CHAPTER II

THEORETICAL FOUNDATIONS OF THE STUDY

2.10 Introduction

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2.10 **INTRODUCTION:**

Systematic review of the existing relevant literature on the topic under study identifies the gaps on one hand, while it prepares a solid base on the other hand. Theoretical foundation of the study, thus, has a diagnostic value and preparatory operations.

Theoretical base of the present study has been presented here under the captions of (i) models in concept formation, and (ii) review of relevant literature on concept formation. As a matter of fact, conceptual learning includes such topics as concept, concept formation, concept attainment, concept identification, concept learning, etc.; however, the review of relevant literature and discussion of mediational models which constitute the core of any cognitive process from which the cognitive products emerge, have been presented here with 'Concept Formation' as a central point of discussion.

2.20 **S-R MODELS OF CONCEPT FORMATION:**

Woodworth (1938) has postulated two theories for explaining the processes involved in concept
formation. They are (i) 'Composite photograph' and (ii) 'Hypothesis theory'.

The composite photograph theory reveals that "the features common to a class of objects summate their impressions on the observer, who thus, gradually acquires a picture in which the common features stand out strongly while the variable characteristics are washed out" (Woodworth, 1938, 801). Heidbreder's (1924) "Spectator behaviour" model also belongs to this category. This theory assigns a passive role to the learner. The 'hypothesis theory' of Woodworth (1938) has been equated with the 'participant behaviour theory' of Heidbreder (1924) which assigns a more active role to the subject. Consequently, under the second condition, the cognitive process of hypothesis formulating and testing operates quickly.

The 'Stimulus Trace and Generalization' models as associated with Gibson (1940), Baum (1954) and Buss (1953) superseded the concept formation models of Heidbreder (1924) and Woodworth (1938). The former investigators explained concept learning in the paired associate list of words by the principles of the gradient of stimulus generalization. This gradient is assumed to arise from an underlying continuum of stimulus similarity. Buss (1953) demonstrated that 'the more stimuli of one kind presented in the learning series, the greater the case of
concept formation. On the strength of their analysis of errors in concept learning, Oseas and Underwood (1952) were able to establish "a gradient of stimulus generalization along a size dimension; concepts based on large and small forms were more rapidly attained than those based on medium forms". However, it is evident from the results derived from stimulus generalization model which stems from S-R paradigm that these models have failed to explain the phenomenon of concept acquisition in complex problems involving multi-dimensions and multi-dimensional values.

Perhaps, cognitive process could be better explained by S-O-R model which intervenes 'mediating processes'.

2.30 MEDIATIONAL PROCESS MODELS IN CONCEPT FORMATION:

Concept formation is a cognitive process which could be meaningfully explained and vividly presented by employing S-O-R (Woodworth, 1954) paradigm of behavioural study. The mediational operations as processed in the form of intervening variables between S and R in the S-O-R paradigm may constitute the core of concept formation abilities. Any behavioural product as a consequence of concept formation process, therefore, passes through mediating process. A brief discussion of such mediating process model may explain to a certain extent the nature of the mental operation which results into the formation and acquisition of concepts.
2.31 Hull's formulation of Processes Intervening S-R:

For Watson (1910), S-O-R formula was a kind of relationship between the organism and environment while Hull (1920) accepted S-O-R on the grounds that S-O-R formulation of organismic-environmental relationship was inadequate to account for learning and thinking. Rather, Hull explained his hypothetico-deductive postulation in terms of intervening variables by employing S-C-R formula. He held that intervening variables are essentially C factor or the unobservable entities employed to account for observable behaviour. He observed that the antecedent conditions can be manipulated as independent variables (C) to observe their effects on behaviour (R) which he expressed as under: A-f-(C)-f-R.

Hull (1951) amended his reinforcement principles and provided an rG-SG mechanism by classifying the molar behaviour. It is the fractional anticipatory goal response (rG) which produces proprioceptive stimuli (SG) that tend to elicit the correct response segments leading to problem situation through mediating process. Thus, meditational process functions as a catalyzing process for explaining complex thinking process.

2.32 Guthrie's View of Movement Produced Stimuli:

Guthrie (1932) advocated the theory of contingency in learning and argued that learning is a conse-
body movement that refers to specific patterns of action, such as salivary secretion, foreleg flexion and the like. He distinguished movement from act, and said that act is a movement or a series of movements which bring effects on the end results. Guthrie emphasized the significance of the proprioceptive stimulation in skill learning, and agreed that the learner carries over the proprioceptive ones from one learning situation to another because of positive transfer when previously learned proprioceptive responses are applicable in new learning situation. It is, thus, inferred that mediational theory is an extension of Hull's formulation while Guthrie's theory is an effort in the evaluation of mediational formulation. (Ramji Shrivastava, 1980, p. 6)

2.33 Tolman's sign gestalt expectation:

Tolman (1932) conceptualized that behaviour is molar rather than molecular. The gestalt interpretation of molar behaviour involves cognitive process which is best explained by mediational model. Tolman's system dealt with docile behaviour as purposive and cognitive which is determined by the sign gestalt expectation. Tolman provided the independent modification of the cognitive (mediational) processes and performance (instrumental) processes. The docile behaviour represented the problem of hierarchy of
demands which are selectively called forth by mediators. Thus, the mediational process, according to Tolman, emerges from sign gestalt expectations. Tolman believed that behaviour is a function of the situation and other antecedent causes \( B = f(S, A) \) and explained it in terms of intervening variables which function in between the independent and dependent variables. Behaviour as the dependent variable is partly the consequence of intervening variables where means and deadliness as two of its component play crucial role.

2.34 Osgood's Mediation Model:

Osgood (1953) identified the limitations inherent in the 'interaction principle' of Hull (1952) and consequently, replaced the mediational model by principle of 'generalization'. He argued that 'as the habit strength at the point of original conditioning becomes stronger with successive reinforcements, generalization spreads more broadly until the habit strength of the antedating compound in association with these reactions rises above the threshold. Since by nature of things, this antedating pattern must occur prior to the original pattern on each trial, anticipatory reaction will disappear". Osgood also questioned Hull's reduction principle and pure stimulus mechanism. Rather, Osgood developed his mediational hypothesis on the base of 'pure stimulus mechanism' which Hull half cooked.
Osgood's (1953) mediational model emerges directly from Hull's (1952) principle of 'pure stimulus mechanism'. Guthrie (1952) as well as Tolman (1932) also employed the same conception for explaining their mediational processes respectively in terms of 'movement produced stimuli' and 'sign-significant expectations'. Osgood, thus, reconciled the theoretical events in conditioning and selective learning, as well as the theories of both Tolman and Hull, by employing Hull's suggestion about symbolism and tried to reveal the representational character of the mediational process that incorporates the theory of sign behaviour. It is evident that Osgood's representational mediational model is based upon Hull's 'fractional goal response'. Osgood based his representational mediational process on sign-stimulus which is self-stimulating in nature, capable of developing mediating reactions. The mediating reaction ($r_m$) produces a distinctive pattern of self stimulation ($S_m$) which can elicit a variety of overt behaviours. A sort of communication relation develops between stimulus mediation and reaction mediation.

$$ S \xrightarrow{\text{mediation}} R_t $$

$$ (3) \quad \longrightarrow r_m \quad \longrightarrow S_m \quad \longrightarrow x $$
2.35 Mowrer's Representational Mediation Model:

Mowrer (1954, 1960b) also developed a representational mediating response theory which has been conceptualized on the principle of 'Semantic generalization'. According to Mowrer, a communicative act involves a process whereby a part of the reaction, produced by one person, thing or event gets transferred to or 'rubbed off on' some other person, thing or event. "Signs are the devices for transferring some of the 'reaction potential' (meaning) of one thing to another thing". (McLaughlin, 1971, 93).

2.36 Hebb's Mediating Process:

Hebb (1953) investigated his neurological model explaining the mediating process known from behaviour to brain function and argued that learning process is facilitated by the cell assemblies. He stated that cell assembly and mediating processes are the two names for the same thing. However, he specified the difference by saying that the idea of cell assembly is a hypothesis concurring the way in which mediating process would function.

2.37 Kendler and Kendler's Mediational Process:

Kendler and Kendler (1962) opened the real nature of mediational formulation. They (1962, p.6) said "some mediating events can be conceivably, and probably will be coordinated to introspective reports,
language behaviour and other observable events”. They further remarked "... the mediating link is conceived of as a perceptual or verbal response, often covert, to the relevant dimension which produces cues that determine the overt response". (Kendler, Kendler and Learnerd, 1962, p.572). According to them, meditational theory assumes that "the external stimulus evokes an implicit response which produces an implicit cue that is connected to the overt response". The inadequacy of such a meditational theory has been criticized by Hunt (1962, p.94) who pointed out that, "Unrestricted introduction of a mediating response into an S-R chain leaves the theorist in the uncomfortable position of being able to explain everything while predicting nothing".

2.40 INFORMATION PROCESSING MODELS IN CONCEPT FORMATION:

From the theoretical discussions on S-R and meditational models, it is evident that learning of simpler kinds of concepts, like those involved in reversal and non-reversal shift experiments (Kendler, 1960) could be adequately accounted for by the meditational theories, but more complex concept learning remains to be one of faith rather than belief. Such an inference gets support from the findings of Shepherd, Hovland and Jenkins (1961). They held the view that S-R and meditational theories did not provide
for sufficient abstraction, stimulus internalization and coding in the internal representation of stimuli. Perhaps, under the existing condition, the theoretical conceptualization of Newell et al. (1958) and Miller, Galanter and Priore (1960) may be considered more promising. They considered the human brain as a complex information processing computer. A programme in these high speed electronic computers is rather a specification of what the organization will do under varying environmental circumstances in terms of certain elementary information processes, it is capable of performing (Newell, et al., 1958, 153).

However, no computer model can match the complex human brain which generates too complex mental outputs to be analysed accurately and adequately.

Bruner (1957) introduced information processing approach to Cognition. He believed that learning or knowing is the same at all levels. He found learning theories to be inadequate to explain the psychological processes involved in cognitive activities. Harper, et al. (1964, 223) summarised his theoretical conceptualizations concerning cognition as under:

"The emphasis, here, is on stimulus in-puts which are better regarded as information, and the structuring of information into definite forms or models...Central to such higher-level processes as perceiving, knowing, thinking, learning, and problem-solving is the development of a symbolic model, structure, system of categories, or generic coding system, which represents environmental information in an economical manner, and which can be used, not only to order information but also to transform it in such a manner that new information is generated". (Harper, et al., 1964, 223).
Mediation process is, thus, considered to be a link operated by the human subject between the input system (independent variables) interacting with the organism in a specific environmental situation or conditions, and the output system (dependent variable). This intervening variable functions in accordance with the psychological potentiality, awareness, motivational forces and action tendencies of the learner. Consequently, the cognitive processing is too complex to be analyzed and predicted accurately. No mediating model is completely satisfactory in its prediction and judgment of behavioural outcome.

Kendler and Kendler (1962) have provided two points about meditational hypothesis that have created confusion. They are:

(i) The meditational hypothesis is neither new nor revolutionary, though Feyer (1911), Watson (1913), Hull (1930), Guthrie (1959) have nourished the concept of mediating process in their own ways.

(ii) The implicit stimulus and response events need not be conceived as having an existence independent of their relation to independent and dependent variables.

Despite these limitations as visualized by Kendler and Kendler (1962), meditational hypothesis
has its unique significance in all process-oriented learning and thinking research problems.

2.50 REVIEW OF RELEVANT LITERATURE ON CONCEPT FORMATION:

Literature on 'conceptual learning' adopted from American Psychological Abstract (1965-1981) and Annual Review of Psychology (1961, 1975) include such topics as 'concept learning', concept attainment, concept identification, concept formation, concept acquisition, etc., and rich literature on varied aspects of conceptual learning is available. All these terms are overlapping; however, fine shades of differences exist between them from the points of view of aims, conduct of experiment, design, technique, task and treatment. The present study has been primarily focussed on 'concept formation' process which we assume different from other categories of 'Conceptual learning' as explained in Chapter 1. An attempt has, therefore, been made in this chapter to review the available relevant literature on 'Concept Formation' alone.

(i) Methods employed to study concept formation:

The pioneer study of Hull (1920) on concept formation was patterned after the paired associate method in memory. Chinese characters were paired with nonsense names and a learned to respond by the
assigned name to each character. He inferred from this study that the appropriate label was learned to each class of stimuli on the basis of common elements embedded in them, although in many cases the learners were not able to verbalize the reason for assigning an object to a category.

Mose (1932) employed a frequency method of reaching an adequate concept involved the process of formulation, testing and rejection of the hypothesis. He experimented upon the 'relational concept' among the members of a certain class of objects. Heidbreder (1948) extended the work on the belief that concepts involving abstract objects are more readily learned than concepts involving abstract relationships of form and number. She, further, demonstrated that in the method of 'spectator behaviour', there existed no hypothesis because of a passive, receptive frame of mind of the learner, and the solution emerged spontaneously whereas in 'participant behaviour' there occurred the formulation and testing of hypotheses one at a time because of conscious attitude of the learner.

English (1922), Stevovich (1927) and Chant (1933) employed introspective method, and demonstrated that the learners used mainly two methods in concept formation process: (1) a global approach which consists in the assimilation of the new object to some
familiar object, and (ii) an analytic approach which consists in breaking up of the new objects into parts which are familiar. Relatively, the latter approach was found more efficient and dependable than the former. <br> DRUNER, ET AL. (1956) have employed the analytical deductive and global hypothesis methods in their studies on 'strategies in concept attainment'.

(ii) Stimulus Factors in Concept Formation Studies:

Kendler T. L. (1962) has summarized the studies conducted on concept formation experiments with respect to stimulus factors under the following heads:

(a) Simplicity-Complexity;
(b) Effect of training; and
(c) Stimulus element Vs. relationship.

Some of the significant studies on each of these stimulus factors have been presented as under:

(a) Simplicity-Complexity:

Simplicity of the concept is considered as one of the essential attributes in the study of concept formation. KENDLER (1962) mentions two techniques of measuring simplicity of stimulus: (i) to record the difficulty of a concept through the response made to it, e.g. by measuring the ease with which it is acquired, and (ii) to measure it directly, independently of the response. This method is more valid
for the assessment of quantitative differences and helps to the establishment of functional relations between measurable aspects of the stimulus and the conceptual behaviour.

Feldprecder, J. (1945, 1946-a, 1946-b, 1949), Grant, D. and Curren, J.R. (1953), and Grant, D.A., Jones, B.L. and Tallant, B. (1949) employed the former technique to compare qualitative differences like abstract and concrete forms, colour and number.

ohlwill (1957) demonstrated experimentally that the 'dominance hierarchy of concepts' varied with different procedures. He differentiated between 'abstraction' as a selective response to a given aspect of the stimulus, and 'conceptualization' as a process of mediated generalization. Kendler (1952, p. 413) has inferred that 'colour and number are more easily abstracted than form, but that form and number are more easily conceptualized than colour'.

Hovland (1952), Bourne, A. and Brown (1955), Bourne (1957), Bourne and Pendleton (1958), Gelfland (1958), Bruner, Wallach and Galanter (1959), and Solley and Messick (1957) applied the latter technique to the assessment of quantitative differences and tried to establish relationship between measurable aspect of the stimulus and conceptual behaviour.

Bourne and Brown (1955) employed information theory
to assess the complexity of stimulus, and found that complexity was proportional to the amount of irrelevant information. They observed relationship more linear than accelerated. Solley and Hessick (1957) reported that the probability of occurrence of a conceptual verbal response was proportional to the number of times the 'referent' of the concept occurred.

Bourne and Westle (1959) offered a theory which incorporated the additivity of stimulus complexity, along with the stimulus redundancy. Bourne and Haygood (1959) observed that increases in redundant relevant information improve concept formation, and that the amount of improvement increases with complexity. They further, reported that redundancy of irrelevant information interferes with performance; however, its effect was found less inhibitory than nonredundant irrelevant information.

Hunt and Kowland (1960) conducted researches on the three types of concepts as classified by Bruner, et al. (1956). They found that conjunctive and relational solutions were found more frequent in deriving a concept than disjunctive ones.

(b) Effect of Training on Concept Formation:

Numerous researches have been conducted on the effect of training in concept formation ability.
It has been hypothesized whether training imparted on a wide variety of instances of the concept is more effective than intensively on a few. Hull (1920) has reported that moderate familiarity with each member of the series from which the concept has been drawn, is more efficient than twice as thorough familiarity with half as many cases. However, Levine, Levinson and Harlow (1959) and Levine and Harlow (1959) did not observe any difference when total number of trials were kept constant and varied the number of trials per problem. On the strength of existing researches, Kendler (1961, 454) inferred that "within the limits tested, it does not matter, whether the number of instances is relatively wide or relatively narrow, or whether there are few or more trials per problem; only the over-all number of trials is important. However, Adam (1954) has expressed somewhat contradictory views. He found that intensive single-problem training produced more transfer than a less intensive multiple training procedure, whereas Gallantine and Warren (1955) observed that the greater the number of training problems, the greater the transfer.

Morrisett and Hovland (1959) studied the impact of training on learning and reported that amount of learning determines the amount of transfer since learning within the problem depends upon the mastery achieved within any one problem. They also pointed out that generalization between the problems
as the second factor of concept acquisition, is strengthened by an increase in the number of problems. It is, thus, inferred that learning within the problem and generalization between the problems which affect training of transfer in concept formation, produce the most efficient learning to learn (Kendler, 1960, 454).

(c) *stimulus element vs relationship*

The studies on concept formation with respect to age has been undertaken by Gonzalez and Ross (1958) who reported that children between the ages of three and five years can acquire the concept of middle size when tested with an intermediate set equidistant from the two training sets, despite their inability to verbalize the basis of solution. On the other hand, Brown, Overall and Gentry (1959) found that "Monkeys which were trained and then transposed on the middle size problem, could learn both relationship and absolute stimulus values; however, the tendency to respond on the basis of absolute values is the stronger tendency, and the relational property is employed as a basis only when differential absolute values are lacking".

On the strength of a comparative study conducted on the formation of auditory concepts based on a recurrent identical auditory stimulus element with concepts based on a recurrent relationship, Hoyer (1959)
did not record any significant difference between these two stimulus conditions. May (1958) observed positive transfer in learning to solve problems composed of a series of digits by one pattern to another pattern which he interpreted in terms of occurrence of stimulus generalization among meaningful stimulus patterns.

From these studies, it is evident that concepts dependent on relationship can be acquired by monkeys and children as well as by adults (Kendler, 1951, 455).

(iii) Intellectual and Motivational Factors in Concept Formation:

Kendler (1951, 455) remarks, "there are relatively few studies of the effect of motivation on concept learning. This is understandable since more concept formation studies deal with human subjects whose drive level cannot be easily manipulated".

Rednick (1957) recorded that extreme manifest anxiety scores (high drive) was positively related to the magnitude of mediated generalization responsivity. Rommow (1958) conducted two experiments. In the first study, three groups of Ss differed in their level of manifest anxiety, while in the second, they were given differential instructions, in order to include three different degrees of ego-involvement. Concept formation tasks were given to all Ss in which the associa-
tive strengths of the correct response and of competing tendencies were varied. He generalized that drive operated on mediating responses in the same way as on overt responses. Rao (1971) studied the strategy in concept learning as a function of general mental ability, attitude and ego strength and found that 'Performance in concept learning was significantly related to individual differences in intelligence, attitude toward problem-solving and ego-strength. He, further observed that kinds of strategy adopted while attempting to solve the relational problem were related to intellectual ability. In the inference problems, the wholist pattern of strategy was associated with high levels of intelligence and ego-strength; and the partlist pattern of strategy with 'low' levels of these variables.

Green (1955) employed an operant stimulus discrimination procedure to evaluate whether the extent of concept formation was inversely related to the ratio of responses to reinforcement. Bourne and Pendleton (1958) recorded an inverse linear relationship between errors and feed-back probability on a four choice concept identification task. Rhine and Silun (1958) confirmed the positive relationship between consistency of reinforcement and efficiency of concept formation. They, further, observed that resistance to change was least for continuous reinforcement condi-
tions. Contrary to this experimental design involving variations in reinforcement schedules, Gormezano and Grant (1958) tested the effect of intermittent reinforcement on the irrelevant concept and found that "the difficulty of learning the relevant concept increases with the degree of reinforcement of the irrelevant concept".

Bensberg (1958) observed that preliminary training, on a given dimension of concept formation, yielded positive transfer when the shifts were shifted to new and different stimuli within the same dimension. Such a result has been confirmed by Kendler and L'Amato (1955) even when the shift involves a reversal of previously reinforced responses. From these results, it is evident that the relevant mediating response has become functionally dominant.

Hovland and Weiss (1953) observed that more Ss attain the correct concept when the amount of information was transmitted by all positive instances than by all negative instances. They, further, recorded that simultaneous display of negative instances was more effective in concept attainment than successive presentation. Cahill and Hovland (1960) have confirmed this result.

(iv) Response Factors in Concept Formation:

A wide variety of responses has been used in concept formation studies which vary from the rate of
lever pressing to complex verbalization. The present review has been concentrated to verbal responses only.

(e) **Verbal Responses in Concept Formation Studies**

The Annual Review in Psychology (1960) on Psycholinguistics covered a large number of studies on verbalization as an indicator of concept formation abilities (Rubenstein and Abron, 1960). Perhaps, Lessing's (1934) contribution in this regard was very significant. He advocated that all higher levels of thinking involve language. Kádler (1961, 457) remarked that experimental studies on concepts reveal the perceptual and linguistic variables contributory to concept acquisition; however, relatively, verbal stimuli and responses are more important because of their being readily engendering conceptualization. Semantic generalization plays crucial role in this process.

The review of literature supplied by Cofer and Foley (1942) and the studies conducted by Cofer and Yarczower (1957) reveal that ability of synonyms to evoke common responses to their associative strength. Branca (1957) demonstrated that semantic generalization is dependent on Ss awareness of the connection. Remarkming on Pavlov's second signal system, Simon (1957) records that, unlike other species, man is an articulate being who produces words that can also act as stimuli. Such stimuli function at the level of
the second signal system. According to Liceblinskaya (1957), a word becomes a signal of the second system only when it becomes a concept "... Only at this stage has the word acquired for the child that 'comprehensive' character distinctive of signals of the second system which cannot be compared either quantitatively or qualitatively with the conditioned stimuli of animals (Pavlov), i.e. with signals of the first system."

While evaluating the relative effect of words heard, seen and pronounced by the subject, Ivachenko (1953) remarked that learning to understand words is easier than speaking. Underwood and Richardson (1956) studied the concept of habit family hierarchy in a word-association context, and recorded that concept learning was positively related to dominance, and negatively related to the degree with which associations overlapped. Varying the variance in the research design, Freeman and Mednik (1958) found that high variance concepts were learnt more rapidly. Kaplan (1959) made a comparative study of the effectiveness of mediated verbal associations derived prior to the experimental situation by means of a paired associates learning technique, and found the performed associations to be more effective.

Osgood's (1957) formulation of representational mediating theory presents another significant trend in the study of conceptual processes. He deals with meaning through a representational mediation process
in which a 'non-significant' stimulus (the UA) becomes associated with a 'significant' stimulus (the CS) when accompanied by reinforcement. The CS comes to evoke a fractional portion of the total behaviour elicited by the significant which becomes its meaning and the basis for conceptual generalization. Segood, LCI and Tannenbaum (1957) have developed their semantic differential scale to measure this meaning. Staats and Staats (1957) developed a classical conditioning procedure that successfully transfers evaluative responses elicited by words to contiguously presented neutral stimuli. Shine (1958) has developed a concept formation approach to attitude acquisition by employing the mediated-response approach to explain attitude learning.

One of the theoretical aspects of verbal responses is that it becomes covert, and as such serves to mediate overt responses. Kendler (1961) remarks that similar levels facilitate discrimination. Studies conducted by Goss and Moylan (1958) and Yarczower (1959) have shown that the effectiveness of verbal mediation in discrimination learning or conceptual sorting is dependent upon the degree of mastery whereas according to Norcross (1958) it depends upon distinctiveness of the previously acquired discriminative verbal responses. On the contrary, Penn and Goss (1957) observed no significant difference in the effect of familiar words and nonsense syllables.
Bruner, Goodnow and Austin (1956) have differentiated between concept learning and concept formation. The process of primitive categorization has been called 'concept formation' by Bruner. In the former concept, the number of dimensions or specific attribute values are known to the subject beforehand and hence, he is properly set to find out the defining attributes of a concept.

Bruner, et al. (1956) have analysed their responses collected on concept learning in terms of types of concepts (e.g. conjunctive, Disjunctive or Relational) and types of strategy (e.g. wholistic or partist). In both types of problems, i.e. 'Selection problem' or 'Inference problem', the results on the nature, kind and form of concepts acquired under different experimental conditions have been presented in terms of these type of concepts and strategies. Rao (1971) has replicated the techniques of response analysis and data processing employed by Bruner, et al. (1956) in their study on 'Strategy in Concept Learning'.

Miller, Galanter and Pribram (1960) developed a heuristic plan as an outline to the subject for self learning of concepts. They remarked that most of the strategies described by Bruner, et al. (1956) in concept attainment problems may be considered as heuristic plans of search. Hunt (1962) analysed the
strategies of concept learning in terms of 'Test operate, Test exit' (TOM) units.

Kendler, Kendler and Marken (1970) trained the college students to differentiate words and two conceptual categories; and concluded that when S sorts words in conceptual categories, the memory of the word 'perse' is reduced, because the words possess many semantic attributes and presuming those attributes that are instrumental in problem-solving, they are remembered best.

On the strength of these studies conducted on concept formation and the allied fields as dependent variables and cognitive and affective components as independent variables, we generalize as under.

2.60 RESUME FROM THE REVIEW OF RELEVANT STUDIES:

1. That, researches on concept formation have been found quite insufficient and inadequate. The researchers have not yet realized that it remained a neglected field of study because of its subjectivism in collecting data by employing method of introspection; and now, there appears a switch over from associative learning to conceptual learning and creative thinking. Rather, from learning as a core of study, investigators are developing interests in this promising field of conceptual learning.
2. That, dependable Indian studies on concept formation and concept learning are rather negligible. N. Vaidya (1975) has conducted significant researches on conceptual learning in science. Rao (1971) studied strategy in concept learning as a function of intelligence, attitude to problem-solving and ego-strength. Ranji Shrivastava (1980) conducted researches on mediational processes in concept identification. Beyond these three Indian studies, there exists no dependable study that adds to Indian literature on conceptual learning. The studies conducted by Bruner (1957) and Bruner, Goodnow and Austin (1956) even now constitute as the base for various types of conceptual learning. The thinking process and conceptual learning have even now been realized as topics of subjective investigation by Indian researchers. Consequently, their results do not get the support of researchers of objective disciplines.

We exactly do not know, how and to what extent, our growing youths acquire various concepts of the developing world, and develop their thinking process. Do Indian children, born and brought up in a composite culture of this developing nation, acquire various concepts alike the American born white or black children? To what extent, the intellectual development and motivational forces that these Indian born children acquire in this developing country, determine
their concept formation processes? Do intelligence and achievement motivation contribute in any way to conceptual learning? If so, how and to what extent? So pupils with superior general mental ability and with greater achievement motivation differ from those relatively with inferior intelligence and lower achievement motivation in their concept formation abilities? These are some of the primary probing questions that have remained unanswered in the past; and which need immediate attention for its investigation by the researchers interested in concept formation processes.

The present study, therefore, has been conceptualized to add to the existing literature on conceptual learning by undertaking such a study which extends the work done by Rao (1971) on concept learning. Rao's (1971) study was based on Bruner's (1957) strategy in concept learning. He studied the effect of intelligence in addition to attitude towards problem solving and ego-strength on concept learning; and thus extended the work done by Bruner (1957) as well as Bruner, Goodnow and Austin (1956).

3. That, though a few motivational factors, as presented in the review of relevant literature affecting concept learning, have been studied by the previous investigators; however, achievement motivation as the single driving force characterized by competitive
involvement, sustained persistence required for the production of unique responses in such process-oriented task as concept formation, has not yet been taken up by any pre-investigators.

These existing gaps in the current literature on conceptual learning, therefore, constitute a significant base for the present study. Both, intelligence and achievement motivation, jointly and separately, may influence the concept formation processes. It is, therefore, worthwhile as well as desirable to study the nature, kind, form and extent of concept formation under different levels and conditions of general mental ability and achievement motivation. We, therefore, assume that concept formation of the Indian children would be significantly affected by the level of their intelligence and achievement motivation. The exact problem of the study could be pin-pointedly presented as under:

"Concept Formation as a function of Intelligence and Achievement Motivation".

The next chapter deals with methodological aspects of putting the hypotheses to test.
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