achieve conservation by
establishing identity between the successive states of past and present. Their cues might be either the continuity of action from one part of the experiment to another (enactive mode) or the constant appearance of the standard beaker (ikonlic mode). Thus the degree of urbanisation and the schooling have the effects on the cognitive thinking of the child. This research study proves, how the individual is living in more advanced society e.g. American develop the more elaborate technique of attacking the problems because they have more matured mode of representation i.e. symbolic mode, at their service. They are able to construct more valid models of reality.

Bruner at al (1966) has summarised the results as follows:

1. From the result of the experiments in Senegal and Mexico, Bruner concludes that differences between rural and urban children can be described as the differences between abstractness and concreteness. It arises due to differential exposure to problem solving and communication in the situations that are not supported by context as in the case with, for example, most reading and writing, the use of monetary exchange and schooling. Rural life seems to be less
helpful for the development of abstraction. These differences are extended in case of schooled and unschooled children. Thus, schooling is the crucial variable in the promotion of abstraction.

The language helps to analyses and synthesize the expression in meaningful whole which helps the individual to communicate and express the ideas freely.

School places the iconic and enactive modes of representation in confrontation with symbolic mode which organizes and integrates them, thus leading to cognitive growth. Modern technical societies with their explosion of knowledge put more cognitive demands on their individuals, thus developing in them the most sophisticated techniques of symbolic representation, while traditional non-technical simpler societies demand only the perfection of simpler forms of representation.

Now qualitative approaches have been discussed in this chapter. Different factors of cognitive development as proposed by Piaget and Bruner are discussed here. These are the approaches of developmental psychologists.

2.1.4. The same problem has been approached by psychometricians like Vernon, Gilford etc. They have used factorial analysis for this purpose. On the basis of the results of the different tests they have found
different factors responsible for cognitive development. Especially research work done by Vernon in cross-cultural context are relevant for this study.

Vernon has explored different individual, social and environmental factors that fell upon the cognitive development of the children of different countries. Following are the factors which enhance the cognitive growth of the children:

(1) Reasonable satisfaction of biological and social needs including exercise and curiosity.
(2) Perceptual and kinaesthetic experiences, varied stimulation, encouragement of exploration, experiment and play.
(3) Linguistic stimulation encouraging 'formal' code and clarity of concepts.
(4) 'Demanding' but 'democratic' family climate emphasizing internal controls, responsibility and interest in education.
(5) Conceptual stimulation by varied environment, books, T.V., 'travel etc.
(6) Absence of magical beliefs, tolerance of non-conformity in home and community.
(7) Reinforcement of linguistic stimulation, family climate by school and peer group.
(8) Regular and prolonged schooling and also demanding democratic, emphasizing discovery rather than rote learning only.
19) Appropriate methods to overcome language problems.
20) Positive self-concepts with realistic vocational aspiration.
21) Broad and deep cultural and other leisure interests.

These factors are reflected in different degrees differentially in the students coming from among the different sub-cultural groups included in this study. Hence these factors can be correlated to differentiate the achievements of the three different groups while interpreting the data gathered in this study.

2.2. Review of related Researches:

There are a few studies in which an attempt to formulate the instructional objectives in Piagetian terms for the cause of instruction has been made and they relate to concrete operational stage.

2.2.1. Hopkins (1971) made an exploration of transitivities formulated from a set of Piagetian derived operations and their implications in transversing learning hierarchies while Sawada (1971) made an assessment of a selected set of Piagetian derived operations for the generation of effective learning hierarchies.

Sawada (1971) was primarily concerned with the construction of a Piagetian model for building systems of objectives that explicitly provide for both intra and inter cluster transfer, the basic constructs of the model being operational reversibility and composition.
Sawada distinguishes between intra-cluster and inter-cluster transfer as follows:

1) Inter-cluster transfer refers to the problem of transversing a Gagne type of learning hierarchy, i.e., problem of transfer between two related clusters of knowledge. While intra-cluster transfer refers to the level of mastery of a given cluster in the hierarchy.

2) Intra-cluster transfer relates to the multiple embodiment of the problem in concept formation, whereas inter-cluster transfer relates to the use of multiple embodiment in extending students' understanding to new but of course related concepts.

3) Inter-cluster transfer can be thought of in Piagetian terms as conservation over Bruner's model of representation matrix: if the student has really mastered a cluster, he should be able to answer test questions regardless of the modes of representation (multiple embodiment) used and then could be said to have achieved conservation (transfer) over the matrix. Inter cluster transfer would correspond to the composition of mental operations.

All the three points referred to above can be given theoretical significance by approaching the two problems of transfer from the vantage point of Piaget and Gagne.
Basic Hypotheses:

When the curriculum (set of instructional objectives) is organised to correspond in basic ways to the structure of the learner's intelligence, then the learner will be more able to cope with the curriculum than with a curriculum not so organised. The approach consisted of:

a) Specifying the structure of intelligence.

b) Identifying a correspondence between intelligence and curriculum.

c) Specifying an isomorphic structure for curriculum.

These three points were extended by viewing both intelligence and curriculum as mathematical systems.

a) Intelligence as a mathematical Concept:

For the sake of specificity and manageability the concrete operational stage was chosen as a focus. Piaget characterises this stage of intelligence by mathematical system called groupings. This consists of reversibility, associativity, identity and special identity.

Sawada used groupings, both of composition and reversibility. Piaget gives more importance to reversibility and hence this was given in the study.
b) Curriculum as a mathematical system:

The elements of curriculum are taken as instrumental objectives as proposed by Gagne (1967).

Objectives are considered as mathematical functions. "Curriculum system" is called as a "system of objectives".

Definition:

The 'System of objective' consisted of a set of objectives and a binary composition denoted by (.), which satisfy the axioms which expressed the properties of the different logical groupings of the concrete operational stage i.e., composition and reversibility. Thus, isomorphism between the structure of intelligence (operations of compositions and reversibility) and structure of curriculum was established by these axioms.

This system was applied to the system of instructional objectives pertaining to the unit of content. The unit of content was a concept of equivalent fractions. With these objectives as a frame of reference four research questions were probed.

Hypotheses were stated as follows:

1) Reversibility: Before being exposed to instruction, do children do as well on an objective as they do on its inverse?

11) After being exposed to instruction do children do as well on an objective as they do on inverse?
iii) Having achieved an objective as a result of instruction do children achieve the inverse objective without further instruction. That is do they get the inverse free of charge?

2) Composition

Do instructional episodes, found to be inadequate, in prior research by Klein cited by Heimer (1973) become adequate simply because the set of objective has been systematized?

To provide data for the above questions instructional episodes were written for all above objectives care being taken to maintain basic structural similarity with the instructional models followed by Klein. This basic similarity was necessary in order to test the hypothesis relating to composition.

A random sample of 30 of grade five children was selected from a master sample of students, Screened by a selection test. Students' objectives provided the data for testing the hypothesis.

Conclusion:

Tests of hypotheses showed that students understanding was not characterized by reversibility or composition either before or after exposure to the
instructional episodes. Thus, most if not all students, were not aware of the fact that the objectives formed a system and as such, attempted to master each objective as an isolated task without recognizing that each objective was an integral part of a larger reversible system characterized by composition. In short, the student did not on his own pick up the strategy of thinking of tasks in terms of reversibility or of composition. Sawada assigns this non-support for the hypotheses to the fact that reversibility and composition were not explicitly attended to in the instructional episodes presented by C.I Systems.

The researches of Hopkins and Sawada tried to combine the development approach of Piaget and learning approach of Gagne to enhance the effectiveness of learning processes.

Same approach is adopted by Suman to prepare instructional sequence of learning material.
Sawda (1971) used M.R.Matrix for evaluation purposes. Mode of Representation Matrix. He has given stimulus in one mode and expected responses in that or another mode. The following table explains the technique.

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Notation - ES-ER. In this case stimulus is in enactive mode (ES) and response is in enactive mode (ER).

Soman's work on cross-cultural study is an important guideline for this research work. He has conducted his research work for his doctorate in education in U.K. (1979)
Title – A cross-cultural study investigating the relative effects of using Piagetian based objectives and an advanced organizer with structured learning material on the acquisition of scientific concepts by Adolescents in Britain and India.

Main objectives of the study are as follows:

1) How are we to study nature of cultural differences with regard to acquisition of scientific concepts?

2) How could we offset the effects of cultural differences on the acquisition of scientific concepts?

In this research it was attempted to formulate a strategy for cross cultural research. The basic strategy used, to study the nature of cultural influences on the acquisition of the scientific concept, was to prepare programmed learning material on Boyle's Law viz., Programmes "G", "A" and "P" based on the different models of learning viz. of those of Gagne, Ausubel and Piaget, and to administer it to the different cultural groups (rural Indian, Urban Indian and British) and to compare the difference in their achievements as revealed by their performances on Post-tests.
Hypotheses:

1) With respect to methods -

The methods P and A will be significantly more effective than the method G. There will be no real differences between the effects of the two methods P and A.

2) With respect to groups under study -

Performance of the British group on Test 1 and Test 2 will be significantly better than that of Urban Indian or Rural Indian groups. Out of the Indian groups, Urban Indian group will perform better on the Test 1 and Test 2 than rural Indian group. Again the differences in the performances of these groups will be reflected to a larger extent in groups taking method G rather than in the groups taking either method P or method A. As methods "P" and "A" are expected to offset the effects of cultural differences on the acquisition of scientific concepts. There would be less significant differences in the achievements of different cultural groups (British, rural Indian and Urban Indian) taking these methods.

Experimental method was used to prove the above hypotheses. The randomized subject factorial design 3 x 3 was used. Three types of cultural groups, with carefully designed instructional methods used for a short period of time were involved in this design.
Three programmes G, A, P were prepared.

Programme G - The learning hierarchy according to Gagne's lines was prepared, objectives were formulated and then the programme was developed. It was divided into three parts 1, 2, and 3 respectively.

Programme A - Here the advance organizer was developed and employed along with Gagnes' learning hierarchy. Kinetic theory of the gases was used as an advance organizer and was used along the programme G. The material on advance organizer contained nearly one and a half page.

Programme P - It was based on Piaget's formulation. The model of INRC group was employed to structure the substantive content of the Boyle's law. A learning hierarchy on Gagne's lines was constructed and the instructional objectives were formulated.

Interaction of three modes of representation was used in the procedure of constructing different hierarchies.

Levels / Subjects

The population was defined as adolescents of age group between 14+ and 16 learning in schools in India and Great Britain areas around about Pune and Birmingham were selected as typically representative of
the population in India and U.K., respectively. Both the cities with the population over one million are industrial centers and educational nuclei having progressive universities, all types of college, schools. Student population in both the cases reflects all the strata of the respective societies—social, cultural, economic, ethical, etc. Random sampling procedures were used to form samples. To represent rural Indian population two villages viz: Narayangaon and Khed near 50 miles away from Poona were taken into consideration. These areas are mainly agricultural which has its reflection in the school environment.

Nearly 400 students of 14 to 16 age were given pre-test and 105 out of them were selected for the further experiment. They were divided in three subgroups and were assigned again randomly to three experimental design. He has used interaction of modes for the development of his programme. Self-instructional method based on a sort of Skinnerian self learning programme was used.

At the end of the trials, allowing for drop-outs due to sickness, absence etc., each group consisted of 30 students each. The data for the immediate as well as delayed post test were assembled. For designing his post test, Goman has used M R Matrix as proposed by Sawada. He has administered immediate post test for evaluation and delayed post test for retention.
Same procedure was followed in Pune city and Great Britain.

ANOVA technique in order to judge the significance between the differences between the different groups was used.

Conclusion:

In the light of the results of the experiment the following conclusions were drawn.

There are significant differences between the effects of the three methods ‘G’ ‘A’ and ‘P’ respectively. The superiority of methods ‘A’ and ‘P’ over that of method ‘G’ is established. Use of advance organizer and Piaget’s formulation in sequencing and ordering instructional material proved to be effective.

There are differences among the adolescents belonging to the different cultural milieu in their capacity to acquire scientific concepts, but these differences could be offset to a considerable extent by adopting methods using advance organizers and Piaget’s formulation.

The systematic use of the interaction of modes while developing the instructional materials may prove to be a very fruitful strategy leading to more efficient learning.
2.2.4. Repercussion on the present study:

This study, though has used Soman's research work as a guideline, it differs from his work in the following manner:

2.2.4.1. Soman's research work is a cross-cultural comparison held between English and Indian students. While this research is an intra-cultural study held in three different areas in Maharashtra viz; Urban, Rural and Adivasi.

2.2.4.2. Soman has worked on the higher level of the formal operational stage i.e. age 15+.

Whereas this study deals with the children of age 11+, who belong to the beginning of formal operational stage (they are in between i.e. the border of concrete operational and formal operational stage).

2.2.4.3. Soman dealt with the achievements in science whereas this study concentrates on the achievements in mathematical concepts.

2.2.4.4. Soman has prepared programme based on self instructional method by doing away with the teacher.

This study has used classroom teaching method and the research worker herself has conducted all the field trials to eliminate error variance due to teacher variable.
2.2.4.5. Soman has used interaction of three modes for the development of programme.

While in this study instead of interaction of modes each programme in each mode was prepared separately using that mode.

2.2.4.6. Sawada and Soman use M R Matrix for evaluation purposes.

The same M R Matrix is used for evaluation purpose in the present study.

In the present study emphasis being on inter-mode comparisons every programme was developed in each mode separately. The tests consisted on three mode questions having equal weightages.