CHAPTER II
REVIEW OF RELATED LITERATURE

The discussion made in the first chapter leading to specific statement of the problem, and objectives and hypothesis suggests the need for a broader review confined to the three variables - Step size, reinforcement and response mode with reference to variation points or types attempted in the past. At the same time a very brief discussion of certain theoretical bases of programmed learning is quite in order to begin with. This chapter is meant for such a review of related literature. The review it is hoped shall enable the investigator among other things to fix the types or points at which transformations are to be effected along the three variables in her study.

2.1 Classical Conditioning

A systematic study of learning with dogs as subjects under controlled conditions was first undertaken by Ivon Pavlov, a Russian Scientist. He measured amounts of saliva flow and similar processes. When he approached a dog with its food, Pavlov found that the dog had started to salivate. This did not usually happen until the dog began chewing. Thus it was premature salivation, salivation at the mere sight of food was obviously a phenomenon that required explanation. Pavlov set out to study the happening systematically. The paradigm developed by Pavlov came to be named as classical conditioning.

First, Pavlov's dog did not respond in any predictable
or consistent way, to the bell as stimulus. The dog was then placed in a harness. A bell was rung and this was followed, a few seconds later, by food. This procedure was repeated for many trials. As a result, the dog began to salivate at the sight of the bell alone. This association between the bell and the salivation response had been conditioned or learned. The association as noted by Pavlov tended to disappear, or extinguish, if periodically at least the bell was again not paired with food. Further, the salivation response happened to be displayed by the dog to stimuli similar to the bell, such as a whistle. It was hence necessary to make the dog discriminate between the sounds by consistently presenting food to the bell and not to the whistle. Eventually the dog would salivate only to the bell and not to the whistle.

In classical conditioning, the food is termed the 'unconditioned stimulus (UCS)', as it is the cause of natural salivation, the unconditioned response (UCR). Before conditioning, the bell is a neutral stimulus as it does not elicit the salivation response. After many contiguous pairings, when the bell alone elicits salivation the bell then is termed as conditioned stimulus (CS) and the salivation the conditioned response (CR).

2.2 Operant Conditioning

In operant (or instrumental) conditioning, the response is not a reflex like salivation to food, and usually must be gradually and carefully developed through the judicious use of reinforcers. Sometimes the response appears only through a trial
and error process. In the operant conditioning paradigm, the response (or some appropriate approximation of it) must be made before a reinforcement is given. The reinforcement can be either giving a reward (positive reinforcer) or removing an aversive stimulus (negative reinforcer).

If all the responses are reinforced without break, the schedule of reinforcement is termed continuous. Many other schedules of reinforcement are possible and have been discussed in detail elsewhere in this chapter.

Skinner and his colleagues unambiguously enumerated the principles of operant conditioning following laboratory experiments involving animals (Ferster and Skinner, 1957; Skinner, 1938, 1953). Their work resulted in an orderly succession of experiments from the laboratory to the classroom. In the 1940s and 1950s, reports of experimental work with extremely deviant children began appearing. Studies with normal preschool children in laboratory settings followed these. Finally, studies carried out in the public school also were published. The latter research projects were carried out first in special class and by the late 1960s in regular classes with normal children (Copeland and Hall, 1976). By the 1970s, widespread interest among educators had been generated. In the recent years, interest has been focused on computer-assisted instruction.

2.3 Evaluation of Behaviour Modification Approach

One of the foundations of what now is labelled as behaviour modification can be traced back to the original work conducted by
the physiologists Pavlov and Bekhterers in their animal laboratories at the beginning of this century in Russia (Michael Hersen, Richard M Eisler and Peter M. Miller, 1975) For almost three decades, a number of animal experiments to show that a previously neutral stimulus like bell would acquire the power to elicit the autonomic reaction like salivation after many pairings with food were carried out This work strengthened classical conditioning position. A number of current treatment strategies used by behaviour modifiers are the result of the principles of classical conditioning.

The American psychologist J.B Watson extended the use of the Russian work to human problems He succeeded in the conditioning of child behaviour among other areas.

Another parallel line of animal experimentation contributed to behaviour modification approach. This came from the laboratories of E.L. Thorndike and then of B.F Skinner. Thorndike kept food deprived laboratory animals in a 'puzzle box'. The animals learned to escape by making a 'correct' motor response in order to open a latch. Once out of the box, the animals were rewarded with food; and gradually they learned to escape progressively faster Thorndike concluded that, if particular behaviours randomly emitted by an organism were followed by a 'satisfying state of affairs' (i.e., positive reinforcement as termed in the later literature), then the connection between the behaviour and environmental event was 'strengthened'. If, on the other hand, the behaviour were followed by an annoying state of
affairs (i.e., punishment) then the connection between the behaviour and experimental event was 'weakened'. These two relationships comprise Thorndike's famous 'law of effect'.

Skinner (1938), made a distinction between respondent and operant behaviour. Respondent referred to the Pavlovian model and the operant referred to Thorndike system. According to Skinner, the rate of a particular response could be controlled by its relation to environmental consequences. He described the process of positive reinforcement. This meant a particular response followed by a contingent (reinforcing) environmental event resulted in a high probability of that response being emitted in the future. On the other hand, in the case of punishment, if the same response were followed by a contingent (punishing) environmental event, the probability of the behaviour being emitted was decreased in the future.

According to Snelbecker (1974) there are two major ways in which operant conditioning is related to behaviour modification. First, operant reinforcement learning principles are extensively used as a basis for instructional procedures. Secondly, behaviour modifiers share with operant conditioners the emphasis on inductive theory construction and a major commitment to using research results for evolving their principles.

2.4 Major Applications

There are at least four facets (Snelbecker, 1974) to the development of behaviour modification, instructional principles and procedures. The first facet is referred to as 'teaching
Individualization has been one accepted characteristic of application of behaviour modification approach. The types of behaviours where behaviour modification is applied have been enlarged, further the evaluation procedures have widened and diagnosis and treatment have been made more suitable to individual needs.

All forms of behaviour modification use contingency management; that is, the giving of a reward is dependent (contingent) upon a particular response being made whenever a particular stimulus is present. Contingency contracting permits an individual approach, because the contract between teacher and student can be highly individualized.

Another major application of behaviour modification is programmed instruction. This is directly a result of Skinner's way of looking at learning process and his theory of instruction. Skinner's theory of instruction assumes that any process or activity has observable manifestations and can be behaviourally defined, that is, defined in terms of observable behaviour. Either or both of the theory's two major operations, reinforcement and stimulus control are emphasized in the educational applications.

As noted earlier, operant conditioning may be represented by...
the following paradigm: Stimulus - Response - Reinforcement

According to Skinner reinforcement must immediately follow a response if it is to be effective, delayed reinforcement is much less effective in modifying behaviour.

Programmed instruction involves arrangement of contingencies that best expedite learning (Skinner, 1968). Programmed instruction relies heavily upon carefully planned stimulus presentation, providing occasions for responding and giving immediate knowledge of results. Programmed material is designed to maintain high rate of successful (correct) response. Thus frames in a programme represent roughly contingencies of reinforcement.

A programme is a long chain of frames or statements (provided normally) in the written form, each giving an occasion for the student to respond in some manner and get reinforced. (A relatively more detailed discussion of programmed instruction has been already provided in the first chapter).

2.5 Indices of Evaluating Programmed Material

There are some indices to evaluate a programmed self-instructional material (Chavan, 1974). A brief note about the indices is made here as will be employed in the study.

1) Error Rate: The error rate of a programme is calculated on the basis of response given by the learner obtainable on each frame of the programme. The formula to calculate error rate is as follows.
Total Number of Errors x 100
Error Rate = ------------------------------------------
Total number of Frames X Number of Individuals.

The error rate can be calculated for any section of a programme or for the programme as a whole. Skinner recommends that in the use of self-instructional devices, the instruction should be so arranged as to ensure the least occurrence of errors. He recommends 5% to 10% errors, for his linear programmes.

The present study is not concerned with 'developing' a linear self-instructional programme, on the other hand it is intended to use the already tested linear programme(s) to create different forms. Hence the error rate as an index of effectiveness will not be employed. Further it is the learner performance in absolute terms, meant as already defined, the improvement or change in the student learning resulting from the programme that is considered in the study.

(2) Programme Density: The density function is an indirect measure of the rate at which material is introduced. Most of the programmers have been using Type/Token Ratio as the measure of the programme density (Green, 1962). Different versions of Type/Token ratio exist depending on basic unit of information considered in the density estimation.

One formula that gives a quick estimate of density of a programme employs types of responses essential as compared to total number of all responses asked for in the programme or a section of it under consideration.
Programme Density = \frac{\text{No of different responses in the section of a programme}}{\text{Token Total no. of responses in the same section of the programme.}}

It will be known later that this formula comes handy helping the investigator in her effort to find programmes with certain pre determined features.

McGuigan and Peters (1965) reported an investigation of the suitability of different measures of pupil achievement for evaluating programmed materials. They suggested gain as a proportion of possible gain. This was treated as 'gain ratio' and an arbitrary value of 0.50 was set as a criterion by which good programmes were distinguished.

Blake (1966) has suggested a 'Modified Gain Ratio', which has a range from 0 to 2 with a suggested water shed at 1.2. Equation (1) to (4) given below show some of these and other indices.

\[ \text{Mean Raw Gain} = \bar{Y} - \bar{X} \quad \text{(1)} \]
\[ \text{Mean } \% \text{ Gain} = \frac{(\bar{Y} - \bar{X}) \times 100}{\bar{X}} \quad \text{(2)} \]
\[ \text{Mc Guigan Gain Ratio} = \frac{\bar{Y} - \bar{X}}{T - \bar{X}} \quad \text{(3)} \]
\[ \text{Blake Modified Ratio} = \frac{\bar{Y} - \bar{X} + \bar{Y} - \bar{X}}{T - \bar{X}} \quad \text{(4)} \]
In the present study, equation (3) as elaborated above will be employed.

Research under variables chosen

2.6 Concept of Step Size

One of the most important features of linear programmed instruction is to work in 'small steps'. According to Susan Markle (1969), a step size is interpreted as the amount of increase in subject matter with each step.

In the early days of programming the principle of 'small steps' was considered to be one of the very pillars of programming; and smaller steps meant a better focus on what is essential, more opportunities for activating the student, and greater ease in ordering suitable sequences.

What exactly is meant by 'small steps'? These are interesting and challenging questions In the literature we find widely differing opinions on how to assess step-size.

Ake Bjestedt (1972) has categorized viewpoints on step size under two categories - 'a priori' criteria and 'a posteriori' criteria. The former represent viewpoints which can be applied to the programmed material as such without first studying individual students reactions. The latter, on the other hand are based on an empirical assessment. 'A priori' criteria are further divided into two categories linguistic formal and conceptual psychological assessment types.
A Priori Criteria

a) The number of words presented to the student in the didule*

The didule is the programme's contribution to a fundamental interactive unit, an interaction between the instructional material and the student having a distinct initial final character. This type of assessment is a linguistic formal basis of assessment. The abundance of words in the units of the Crowder programme is one of the reasons why most reviewers say that Crowder works with 'large steps' than Skinner.

b) The average length of response expected from the student

This type of assessment is less common but quite feasible basis for assessment. An exercise which demands the students to write down ten terms is obviously 'larger' than one that only demands the student to tick one of the ten given terms.

c) The number of response requests in relation to the number of new concepts or in relation to the number of new statements about concepts:

More didule in a programme then more are the number of frames and smaller hence are the steps. This is an example of conceptual psychological criterion. In this connection varying degrees of 'concept density' (or more generally 'information density') are possible.

In empirical experiments, the effects of the size of the step has been studied by starting with an already existent
programme and eliminating a certain number of didules from it. (presumably those that do not destroy the sequence i.e., review items and practice items) and then comparing educational effect of the larger programme (with 'smaller steps') and of the shorter programme (with 'larger steps').

Obviously deleting didules results in shortening the programme. Hence total time required for completing the programme is reduced. In a way, it becomes an unequal comparison.

Experiments have often shown the advantage of comparatively small steps for the learning result, with regard to knowledge, but at the same time it has sometimes but not always taken more time.

d) The number of stages in the intermediary process between perceived response request and final response behaviour.

We do not know with any certainty what the intermediary process looks like in any individual student. Sometimes it is a matter of the student just 'copying the given information' repeating a phrase in a language laboratory or writing down a new term. In other cases, a long series of intermediate activities have to precede the final response; for example, when the students' task is to solve a complicated mathematical problem. The more complicated the intermediary process, the larger is the step which the student is to take.

_A Posteriori Criteria_
a) The average working time of the student group per didule. The faster the student finishes a didule, the smaller the step is.

b) Frequency of mistakes: A small step is a step toward mastery that the student is capable of taking without making errors. A small step is a step which the student is able to take, a large step is a step he cannot take. As a result of such a view, the appropriate step size will, in fact, vary from individual to individual.

c) Reduction of mistakes after the addition of information. In the assessment one has to investigate whether the student can give the correct answer to the response requests before the information section of the didule has been presented; and similarly whether he can do this after the information section has been presented. Tasks in which the differences between the frequency of correct solutions before and after the presentation of information is small may be said to imply, in a sense, small steps. In this case small steps are those when practically everyone is able to solve the exercise in advance, and large steps when practically no one can solve the task afterwards. But as a rule the programmers do not use the term in this sense.

2.61 Studies on Step-Size

Numerous reports in the research literature have pointed out that 'small steps' led to higher achievement or fewer errors.
A common definition of step size however is not available. Experimental attempts to determine or define step size are numerous Coulson and Silberman, 1960; Haisanger, 1964; Kapel, 1965; Krumboltz, Smith and Moore, 1962; (in Furukawa, 1970). In these studies the difference of step size varied firstly from one of physical length to one of difficulty in making a correct response. Secondly, the programmed instruction itself differed from constructed response to multiple choice with and without repetition or remedial work, to materials designed to teach either very simple or very complicated learning tasks. Thirdly, the time spent on the learning tasks in most cases, was not held constant.

Moris, Blank, Mckie and Rankine (1970) reported that small step programme produced higher post-test scores, took more time to complete and had a lower error rate than large step programme Nahed-Abd-El Azize (1970) compared programmed text with the essay format and found that both the methods produced equivalent results, and retention was significantly higher in the programmed text group. Krieger (1974) studied the effect of structured text as an alternative to the method of small steps in programmed instruction. Results indicated that males did significantly better with the structured text than with the third alternative, the traditional method Learning time was reduced to 29% when the structured text was used. It was concluded that breaking down a text into numerous small steps leads to waste of time, when trying to master the content.

The question of whether it is more effective to interperse
question within the instructional material, such as is done in a programme or more effective to ask a series of questions after a relatively lengthy presentation was studied. The latter alternative proved more potent in a study by Roderick (1968)

An interesting study of Floyd (1973) investigated the effects of differential frame size i.e. 1, 3, 7 and 12 words practised per frame and concluded that subjects engaged in vocabulary development programmes with a 3 word frame size led to greater learning.

Some studies in the literature have employed a new concept called chunk in studying step size. Chunking implies that people have fixed memory capacities, a capacity which can be measured after single exposure to verbal materials. By definition a chunk can be one or more words. There must exist however 'enough internal predictability or structure within the collection of words to enable us to reconstruct some of them from those we actually remember'.

Sendek Mary (1977) investigated the effect of syntactically prechunked prose material upon the recall of semantic content. Three types of presentation modes were constructed Mode A in which the sentences remained intact, Mode B in which the sentences were chunked into minor phrases, Mode C in which the sentences were chunked into segments in which the words belonged to the same sentoid. Both chunked modes enabled the subjects to recall significantly more propositions than the unchunked mode, of the two chunked modes presentation Mode-C has the most
facilitative effect Subjects were able to recall significantly more propositions when the textual material was segmented into syntactic chunk in which the words belonged to a common sentoid, than when the material was segmented into syntactic chunks with minor phrases.

Furukawa (1970) attempted to obtain maximal subject achievement by matching programmed instruction stepsize with learning ability of the subject, both measured in terms of number of chunks in programmed learning responses and in short term memory, smaller steps led to higher performance. However both post tests showed 7 and 14 chunks to be best.

Vincent (1968) compared three forms of programmed instruction. They were linear short step, long step linear, and branched programmes. The branched form of the programme was prepared from the basic form by identifying key items and rearranging the basic programme to allow students who answer the key items correctly to skip over practice and review frames. The long step form of the programme was prepared by deleting repeating, practice, and review frames. The following important conclusions were drawn Students using long step form learned more than the control, but the difference in gain means were not significant. Students retained significantly more in the conventional lecture-demonstration method than those using the three forms of programmed material.

2.62 Step-Size Distinction in the Present Study
It is not clear from the studies reported in the past whether sufficient care was taken to establish the equivalence of programme forms used as treatments at least in terms of certain programme characteristics like the vocabulary and complexity of sentences, the number of sentences and response occasions given and time taken. The effort should have been to vary the step size or density, purely in terms of didules/chunks/sentoid or number of words to be covered at a time. Deleting practice and review frames from a linear programme (Vincent 1968) in order to obtain a large step introduces a difficulty as it reduces the time required for going through the step and thus time becomes a variable.

From the discussion on stepsize made so far, a feasible way to guage stepsize, before administering a programme appears to be that of counting either the number of words or sentences, as they in turn represent a didule. Some researchers have employed what they call a "Chunk" or "Sentoid" which also may be represented in practical terms, in terms of number of words. There are others who have forwarded the idea of operations. A minimal operation can be reading, recalling or writing a word. Thus what is covered by the student at a time purely in terms of length (i.e., in terms of say words, sentences or didules) should be regarded in saying whether a step in large or small.

Retaining time as it is and combining small steps to make large ones referred to as para size (equal to paragraph) in the present study, enables objective comparison of the two forms. In this case a small step may be a sentence (or two)
an idea or a piece of information. Thus small steps if combined, a factor facilitating the student learning better may be removal of unnecessary interruption of responding in the course of reading. On the other hand responding occasion may be heaped at the end of each large step. This may also help 'thinking' and responding in the context besides enabling review in practical terms.

2.7 Concept of Reinforcement

2.71 A brief history of Reinforcement Theory

In the late 1930's and early 1940's researchers generally agreed that the strengthening of appropriate response and the related gain in learning were due to the consequences following such responses (Robert Glaser, 1971).

In the late 1940's and early 1950's the theorists who were the opponents of reinforcement theory were in the position of defending themselves against those who argued that one can learn 'through processes perceptional or cognitive organization which depend only upon temporal contiguity'. The cognitive theorists agreed on the law of effect as an important influence in the modification of behaviour. But they differed in pointing at the inadequacy of the operant or the after effect of reinforcement in causing cognitive organisations.

It was in this period a number of important issues relating to difference between S-R reinforcement theory and cognitive field theory came up. Whether the learning process involved an
unbroken change in the S-R strength or whether it involved a separate chain of acts became the continuity-noncontinuity controversy in the literature of those days. Another issue was about the nature of the product of the learning. Was the process a specific stimulus response relationship (response learning)? or was it a cognitive organisation or expectancy (a place learning)? Skinner's operant respondent distinction was generally accepted. It represented either a basic difference or a more procedural difference. It was concluded during this period that the then existing theories and explanations did not predict occurrence of different kinds of learning under conditions considered by them.

By the beginning of the 1960's, the investigations beginning from Thorndike to statistical learning theory meant to suggest definitely that learning would not occur unless the consequences of the specific learning act belonged to a general class of reinforcers. Estes (1967) pointed out that all reinforcers served one or more of the following purposes: eliciting of a response, terminating a continuing behaviour affairs, delaying of interfering responses, and reduction of needs. The justifications for treating these in a single class of 'reinforces' were (1) that they all seemed to have similar effects on response probability and (2) that the particular events or operation used as reinforcement made little difference upon subsequent processes such as generalization and transfer, retention, distribution of practice, and discrimination.
In the late 1960's there were some new developments, one of these concerned reinforcement effect related to the probability of occurrence of these activities in an organism's repertoire. Another development concerned behaviour sequences that terminate in a reinforcing event. Each response in the sequence could act as a reinforcer for a previous response. For some investigators, a behaviour chain was helpful in analyzing conditioned reinforcers. Another development was the study of sensory reinforcement (Fowler, 1971).

Thus the most influential, true reinforcement theory appeared in 1943 as Hull's Principles of Behaviour. According to Hull, not only reinforcement is necessary but also the amount of learning depended on the amount of reinforcement.

According to Glenn E. Snelbecker (1974) the stimulus which follows a response and which strengthens or increases the probability of that response is called a 'reinforcer', in operant terminology. Pavlov himself called all events which strengthened behaviour 'reinforcement' and all the resulting changes 'conditioning'.

Educators are mostly dealing with changing or strengthening behavior. It seems natural that much of the discussion about behavior modification is focused on reinforcement.

2.72 Classification of Reinforcers

There are several types of reinforcers available including social (Stevenson 1965), activity (Premack, 1965), material
(Becker, 1971), token (Allyon and Azrin, 1968) and covert (Becker, 1973; Cautela, 1970; Rimm and Masters, 1979).

**Social Reinforcers:**

In general individuals are responsive to a range of social reinforcers—smiles, verbal approval, attention, or physical contact (Lipe and Jung, 1971). Social reinforcers such as praise or touch are repeatedly used in schools and classrooms in the management of student behaviour. Social reinforcers are easy to administer. They are naturally occurring, and more resistant to satiation than material reinforcers (Kazdin, 1981).

**Activity Reinforcers:**

This involves performing a preferred activity of any nature. Premack's principle states that one can make people to involve in one activity by promising them the privilege of engaging in another more desirable behaviour when they are finished (Premack, 1965).

**Material Reinforcers:**

These are consumable such as candies, toys and music. These work particularly well with young children, but people of all ages respond to valued consumables.

**Token Reinforcers:**

These are objects with value that can be accumulated and used later; that is, a token can be traded off a reinforcer of another kind—social, material or activity.
Covert Reinforcers

A new concept to the behavioural literature is that of covert reinforcers. Only in the last few years, psychologists have realized that the thoughts, images, and self-evaluations, contingent on their behaviour play a role in maintaining the behaviour (Rimm and Masters, 1979). These are covert responses and can be changed such that new behaviours are established, particularly those involving self-control.

The classification given above does not appear to have taken into consideration a transition that may be required from explicit verbal (contrived) reinforcement or even for that matter from complete knowledge of correct response (KCR) that has been employed profusely in arranging instructional contingencies like programmed instruction, to what has been obliquely referred to as 'covert' reinforcer.

As Skinner (1968) himself points out, the transition from external reinforcement to self generated reinforcement of knowing one knows is often badly handled. This clearly indicates that there is some relationship between the nature of reading material provided to the learner and self generated or self evaluational reinforcement. The present investigator feels that there is no literature available on this point.

Patterson (1977) has also rightly pointed out that behaviourists have not attempted seriously to proceed in this direction.
There are two main schedules of reinforcement. A schedule by which every response is followed by a reinforcer is called a continuous schedule of reinforcement. In most cases, however, a child emits many responses that are not followed by a reinforcer, yet the behavior is strengthened because at least some responses are reinforced. All such schedules, in which some responses are followed by reinforcers and some are not, are called, collectively, intermittent schedules of reinforcement. There are many combinations of intermittent schedules, some of which depend on the number of responses a child emits, and others which depend upon the passage of a certain amount of time. These schedules that are based on the number of responses made are called ratio schedules. Whereas those that depend on the passage of some period of time are called interval schedules. The schedules of reinforcement is one dimension of the contingencies of operants and their reinforcers. That is, the schedule determines which responses will be reinforced and which will pass unreinforced. Hence, all schedules except a continuous schedule dictate that some, not all, responses emitted by the individual need be reinforced.

There have been several noteworthy attempts to classify reinforcement schedules more systematically.

Catania (1979) has attempted a good classification on the various types of schedules.
At this stage the present investigator feels that using ratio schedules as one point of transformation from extrinsic to intrinsic may prove useful and easily manageable. In practical terms, a ratio schedule will reduce the number of extrinsic reinforcing occasions by a given ratio.

2.74 Studies on Reinforcement

In the sphere of human learning, apart from material reinforcers, there is another very important reinforcing agent which helps improve and sustain efficient learning. This agent is called ‘knowledge of results’. Knowledge of result means the information which is available to the subject about the success or failure in the course of task performance which in turn helps in evaluating the response just made or previously made. The consequences or after effects of an act are important determiners of subsequent achievement. KR thus helps the performer to discriminate along a sensory continuum in a given situation, transfer fine response adjustments from the situation to another and thus increase the potential to make a more nearly correct response (Madan, 1962). Reinforcement in the form of reward or punishment or KR enables the subject to make his responses goal-directed (Locke, 1967) and eliminate wrong responses. According to Vidhu Mohan (1969) KR has a facilitative function (a) of informing the subject about the type, extent and direction of his errors. The subject can generally use such information to correct his errors or improve his method of performing the task (b) of motivating the individual to persist and put in more
In the present study the investigator is interested in the experimental factor of KR and hence grouped the various studies reviewed under the following headings:

a) Frequency of KR
b) Precision of KR
c) Other studies

(a) Frequency of KR: A bulk of literature goes to show that the more often the KR is given, the better and faster is the learning. This generalization was simply supported by research work in Ammon's review (1956). Since then it has received further support in the work of Bilodeau and Bilodeau (1956), McGuigan (1959), Madan and Dey (1964), Mohan and Deol (1970), Mohan and Damrel (1971), Mohan and Gupta (1972), Loraine (1970) while studying the effect of percentage of KR and associability of items in acquisition and extinction of paired associates found the 50% KR group taking longer to reach criterion than 100% group.

However, some of the studies have reported a failure of differential effect of frequency of KR. Goldstein and Rittenhouse (1954) failed to find difference between 50% and 100% KR schedules. McCormack et al. (1963) found no dependable change in reaction time when 30%, 50%, 70% and 100% KR was given. Mohan and Mann (1970) too found no significant differences in the performance on choice reaction time when the frequencies of KR varied from 25%, 50% to 70%.
(b) **Precision of KR** - The amount or magnitude of reward is positively related to performance. As suggested by Ammons (1956), the more the information contained in KR the better it is for performance. In other terms, the more precise the KR the more rapid the improvement. Trowbridge and Cason (1932) replicated Thorndike's dividing the subjects into three groups: no KCR, KCR in terms of right and wrong, and KCR in terms of exact magnitude of discrepancy. The group given exact information surpassed in their performance to the other two groups.

Estes (1967) found greater effectiveness of saying 'right' after a response than saying 'wrong'. Zeigler and Paul (1962) had observed that praise was more reinforcing than correct reinforcers with small class children, while the reverse was true in the case of the middle school children. McAllister et al., (1969) found that negative comments were sometimes useful in establishing conditions under which praise would be more effective.

Though it has been amply proved that immediate knowledge of result facilitates learning, there are innumerable studies that show programmes teaching as well when the KR after each frame is omitted (Krumboltz and Weisman, 1962; Anderson, 1971; Tsao, 1978).

Anderson (1971) reported that KR after wrong answer was slightly better than KR after right answer and review of incorrect frame failed to improve performance in the immediate and delayed criterion tests. Hsuing (1977) studied the effect of providing KCR to differing error rate programme and concludes...
that subjects learn as well when KCR is omitted. One explanation given is that in the low error rate programme, items are easy, and hence subjects are confident of their responses, so they bypass KCR.

Eugene Douglas Rubin (1970) has supported this viewpoint and reported that subjects often do not look at every correct answer, and when they do look it is for response which were written incorrectly.

Carels (1975) studied the effect of false feedback, the subjects were grouped into control (no feedback), true feedback (TF) and false feedback (ff), and reported that controls did less well than those given true feedback but out-performed those given false feedback.

Kulhavy (1979) administered a 25 frame programme to 720 undergraduates who did or did not receive feedback after each frame; half of the subjects in the feedback group were not allowed to see the programme text while responding to frame questions. Subjects rated their answers in the question alternatives selected, and all learners received an immediate post-test over the programme content. Feedback facilitated post-test recall and reduced programme errors.

Campeau (1968) analyzed the effects upon criterion performance of subjects' test anxiety level and the presence or absence of feedback in programmed instruction, and reported that high anxious subjects did best under the feedback condition and
low anxious subjects did well under the no feedback condition.

(c) Other Studies Reviewed on Reinforcement

Some more studies reviewed and that could not be grouped in the aforementioned categories are by Goverdhan (1972), Besson (1973), Howard (1967), Bandura (1971), Raymond (1974) and Green and Repper (1974).

The intrinsic reinforcement condition studied by Howard (1967) includes variations in knowledge of results provided for students responses to sets of mastery items inserted at various points in the instructional material. The extrinsic reinforcement condition consisted of variations in the amount of money that could be earned, by subjects for acceptable performance on a final criterion test over the material.

Goverdhan (1972) studied the effect of different delays of KR in a learning task, and found that as the delay in KR increased, the errors also increased, and were fewest with immediate knowledge of results. Subjects doing well on one task as a function of KR did not necessarily do well in the other task.

Beeson (1973) subjected undergraduates to immediate knowledge on either the first or second half of the items on multiple choice tests, and delayed knowledge on two, remaining items. Subjects in the immediate KR condition scored significantly higher and immediate by item KR does not depress test performance. But Strand, Horoid and Rust (1973) reported
that IKE (immediate KR) caused a loss of accuracy and when coupled with defining the task as a test, yielded a lengthening of task completion time.

According to Bandura (1971) self-monitoring reinforcement mechanism can serve to alter and to maintain behaviour when extrinsic reinforcement feedback is absent or operates in conflicting direction. A self-reinforcing event involves a self-prescribed standard of behaviour which serves as the criterion for evaluating the adequacy of one's performance. Most performance do not provide objective feedback of adequacy and consequently the attainment of other persons must be utilized as the norm against which meaningful self evaluation can be made. As a second feature a self-reinforcing event often entails social comparison process; third, the reinforcers are under the persons own control and fourth, he serves as his own reinforcing agent.

Other studies reviewed on the concept of intrinsic and extrinsic reinforcement are by Raymond (1974), Green and Repper (1974). In these studies providing no reinforcement was taken as intrinsic reinforcement condition and providing correctness, mediated through the experimenter was taken as extrinsic reinforcement condition.

2.75 Extrinsic-Intrinsic Reinforcement Distinction in the Present Study

In studies on applied learning the term 'reinforcement' frequently has been used to describe a variety of stimulus conditions without specifying the effects for e.g., in many
studies knowledge of results for students' response to enroute test items over the instructional material has been treated as reinforcement. Reinforcement in these studies is a condition that is intrinsic to i.e., built into the learning material. In other studies, reinforcement is a stimulus condition extrinsic to the learning material; and mere presentation of reinforcement is contingent upon level of performance on the instructional material. But the reinforcement is not a condition built directly into the material. Gold Stars, course grades, and special awards for performance serve as examples of extrinsic reinforcement.

DeCecco and Crawford (1977) have rightly commented that early programmers have failed to distinguish between the motivational and informational aspects of immediate knowledge of results. Providing stars, grades, etc., act merely as motivational agents, and are in no way related to activities engaged in. Tokens given for interesting classroom activities thus will lead to a decrease of interest (Patterson, 1977).

Tokens do not seem to lead to long term learning, or to generalization. The children will learn how to obtain tokens not to value the activities involved. When tokens cease, extinction occurs. The authors Levine and Fernacht (1974) write, 'Therefore once token type programmes are instituted it may never be possible to fully withdraw tokens without behaviour going at least back to baseline. Furthermore, since tokens tend to decrease the intrinsic value of activity, they may actually do more harm than good.'
In the present study the investigator is proceeding from a Skinnerian type of programme, and the concept of extrinsic and intrinsic reinforcement will be discussed in this context only. Giving tokens as reinforcer in the present study is felt not at all appropriate. In this study providing KCR in the programme is controlled by the programmer and hence regarded as extrinsic reinforcement, and when KCR is not provided, then it is intrinsic as the student gets reinforced by reading subsequent material.

Skinner has also emphasized the desirability of moving from contrived reinforcers to natural or intrinsic reinforcers. He admits, however, that 'natural reinforcers' may not automatically replace the contrived positive reinforcers of the classroom. But he neglects to tell just how one can move from contrived to natural reinforcers.

Reinforcers are classified into several types in Mitzel(Ed.), "Encyclopedia of Educational Research" (1982) like social, activity, material token and covert types, which have more bearing on laboratory experiments. In the present context, some other reinforcer like KCR has to be discussed.

As teachers we are free to use any available reinforcers provided there are no harmful by products and provided the resulting behaviour can eventually be taken over by reinforcers the student will encounter in his daily life. The student who knows how to study knows how to amplify immediate consequences so that, they prove reinforcing.
Skinner (1968) has rightly said that the transition from external reinforcement to self-generated reinforcement of knowing one knows is often badly handled.

In the present study KCR deliberately provided for by the programmer in the programme will be treated as extrinsic reinforcement and providing no KCR in printed form while the students can confirm their correctness of response by their own reading of frame will be treated as intrinsic reinforcement. Frames also provide a source of informational feedback apart from that provided by the printed answer.

As cited early this is supported by studies of Raymond (1974), and Green and Repper (1974).

It is relevant at this juncture to say that amount of extrinsic reinforcement, can be reduced by ratio schedules. This automatically means—the scope for intrinsic reinforcement is increased. It is likely that the stepsize and the nature of step have the effect of improving intrinsic reinforcement. The way in which the three variable (viz., step size, reinforcement and response mode) can be ascertained by creating appropriate treatment combinations. This point will be more evident when response mode is discussed. This is to say that there is a point when response becomes more obvious to the individual. Then there is likelihood of individual deriving intrinsic reinforcement.

2.8. Concept of Response Mode:
Response mode has been defined as 'the form of response the student makes while working on a programme' (DeCecco 1964).

Mode of response may be broadly classified into two categories: overt response and covert response. Overt responses are those which are publicly observable. They include such activities as writing, speaking, pushing a button and pointing. Covert responses, on the other hand, are those which are not publicly observable. It refers to a response which a student presumably makes in the form of thinking while reading silently. It is internally made. It may be noted here that the two types of responses are not mutually exclusive because it is difficult to imagine an overt response without first thinking it internally.

Modes of responding raised both practical and theoretical problems. On the practical side, it has been suggested (Leith, 1964) that the performance of some subjects is diminished by the requirement that they should make overt responses. Thus some subjects find frequent overt responding tedious and consequent loss of motivation makes them pay less heed to the learning task. Also when the response is to be written it has been found, not unexpectedly, to take longer than for example, reading or mentally constructing the response. It was found that some pupils could learn as much without responding and this took less time, then, it could be feasible to advise many learners to read through the programmes. This may also lessen the risk of boredom. While Skinner (1959) has insisted on overt responding, the results of the researchers, employing both overt and covert methods, have been equivocal.
There seems to be less disagreement among the practitioners of programmed instruction about another factor which he recommends viz., that the learner should construct or compose responses or solve problems for himself before the right answer is shown. This point of view follows from Skinner's (1959) account of 'operant conditioning' in which the learner first makes a response and receives a reinforcement, which is contingent on the making of the response. Thus the important point in Skinner's theoretical structures are (1) response must be emitted by the learner, and (11) on being emitted it must be reinforced. Viewed from Skinnerian angle if one is to design instructional material, overt responding and providing reinforcement are essential requisites. But the problem educator faces is of making the individual learn in a variety of contexts involving a variety of instructional materials. While using instructional materials like linear programme is alright to begin with, the major problem yet left unanswered is how materials equally or nearly effective without such interferences like overt responding and extrinsic reinforcement required can be designed.

In Tobias (1973) review article, the areas examined include research findings, knowledge of results, computer assisted instruction, conditioned response, familiarity factors, blackout ratios, and the factor of time. Findings suggest that studies designed to manipulate time on task are relatively rare.

Grundin (1969) has reviewed 47 comparative studies of response mode and/or frequencies of correct response information
in linear programmes. The review supported Holland's opinion, overt responding is effective when programmes are 'long enough'. Nine significant differences favouring overt correct response has been reported. Eight of them have been obtained using programmes with more than 100 frames. Of the 11 negative differences, 9 have been obtained using shorter programmes (< 100 frames). Holland is of the opinion that overt responding is more efficient than covert, if the programme is 'long enough'. The authors' analysis shows the same tendency of overt correct response compared to NCR. There is no significant effect of CRI reported. There is however a tendency for CRI to have a positive effect in programmes with less than 200 frames and negative effect in longer programmes. In all 13 studies, overt responses were required. Knowing that CRI will be given, the students may tend to skip the checking 'in thought' that otherwise probably proceeds the overt response. If so, he will not utilize the intrinsic feedback properties of the programme frames. But he will reduce his total amount of work on the programme. Thus, this tendency may be more marked the larger the programme is. It seems generally agreed Anderson, 1967; Holland, 1965; Leith, 1967 (in Grundin, 1969), that the effect of overt responding depends on certain learning material characteristic especially in the sense that it has a positive effect on response learning. This interaction between programme and response mode is discussed and convincingly demonstrated in Leith's excellent analysis of the role of overt responding as well as in Anderson's review of response factors.

Studies comparing the effect of overt and covert response
mode has sometimes yielded complicated pattern of results, Goldbeck and Campbell (1962) using a social studies programme with a group of seventh-grade pupils found overt response to be advantageous only at the upper difficulty levels, and a similar finding was obtained by Eigen and Margulies (1963) for overt responses at easier levels. It is suggested it may serve only to give an illusion of learning. Related to this is the interaction between response mode and the ability of the group tested, or again with its age, maturity and background of knowledge. Response mode may not be important when the learning is easy, or the material familiar. Evans, Glaser and Homme, (1962), in fact make the converse point that the mode of response probability of responding correctly is not high, and a similar view is held by Leith and Burke (1965). Many researches in which the samples tested were not stratified in respect of ability or background (e.g. Alter and Silverman, 1962; Evans, Glaser and Homme, 1962; Hughes, 1962) have found no significant differences in learning via overt and covert responses, though learning with overt responses took longer.

2.81 Studies on Response Mode:

One of the response mode issues which has received considerable attention deals with the question of the superiority of response mode. Researchers, the world over, have tried to study the relative effectiveness of different response modes. A survey of the related studies done in this field is presented in the following paragraphs.
Ghuman (1977) in his experimental study compared progress of two groups, who used two different methods to complete M N Hoskowitz’s mathematics learning programme called ‘what are the chances? Forty, 13-14 year olds were randomly assigned to one of the two methods. Group A, read problem, think of answer, write answer, and check answer, or Group B, read problem, copy answer. The results supported the contiguity theory of Guthrie but not Skinners theory of operant conditioning. Contiguity theory of Guthrie (1952) predicts that overt responding, or constructing a response would interfere with learning for all groups. In the study by Ghuman no significant difference was found between the ‘construct or write’ and the ‘read and copy’ groups. Furthermore, the latter group took less time to finish the programme. The results of the experiment suggest that overt responding with children of even lower age group (up to 13 years) was not necessary. Since they had passed the response style of learning and the material they were learning was not completely unfamiliar.

Williams (1963) found that active responding (constructing the response or multiple choice) was superior to passively reading the programme with or without emphasis when the test items required technical terminology. The achievement from the constructed response mode was superior to the other response mode including multiple choice.

Shah (1971) experimentally compared the relative efficacies of 4 response modes in programme learning, overt constructed response, writing the response already given, covert constructed
responding and reading the response already given. Results showed that covert responding was, at least as effective as overt responding from the viewpoint of both immediate and delayed test scores.

Wittrock (1963) reported that the interaction between response mode and mental age implies that relevant overt responding may enhance learning of different concepts by primary school children, who are average in scholastic ability (IQ below 120) but that relevant overt responding may add nothing to learning of concepts by children with high scholastic ability (IQ above 120). However, the interaction was not statistically significant one year later. Goldbeck and Campbell (1962) reported a related finding - that the overt response groups performed below the covert response groups at the lowest level, but above the covert response groups at the interaction difficulty level.

Krumboltz and Weisman (1962) found that an overt response mode better only on a delayed post test, while Stolurow and Walker (1962), with another statistics programme found no significant difference, between the overt and covert response groups (though the latter learnt more quickly). Again Lambert, Miller and Wiley (1962) using a programme on sets, relations and functions with samples stratified with respect to ability found no significant difference between response modes for the higher ability levels. The significant difference between response modes were found by Tobias and Weiner (1963) working with college students, and Buckland (1967) working with 11-year olds. The importance of the nature of the materials in relation to the age and maturity of
the students was brought out by Leith and Ghuman (1967) using third, fourth and fifth formers, the covert answer group was found to be the poorest in the third form, while the overt-response group poorest in the fifth. It is suggested that the fifth formers were able to assimilate the concepts without needing to make overt responses, and they were held back when such responses had to be made.

Michael et al., (1977) studied the effect on learning when students respond to questions of different degree of complexity following segments of instruction. The study involved 5 groups of 7th grade students; questions of differing degrees of complexity were interspersed every twentieth frame of the programmed material, for three treatment groups. The fourth treatment group read a paragraph related to the questions. The fifth group acted as a control group. The groups that completed the instructional materials and responded to the interspersed questions scored significantly higher than the group that completed the instructional material and did not respond to questions.

Goldbeck and Campbell (1962), Silverman and Alter (1960), Holland (1965), reported that overt responses did however produce significantly greater learning when the subject content utilize a technical or specialized vocabulary, and when there was a time delay in the administration of the criterion measures (Goldbeck and Campbell 1962; Krumboltz and Weisman, 1962).

Theodore and Edward (1975) investigated attribute by treatment interactions between prior familiarity and response.
mode to programmed materials. The data yielded significant response mode by familiarity interactions

Based on these earlier findings and discussions in the literature, some studies suggested that there is an interaction between response mode and the subjects prior familiarity with the material to be learned. They hypothesized that overt responding would produce higher achievement if the material to be learned was new to the subjects, and that there would be no difference in achievement between the subjects exposed to different response modes for material with which the subjects were already familiar. A plausible explanation the failure of many studies to find superiority for the constructed response mode was that subject's were already familiar with the material to be learned before they began their instructional programme. It appeared that when the response was already in the subject's repertoire. There was no benefit in constructing the response, but when the response was new to the subject's constructing the response improved performance.

2.8.2 Overt Covert Distinction in the Present Study:

The review of various studies noted, clearly tells that overt responses include such activities as writing, speaking, pointing, etc, and covert responses include activities like thinking or reading silently. But no study creating different forms by introducing some intervening points along overt covert response mode variable was located. In the present study overt responding will be to ask students to construct answers and write
them down, and in covert responding the students will be asked to think the response. The investigator has felt that two more types can be fixed between overt and covert types. By asking the students to underline their responses in subsequent tasks, they are no doubt responding overtly but a little less overtly when compared to writing the response. So the second type to be introduced in the study is asking the students to underline their responses in the subsequent frames. The third type will be to ask the student to think of the answer, after reading a sentence that follows each frame, this sentence is built in such a way that it evokes thinking in the student, and it also directs the thinking, thus the third type is evoking thought response, which is definitely less covert than thinking and more covert than underlining. Thus the four types decided by the investigator for creating different forms involving response mode are written responses, underlining response in subsequent task, evoking thought response and thought response.

2.9 Two Variable Studies

Some studies employing two variables out of the three chosen variable were located and are presented below.

In an interesting study by Lewis and Whitwell (1971) the effect of reinforcement to key frames and no reinforcement, with three levels of response, overt responses to all frames, overt responses to key frames and covert response was investigated. These were worked by boys of two age groups (11 and 13 years), and learning was assessed by tests of retention, transfer and
generalization. The results showed that for the 11 year olds, covert responses produced the most learning with subsequent reinforcement. For the 13 year olds, the combination of reinforcement and overt response to key frames only produced the most learning, although differences among the separate tests were also important.

Gupta (1972) reported a study of interaction between step size and response mode for a programme in action research. Three factors were studied: viz., step size (large step, small step), response mode (overt, covert) and taxonomic category (knowledge, comprehension, application). A 2x2x3 factorial design was employed and following conclusions were drawn: Small step programme may be more effective with overt response mode; large step programme may be more effective with covert response mode; retention in learning by the large step and covert responding seemed to be higher than all other experimental groups; and small step with overt responding seemed to show least retention.

Davis (1970) studied the interaction of individual differences with the modes of presenting programmed instruction. The modes of presentation was overt versus covert responding and constructed versus multiple choice. The modes of presenting programmed instruction did not significantly affect learning outcomes. The second part of the experiment included a variable not included in the first part i.e., feedback versus no feedback. The following major experimental treatments were included in the experiment: (a) Discrimination feedback (b) Discrimination no
feedback (c) Reliability feedback. Modes of presenting programmed instruction did not significantly affect learning outcomes. No significant interactions were obtained. With one exception (reading) ability measures were not significantly related to educational treatments and appear to be of questionable value for prescribing instruction. The subjects allowed to select their own treatment modes did not do significantly better than subjects whose treatments were prescribed by the experimenters.

Monterio (1977) studied extrinsic intrinsic reinforcement and stimulus presentation viz, (a) Non-manipulative perception of prepared stimulus (SP) (b) perception of stimulus manipulated by others (PA) and (c) active manipulation of stimuli (CA). These were accompanied by 4 condition of reinforcement (i) no reinforcement (ii) individual reinforcement (iii) group reinforcement and (iv) individual and group reinforcement. Each combination of reinforcement and stimulus presentation was developed in programmed material. The results speak in favour of the CA condition, when compared to SP and PA; but no difference was observed between SP and PA.

2.10 Interest in the Present Study

The findings of studies on stepsize, reinforcement and response mode reported in the foregoing paragraphs have so frequently lacked consistency that we are still unable to make any general statement involving the variables.

A combined study of stepsize, reinforcement and response mode in programming has not attracted serious attention further
more gradual transformations in the three variables chosen at fixed points in order to create differences has not been so far attempted. Thus, the investigator of the present study was motivated to study effects of different combinations of stepsize, reinforcement and response mode on learner reading material interaction. Hence the study of the kind undertaken by this investigator is with the hope that it would yield information on the effect of learner reading material interaction on learner performance. This would have direct or indirect bearing on preparation of programmed learning material.