CHAPTER – I

INTRODUCTION

The child is born with certain biological inheritance. Biological heredity alone is not enough to enable him to develop harmoniously in a social culture. To equip him with necessary skills, information, concepts and attitudes to enable him to adjust properly in his environment, society has created a separate agency-school where he can develop all the qualities and abilities required for the successful social adjustment. Education has been defined in different ways according to the society. Education in a way is development of the desirable habits, skills and attitude, which make an individual a good citizen. In the process of Education, the person tries to shape the behavior of the young children, in accordance with aims and objectives of national life.

Education and its objectives have undergone a tremendous change in the past few years. Consideration of the changes in the nature, and status of science in twenty first century evoked massive reconsiderations of the objectives of science education. As science has come to hold a very important place in our world, our lives and our political considerations, Teaching of science has acquired great social significance. As a result the main purpose of science education is to develop the students’ “scientific temper”, a purpose that the traditional science curriculum has failed to fulfill effectively. The new science course put
emphasis on the nature and structure of science and on the processes of scientific enquiry.

Since it is understood that a change in materials alone does not automatically lead students to an improved understanding of science, the developers of new courses advocate corresponding changes in teaching technology.

In traditional teaching, lecture by the teacher and reading and recitation by students are the predominant activities, since these instructional techniques are thought to be most efficiently "covering a great deal of text material". In a typical class there are many differences between learners. It is usually impossible for a teacher to meet all the needs of each individual student at the same time so he or she must follow a course, which will present the best option for the greatest number. The results of this compromise are that some students find certain lessons proceeding too slowly while others find the same lessons too hard.

Individual differences, which have a marked influence on rate of learning, include differences in intellectual ability; differences in academic background; and differences in manner or style of learning. In regard to the last point it is becoming increasingly obvious to educators that people differ greatly in the way they think - some prefer, for example, to see things as a whole while others would rather approach an issue or area of knowledge more analytically.

Thus in present teaching the focus is to be shifted from teacher centered to student centered keeping in view
the individual differences. Hence the teachers have to develop such teaching strategies so that students can learn according to their own cognitive styles and study habits and. One of the techniques is self-learning modules.

1.1 THE CONCEPT OF MODULE

Modules are relatively a new means of instructions. A module is Self-contained, Self-pacing and Self-learning by nature but a teacher has a positive role to play in its use. According to Husen (1985) "A module is a set of experiences designed to facilitate the learner’s demonstration of specified objectives". A module is a self-contained and independent unit of instruction with the primary focus on a few well-defined objectives. The substance of a module consists of materials and instructions needed to accomplish predetermined objectives. The boundaries of a module are definable only in terms of stated objectives (Creager and Murray, 1971).

A self-learning module is one type of instructional material with which a learner can acquire knowledge, skills and attitudes in the absence of a teacher. It differs from other types of instructional materials. It is self-contained and independent of live instructions. In the words of Abedor, A.J. (1978)

“A self-learning (instructional) module is a set of self-contained material used independently by student to achieve a predetermined set of learning outcome".
A module contains three co-coordinated basic elements of instruction viz. (a) objectives (b) Learning activities and (c) evaluation. It is in these characters that the modules differ from other instructional materials. Other forms of instructional materials either do not have all the 3 elements i.e. objective, learning activities and evaluation or if they do have then the elements themselves are not coordinated. The philosophy behind instructional modules is based on the generally accepted fact that each learner is unique and is different from others in background, experience, inherent qualities, habits and learning styles, and as such should be allowed to grow and develop to the fullest potential. Modular approach is an attempt to make the instruction individualized so that the student learn at his own pace according to the interests, capabilities and capacities. Modular approach appears to be an effective and economical way of developing specific knowledge and skills with the minimum of teacher’s direction and supervision.

The modules can be prepared in different forms.. One of the unique characteristics of the modules is that they can be sub-divided into smaller modules units to meet the needs of each individual student or group of students. In other words, they can be designed for individual or group study or both. Since a module often consists of self-contained modular units, component can be used singly or in combination with others in accordance with the varied needs and interests of the students. One of the important characteristics of a module is that they are meant for self-
study and self-evaluation by a student or a group of students.

A learning module, therefore, is a package of selected information which focuses on a specified subject that has been appropriately designed to provide the learner an educational opportunity in a self-directed learning format.

No single definition of a module has been acceptable to everyone, and as a consequence, the term has been applied variously to include all sorts of units, materials, and the combinations. However, in each case a module seems to represent a self-contained instructional package covering a single conceptual unit of subject matter. The idea did not have its inception in any one individual or individual group, but was generated spontaneously by many people interested in improving education and instructional design. The use of modules grew rapidly through 1960s and 1970s and currently the modular approach is well entrenched as a means of tailoring instruction to individual needs. Nearly all individualized instructional strategies are based on the use of modules and minicourse.

1.1.1 Comparison Between Conventional Learning and Self-Instructional Module

With normal or "conventional" instruction, learners meet together regularly in classes & much of their learning is done face to face with a teacher. Although they may spend a considerable amount of time learning on their own, this will usually involve them in using materials that already exists - e.g. books & journals. That is their private study
materials will not have been created especially for them, with their particular course needs in mind.

Self-instruction, on the other hand, depends on materials specially written – or at least specially selected & modified – with particular course objectives in mind. Furthermore, they will be structured in such a way that learners do most, if not all, their learning from the materials alone. The materials must carry out all the functions a teacher would carry out in the conventional situation – guiding, motivating, intriguing, expounding, explaining, provoking, reminding asking questions, discussing alternative answers, appraising each learner’s progress, giving appropriate remedial or enrichment help. ..& so on. Table 1.1 summarises the differences between conventional learning and self-instructional modules.

**Table 1.1 Comparison of conventional learning with self-instructional modules.**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Condition of learning</th>
<th>Conventional learning</th>
<th>Self-Instructional Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Proximity in time and space of all elements to be learned enhances learning.</td>
<td>Students may not get all the information to achieve the objectives but may later have to follow up with other activities in different places and at different times.</td>
<td>It is essentially self-contained and so all information necessary is available at the same time and place.</td>
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<td>2</td>
<td>learning is more effective if individual differences are catered for.</td>
<td>Students are forced to go through the course in a lockstep manner. They begin at the same time and are expected to finish at the same time.</td>
<td>Each student can proceed at his or her own rate and is free to skip any portion of the package as long as mastery can be demonstrated. Each student is also free to repeat any portion as often as necessary.</td>
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<tr>
<td>3</td>
<td>Learning is more effective if the learners are told precisely what they should be able to do after instruction.</td>
<td>Frequently objectives are not written down and teachers are free to interpret content as they wish. Students are not told precisely the objectives of instruction.</td>
<td>Objectives are written down in clear, unambiguous terms.</td>
</tr>
<tr>
<td>4</td>
<td>Structuring a learning sequence into logical steps enhances learning.</td>
<td>Conventional materials are typically characterized by lectures, reading the text, group discussions and sometimes an isolated laboratory experience. Many a-time these experiences are not sequentially integrated.</td>
<td>Packages provide for a combination of learning experience in an integrated sequence so that each learning activity can enhance and complement the others.</td>
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<tr>
<td>6</td>
<td>Active participation in learning enhances its effectiveness.</td>
<td>The student's role is usually passive - reading the text, following instruction or just listening to the teacher.</td>
<td>Packages provide for active student participation. Students learn by doing.</td>
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</tbody>
</table>
7 Learning is more effective if learners receive information quickly on their rate of progress. In traditional courses students are reinforced and corrected only after major examinations. The package permits immediate reinforcement and correction at every step of the learning.

8 Learning as a member of a group enhances the learning of an individual. This is catered for in conventional classes although the size of the class is often too large to reap full benefit. Most learning packages are entirely individualized, but group experiences can be built in.

1.1.2 Components of a Module

The following are the main components of the module:

1. **Title.** The title of the module should be clear and concise.

2. **Introduction.** The introduction should give the background and rationale of the module as well as the target population for whom the module has been developed.

3. **Overview.** The overview introduces the learner to the theme of the module – its purpose, structure, organization and uses. It should give an overall impression of the module and its content.

4. **Instruction to the Users.** This component should include clear instructions to the learner as to how this should proceed, and what he has to do after each step or stage. This is an important component of the
module as it would help the learner in self-learning. Most of the instructions are relating to the different components of the module such as how to take pre-test, formative test, summative test and how to undertake learning activities etc., can be given in this section. Some of the specific instructions related to evaluation and learning activities can also be given at the appropriate stage.

5. **Entry Behaviour Test.** Sometimes it is necessary to include a test specially designed to check whether the students have necessary background to understand the module. The pre-test is taken by the learner at the beginning. This helps to find out the level of knowledge and skills that the learner already has. This helps the learner to find for himself the entry points in the module. If they fail this test than they should be advised on how to catch-up by means of reading, solving problems or completing specified practical task.

6. **Objectives.** The instructional objectives of the module should be clearly stated. They should specify the expected learning outcomes in terms of behaviour. A behavioural objective should be stated clearly and precisely so that the learner would know what the learning outcome of a given activity would be.

7. **Learning activities.** Learning activities should be provided in a planned and sequenced manner. These
activities enable the learner to develop behavior in a pre-determined direction.

8. **Formative tests.** Formative tests are given at the end of each learning unit or learning activity. The formative tests help the learner to know whether he has achieved the expected behavioural outcomes. If he has not reached the expected masterly level, he should go through the learning activities again in consultation with the teacher.

9. **Summative Evaluation.** The summative evaluation is done with the help of a post-test. The post-test helps in knowing how well the learner has attained learning outcomes. In some modules the pre-tests and the post-tests are the same but it is advisable to have two parallel versions of the same test.

**1.1.3 DEVELOPING A MODULE**

The following are the steps, which can be used for developing a module:

1. Identify the target group.
2. Identify learning needs of the group.
3. Decide terminal behaviour.
4. Identify entry behaviour.
5. Assessment of entry behavior through pre-test.
6. Teaching frames including objectives, learning activities, formative evaluation and summative evaluation.
7. Try-out of the module.
8. Revision and finalization of the module.

1.1.4 ESSENTIAL CHARACTERISTICS OF SELF-LEARNING MODULE

Researches on instructional processes have shown that the existence of certain characteristics in instructional material greatly improves learning.

In a self-learning module some of the important and essential characteristics that should be present for effective learning are listed as follows:

1. **Essentially Self-Contained:** Most modules contain within themselves all the material needed to achieve the objectives of the module. Frequently the term "package" is used in connection with self-instructional materials such as modules and this reflects the idea of a "closed" self-contained unit.

2. **Self-Instructional:** the student using module is given the opportunity to conduct self-paced study with in-built "instant-replay". Furthermore modular packages can be sequenced in a variety of patterns to build unique courses of study catering for students with different interests and needs.

A basic assumption made in the development of any self-paced learning package is that learning is a process, which must be undertaken by the learner. Responsibility for learning shift from the teacher to the student. Self-instructional systems such as module are student-centred.
3. **Concern for Individual Differences:** Self-instructional modules allow the rate of learning to be adjusted to suit the needs of each individual student. The slow learner is able to repeat any part of the package, which was found difficult. Fast learners can move more quickly provided they could demonstrate achievement of the objectives set for that module. In many cases students using modules can work alone and this frees them from keeping to the average pace of a group.

4. **Statement of Objectives in behavioural terms:** It almost goes without saying that students learn more efficiently when they have a clear directive about what is it they should learn. Clearly stated objectives have a key role for those who write modules, for the teacher who uses them and for the student studying them. At the developmental level statements of objectives give direction and focus. Well-stated objectives give the developer criteria for the selection of subject matter, learning activities and test items. He or she knows exactly what the learner is expected to achieve and so can design all aspects of the module to meet each objective. The teacher gains insight into the suitability of the module for his or her students and can closely monitor progress towards the achievement of the objectives. For the student, objectives exactly describe what is expected and provide goals to be mastered. Each student's learning activities become goal oriented. Modular packages therefore take full advantage of the benefits of a clear statement of objectives.
5. Optimal Association, Sequence and Structure of Content: In construction of a module close attention is given to the most appropriate sequencing of meaningful material. Basic ideas upon which subsequent information is dependent are presented first. This is in line with views by educators such as Robert Gagne who claim that instruction is most effective when information is sequenced as a hierarchy of ideas. Simpler concepts lead to more complex ideas. In a module each terminal objective requires its own hierarchy.

Gagne would cater for individual differences in the backgrounds of learners by letting each student start at an appropriate point in the hierarchy. Other educators such as Robert Mager would prefer to respond to individual differences by allowing each student to generate his or her own learning sequence, relating what needs to be known to what is already known. According to this view if the sequence of learning events does not suit a student, then with appropriately designed self-instruction he or she is free to alter the sequence to suit specific needs.

It is easy to see how modular instruction can accommodate both the Gagne and Mager points of view. By inspection of published objectives students can choose only those learning sequences within a module that are relevant to their needs (Gagne) and can also select and sequence modules according to their individual requirements (Mager).
6. **Utilization of a Variety of Media and Methods:** It is well established that students differ in their responsiveness to different media of instruction. Modules have the further characteristic of providing opportunities for a wide variety of methods of instruction, varying say, from straight out reading, through problem solving and discussion sessions, to practical work and the exploration of media. In this way, they avoid monotony and maintain interest and motivation.

7. **Gaining and Maintaining Attention:** Gaining and maintaining learner’s attention is very important in self-learning but is one of the most difficult jobs in instructional design. Research has shown that the most successful method of gaining and maintaining attention is through skill of stimulus variation. Frequent variation in instructions to the learners. Various techniques suggested by different educationists for gaining and sustaining attention are:

   - Use of Diagrams, sketches, charts, photos, cartoons
   - Use of in text question
   - Use of humor
   - Introduction of variety of activities
   - Use of techniques of emphasizing underlining, capitals, or use of boxes etc

8. **Information provided on Progress (i.e. Feedback):** An important characteristic of modules is that they provide continuous feedback to students on their performance and especially to their progress towards achieving objectives. They do this by building in at frequent
interval in-text questions, checklists and quizzes and by immediately providing answers to these so that students can themselves check up on their levels of knowledge, understanding and skill. Modules generally require students to make regular written responses and the correct or model answer is then provided on the next page. Students who fail to answer correctly quickly see where they went wrong and can return to appropriate learning sequence to improve their knowledge and understanding. This is one of the most important characteristics of modules.

9 Immediate Reinforcement of Response: Closely related to the previous point is the question of reinforcement. By reinforcement in this context is meant consolidation of learning through reward for success. Self-instructional modules use reinforcement of correct responses to shape behavior. As we have seen above, students are more in control of the size of each learning step. Students can see immediately if they are right or wrong. If they have been conscientious in studying the material they are usually correct. The satisfaction gained from success provides rewards, which are the basis of reinforcement. As in the case of feedback, reinforcement is most effective if it is immediate and modules provide this immediacy.

10 Active Participation by the Learner: Modules characteristically encourage students to actively participate in the lesson. Since students are usually in control of the lesson, they decide when to move ahead, when to study a
particular specimen, when to answer questions, and whether or not to repeat a section, which has not been well understood. Modules also encourage maximum participation by their very design. They continually pose questions; instruct in activities and challenge learners to achieve specified objectives. Active participation is guaranteed.

11. Mastery Evaluation Strategy: The most effective modules utilize a system of student assessment, which requires mastery of the objectives. By mastery is meant achievement of a preset standard as judged by a prescribed criterion or level of performance. It is assumed that students will "master" one module before proceeding to the next in a sequence.

Modules, and sometimes units within modules, usually conclude with a carefully structured mastery test with items corresponding one-to-one with the objectives. Students can check off which objectives have been attained and which have not been attained.

Thus, while developing a self-learning module the above mentioned characteristics should be taken care of, so as to make the self-learning module more effective.

1.1.5 ADVANTAGES OF SELF-LEARNING MODULES

The modular approach offers avenues for individualized study on the part of the students. The following is a list of some of possibilities inherent in such a scheme of study for the students.
(1) The student must be involved in the learning process so his or her commitment to the task is likely to be enhanced.

(2) A large pool of modules will permit students to explore portions of subjects of particular interest.

(3) The students have full control of the rate of study, thus they can progress at their own pace.

(4) Students are not forced to cover materials, which are already known to them.

(5) The consequences of failure are reduced, each student can master each module completely before proceeding to the next.

(6) Each student has the opportunity to develop a sense of responsibility for his or her own learning.

As we have seen that the main driving forces behind the introduction of modules lies in the fact that they have roles that can help solve key educational problems. This is largely because they satisfy the basic conditions to promote efficient learning and are extremely flexible in execution. In addition they have several possible advantages in administration also as Modules are economical to use. Modules can be exportable from one campus to another so that the expense of preparation can be shared among institutions. Many can benefit from the modules prepared at any one institution. Thus, despite the fact that initial cost of design and development of modules are high they are ultimately extremely cost effective.
1.2 PROCESS SKILLS

One of the most important and pervasive goals of schooling is to teach students to think. All school subjects should share in accomplishing this overall goal. De-Duve (2002) has characterized science as being “based on observation and experimentation guided by reason and this combination is what distinguishes science from other paths of knowledge" Science contributes its unique skills, with its emphasis on hypothesizing, manipulating the physical world and reasoning from data. The major goals of teaching science in schools include making students competent to deal with scientific issues, recognize the relevance of science to their everyday life and societal issues, communicate effectively with others about science and solve problems using their scientific knowledge. But mechanical transmission of contents and processes of science to the students in the classroom cannot achieve this goal. It is required to actively involve the students in scientific activities and help them to use different processes like scientists.

The older view relating to teaching science was to transfer the knowledge established by the scientists to the students which was considered as product approach but today, Science and teaching students about science means more than scientific knowledge it is considered to supplement product approach with process approach i.e. to include skills that scientists use in the process of doing science. Since science is about asking questions and finding
answers to questions, these are actually the same skills that we all use in our daily lives as we try to figure out everyday questions. When we teach students to use these skills in science, we are also teaching them skills that they will use in future in every area of their lives.

The scientific method, scientific thinking and critical thinking have been terms used at various times to describe these science skills. Today the term “science process skills” is commonly used. Popularized by the curriculum project, Science – A Process Approach (SAPA), these skills are defined as a set of broadly transferable abilities, appropriate to many science disciplines and reflective of the behavior of scientists.

Since 1960, the emphasis on science process skills in science curricula has made its acquisition as one of the major goals of teacher education program. Several studies have indicated that teachers who are proficient in process skills use strategies that give children opportunities to learn those skills (Butts and Raun, 1969; Ashley and Butts, 1972; Jaus, 1972) Tamir and Amir (1987), Germann (1989) and Ugru (1990) have made many attempts in the area of development of process skills.

1.2.1 SIX BASIC PROCESS SKILLS

The science process skills form the foundation for scientific methods. There is a strong belief that children who are properly introduced to science through process skills will find the skills useful throughout life while it is possible...
to forget science content; process skills tend to remain with many individuals for relatively longer period. There are six basic science process skills:

- Observation
- Communication
- Classification
- Measurement
- Inference
- Prediction

These basic skills are integrated together when scientists design and carry out experiments or in everyday life when we all carry out fair test experiments. All the six basic skills are important individually as well as when they are integrated together.

The six basic skills can be put in a logical order of increasing sophistication, although even the youngest students will use all of the skills alongside one another at various times. In the earliest grades students will spend a larger amount of time mastering skills such as observation and communication. As students get older they will start to spend more time using the skills of inference and prediction. Classification and measurement tend to be used across the grade levels more evenly, partly because there are different ways to do classification and because methods and systems of measuring must also be introduced to children gradually over time.
Integrating the basic science process skills together and gradually developing abilities to design fair tests is increasingly emphasized in successive grade levels. The Virginia Standard of Learning (SOL) 4.1 for fourth-graders includes, for example, creating hypotheses and identifying and manipulating variables in simple experiments. At this level, the students are beginning to really ask and answer their own questions in a scientific sense.

Science Begins With Observation

Observing is the fundamental science process skill. We observe objects and events using all our five senses, and this is how we learn about the world around us. The information, gained through observing leads to curiosity, questioning, thought and forming interpretations about the environment, and further investigation. The ability to make good observations is also essential to the development of the other science process skills such as communicating, classifying, measuring, inferring, and predicting. Martin (1972) was more explicit:

"Scientific theories are primarily tested against observation and accepted, rejected, or modified mainly because of observational data. Observation is thus generally considered to be the touchstone of objectivity in science; it seems to be primarily observation that provides an independent standard for the evaluation of theories and hypotheses. If it were not for observation, there would be little reason for choosing between scientific theories and
fictional accounts, between science and pseudoscience, between warranted assertions and fanciful hopes."

The students, especially younger children, need help in order to make good observations. The students should be encouraged to make detailed descriptions of their observations of the phenomenon so that they can increase their understanding of the concepts being studied. There are many ways to prompt the students to make more elaborate descriptions. For example, if something is changing, students should include, before, during and after appearances in their observations.

Observation And Communication Go Hand In Hand

Students have to communicate in order to share their observations with someone else, and the communication must be clear and effective if the other person is to understand the information.

Students can communicate their observations verbally, in writing, or by drawing pictures. Other methods of communication that are often used in science include graphs, charts, maps, diagrams, and visual demonstrations.

Classifying Into Groups

Students in the early grades are expected to be able to sort objects or phenomena into groups based on their observations. Grouping objects or events is a way of imposing order based on similarities, differences, and interrelationships. This is an important step towards a
better understanding of the different objects and events in the world.

There are several different methods of classification. Perhaps the simplest method is serial ordering. Objects are placed into rank order based on some property.

**Measurement**

The additional science process skill of measuring is really just a special case of observing and communicating. When we measure some property, we compare the property to a defined referent called a unit. A measurement statement contains two parts, a number to tell us how much or how many, and a name for the unit to tell us how much of what. The use of the number makes a measurement a quantitative observation.

**Making Inferences And Predictions**

Unlike observations, which are direct evidence gathered about an object, inferences are explanations or interpretations that follow from the observations. For example, it is an observation to say an insect released a dark, sticky liquid from its mouth, and it is an inference to state, the insect released a dark, sticky liquid from its mouth because it is upset and trying to defend itself. When we are able to make inferences, and interpret and explain events around us, we have a better appreciation of the environment around us. Scientists’ hypotheses about why
events happen as they do are based on inferences regarding investigations.

Students need to be taught the difference between observations and inferences. They need to be able to differentiate for themselves the evidence they gather about the world as observations and the interpretations or inferences they make based on the observations. We can help students make this distinction by first prompting them to be detailed and descriptive in their observations. Then, by asking students questions about their observations we can encourage the students to think about the meaning of the observations.

Making predictions is making educated guesses about the outcomes of future events. We are forecasting future observations. The ability to make predictions about future events allows us to successfully interact with the environment around us. Prediction is based on both good observation and inferences made about observed events. Like inferences, predictions are based on both what we observe and also the mental models we have built up from our past experiences. Predictions based on our inferences or hypotheses give us a way to test those inferences or hypotheses. If the prediction turns out to be correct, then we have greater confidence in our inference / hypothesis. This is the basis of the scientific process used by scientists who are asking and answering questions by integrating together the six basic science process skills.
Bloom has identified the following process of scientific inquiry.

1. **Observing and measuring** which includes following subcategories.

   (i) Observation of objects and phenomena.
   
   (ii) Description of observation using appropriate language.
   
   (iii) Measurement of objects and charges.
   
   (iv) Selecting the appropriate measuring instrument.
   
   (v) Taking account of the calibration margin of a measuring instrument.

2. **Seeing a problem & solving ways to solve it**: -

   It includes the following subcategories.

   i. Recognition of a problem: - The recognition of a problem may pass through several stages from an awareness of the problem area of the identification of a specific problem that can be investigated experimentally.
   
   ii. Formulation of a working hypothesis: - It would give direction to the investigation.
   
   iii. Selection of suitable tests of a hypothesis: - It involves choosing a particular empirical approach or a series of experiments that logically can verify the hypothesis if it is correct. This subcategory is concerned with the question whether or not a
proposed experiment constitutes a valid test of the hypothesis; it is not concerned with the manipulative details of an experiment or the construction & use of apparatus these latter concern are included the next subcategory.

iv. Design of appropriate procedures for performing experimental tests.

3. **Integrating data and formulating generalizations:**

   experimental data are obtained by the student in the form of recorded observations and measurements, and he must process these data to yield values for the quantities under study. This process skill includes following subcategories.

   i. **Processing of experimental data:** It is concerned with the students' behaviour in manipulating, adjusting and organizing his observations and measurements other aspects of data processing that fall under this category are organizing data in tables or in other readily readable formats and for more advanced science students, carrying out an error analyses.

   ii. **To make a presentation of data in the form of a functional relationship.**

   iii. **Interpretation of experimental data and observations:** This is the first stage in the students' analysis of the results of his experiment. If the
observations are qualitative, their interpretation involves collating them mentally and formulating a discrete concept of what the experimental results signify. In the data are presented I the form of a graph, their interpretation also includes formulating a conception of the trends or the functional relationship displayed and translating this information into an equivalent verbal or symbolic form.

iv. Extrapolation of functional relationship beyond actual observations and interpretation between the observed points.

v. Evaluation of a hypothesis under test in the light of experimental data obtained.

4. Building, Testing and revising a theoretical model

5. Application of scientific knowledge and methods

6. Manual Skills

In summary, successfully integrating the science process skills with classroom lessons and field investigations will make the learning experiences richer and more meaningful for students. Students will be learning the skills of science as well as science content. The students will be actively engaged with the science they are learning and thus reach a deeper understanding of the content. Finally active engagement with science will likely lead students to
become more interested and have more positive attitudes towards science.

1.3 STUDY HABITS

A good learning does not depend on good teaching alone but on satisfactory learning procedures also, efficient learning depends upon the learner's ability to schedule his time, the plan of his study, the habit of concentration, note taking, mental review over learning, the judicious application of whole and part method, massed and distributed learning and so on. In other words, learning involves the development of proper study habits and skills. A study habit implies a sort of more or less permanent mode and method of studying.

According to Good’s Dictionary of education (1973) “Study habits is the tendency of a pupil or students to study when opportunity is given, the pupils’ way of studying whether systematic or unsystematic, efficient or inefficient.

It has been found that those who have good study habits excel others of equal intelligence.

Many capable children at all grade levels experience frustration and failure in school. It's not because they lack ability, but because they do not have adequate study skills. Good study habits are important for success in school. Knowing how to study effectively fosters feelings of competence, develops positive attitudes, and helps children realize they can control how well they do in school and in
life. Good study habits also lay the groundwork for successful work habits as an adult. Thus one of the continuous objective of teaching should be the improvement of study habits and skills of the students .as it is a common belief that a man who does not have good study habits, how far intelligent, capable and proficient he may be, cannot be an efficient learner.

Singh, H., (1984), Patel (1986), have found a positive and significant correlation between study habits and achievement. Patel M. R. (1996) found that pupils with good habits get significantly more achievement than those of poor study habits. Thus study habits of a person play a very important role in his learning.

1.4 COGNITIVE STYLES

Cognitive style is broad dimension of individual differences that extends across both perceptual and intellectual activities. A comprehensive review of research in cognitive psychology has indicated that people exhibit significant individual differences in the cognitive processing styles that they adopt in problem solving and other similar decision-making activities (Robertson, 1985). As for individual differences, different researchers have different definitions and conduct research from different perspectives accordingly. However, findings from both qualitative and quantitative research have indicated several consistent major dimensions of individual differences (Dunn, DeBello, Brennan, Krimsky, & Murrain, 1981; Riding & Cheema,
The construct of cognitive styles was originally proposed by Allport (1937), referring to an individual's habitual or typical way of perceiving, remembering, thinking, and problem solving. Since then, especially in the last few decades, there has been additional considerable research in this area. Cognitive style has been broadly investigated by psychologists. There are many different definitions of cognitive style. Tennant (1988) defined cognitive styles as "an individual's characteristic and consistent approach to organizing and processing information" (p. 89). Riding, Glass, and Douglas (1993) termed cognitive styles as "a fairly fixed characteristic of an individual" (p. 268) and "are static and are relatively in-built features of the individual" (p. 268). Based on the above definitions, cognitive styles refer to the individual's consistent and characteristic predispositions of perceiving, remembering, organizing, processing, thinking, and problem solving. The way we learn things in general and the particular approach we adapt when dealing with problems is said to depend on somewhat mysterious link between personality and cognition. This link is referred to a cognitive style.

Cognitive style can generally be described as the manner in which the information is acquired and processed. Cognitive style measures do not indicate the content of the information but simply how the brain perceives and processes the information.

It has been observed that certain individuals tend
to respond very quickly in most situations (impulsive cognitive style) others are more reflective and slower to respond (reflective cognitive style), even though both types of individuals are equally knowledgeable about the task at hand. Cognitive styles thus suggest that individuals approach the same task in different ways but those variations don't reflect level of intelligence or patterns of general abilities.

1.4.1 FIELD DEPENDENCE-INDEPENDENCE COGNITIVE STYLE

Work on cognitive styles of field dependence-independence has resulted in the formulation of various concepts and methods and these are increasingly being applied to research on problems of education. The field dependence-independence dimension was first proposed by Witkin (1962; 1979). According to Witkin, field dependence-independence is value-neutral and is characterized as the ability to distinguish key elements from a distracting or confusing background. Field dependence-independence has important implications for an individual's cognitive behavior and for his/her interpersonal behavior. The construct has been related to intellectual functioning and to hemispheric functioning and these two variables have been related to each other.

The concept of field dependence emerged initially from the studies of perception of the upright in space conducted by Witkin el al (1954). Through the various studies of RAT (Room Adjustment Test), BAT (Body Adjustment Test), and
Field-dependence-independence refers to a consistent mode of approaching the environment in analytical terms. People differ in the extent to which their perception is analytical. The field may be perceptual or it may be abstract, such as a set of ideas, thoughts, or feelings from which the task is to perceive specific subsets. The field-independent person is able to concentrate the relevant items while withholding attention from irrelevant items. They thus tend to perceive figures as discrete from their backgrounds. They are generally more facile on tasks requiring differentiation and analysis. FI hinges on the perceptual skill of "seeing the forest for the trees". A person who can easily recognize the hidden castle or human face in 3-D posters and a child who can spot the monkeys camouflaged within the trees and leaves of an exotic forest in colouring books tend toward a field independent style. Field dependence is, conversely, the
tendency to be “dependent” on the total field so that the parts embedded within the field are not easily perceived, though that total field is perceived most clearly as a unified whole.

Field-dependent persons have trouble, breaking information down into units and recombining the parts into new patterns. Such individuals cannot withhold attention from the context in which the relevant figure is embedded. Research data points out that field Dependence-independence extends into psychological domains beyond cognition (Witkin, 1976). Such individuals differ from each other in important personal characteristics and in interpersonal relations. Specifically, field independent people tend to be more autonomous in relation to the development of cognitive restructuring skills and less autonomous in relation to the development of interpersonal skills. Conversely, field dependent people tend to be more autonomous in relation to the development of high interpersonal skills and less autonomous in relation to the development of cognitive restructuring skills. Listed below are the principal characteristics of the two cognitive styles
Table 1.2

Characteristics of Field Dependent and Independent Individuals

<table>
<thead>
<tr>
<th>S.No</th>
<th>Field dependent</th>
<th>Field independent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Are better at learning material with social content</td>
<td>May need help in focusing attention on material with social content</td>
</tr>
<tr>
<td>2</td>
<td>Have better memory for social information</td>
<td>May have to be taught how to use context in understanding social information</td>
</tr>
<tr>
<td>3</td>
<td>Require externally defined structures, goals and reinforcement i.e. self view is derived from others</td>
<td>Tend to have self defined goals and reinforcement i.e. have sense of separate identity</td>
</tr>
<tr>
<td>4</td>
<td>Are more affected by criticism</td>
<td>Are less affected by criticism</td>
</tr>
<tr>
<td>5</td>
<td>Have greater difficulty in learning unstructured material.</td>
<td>Can impose their own structures on unstructured situations</td>
</tr>
<tr>
<td>6</td>
<td>Holistic i.e. perceive a field as a whole; parts are fused with background</td>
<td>Analytic i.e. perceive a field in terms of its component parts; parts are distinguished from background.</td>
</tr>
<tr>
<td>7</td>
<td>May need more explicit instructions on how to solve problems</td>
<td>Are more likely to be able to solve problems without explicit instructions and guidance.</td>
</tr>
</tbody>
</table>

Evidence of differences in characteristics falling in domain of social behaviour between Field dependent and field independent individuals is impressive. Field dependent (global) individuals tend to identify more with a group, and are susceptible to external influence and markedly affected by isolation from other people. Thus, they tend to more oriented towards people and social relationships, work best in groups and prefer such subjects as history and literature while Field independent individuals are more likely to do well with numbers, science and problem solving tasks (Shuell, 1981). Taken collectively, the social characteristics
that distinguish persons with contrasting styles suggest that relatively Field dependent persons are likely to be attentive and make use of prevailing social frames of references. On the other hand Field independent individuals tend to have a more impersonal orientation, not sensitive to social undercurrents "unaware of their social stimulus value and individualistic".

Thus these social domain characteristics of Field dependence-independence can be linked up with classroom situations so as to produce differences in achievement. Witkin, Moore, Goodenough, and Cox (1977), have also inferred that field independent persons tend to be intrinsically motivated and enjoy individualized learning, while field dependent ones tend to be extrinsically motivated and enjoy cooperative learning.

One valuable use of knowledge about the effects of student's cognitive styles, studied individually or in interaction with instructional strategies, may be to provide guidelines on how to adopt teaching strategies to match the learning needs of dissimilar students. Teachers' adaptation will be a realizable goal if we are able to identify particular teaching strategies, which teachers may use either spontaneously or with training, when teaching students with different cognitive styles. (Witkin et al, 1977)

1.5 EMERGENCE OF THE PROBLEM

The main aim of education is to prepare the individual for later life, as life is full of unforeseen problems, the
education system should aim at not only providing bookish knowledge but also practical skills to tackle all situations arising in day to day life. That is why most of the modern curricular designers for school curriculums have stressed that reasonable portion of the school curriculum should emphasize the development of process skills among students.

Process skills are also sometimes referred to as the scientific process and these are the tools which most rational human beings use. With this tool the problems are unraveled and solutions found. In complex societies the individual will be facing large number of problems and his adjustment will depend upon his capabilities to solve the problems successfully. The main role of teacher is to provide such opportunities to the students so as to develop process skills among them. By using a process skills approach to classroom instruction the student will become "owner" of his/her content knowledge and will be able to benefit in a "real-life" application of the units of study. Each student will be participating in the construction of the concept being taught and therefore will be in control of level of knowledge he/she gains.

A number of methods of teaching have been developed for teaching different subjects at different levels. The attempts are being made to bring necessary reforms and improvements in the organization of learning experiences at the various level of education in our country as well as abroad. More emphasis is being laid over methods and
techniques that may help the students to acquire process skills or problem solving skills instead of merely helping them to acquire knowledge. As a result the method that promote self-learning and discovery are being duly promoted in the teaching learning process.

Traditional education was based on the assumption that knowledge could be transmitted in the learner by a sort of intellectual feeding process. Thus subject was taught according to will of the teacher and little attention was paid to the eagerness, curiosity and the capabilities of the pupils. But soon, this gave way to child centered education due to efforts of progressive educationists. As a result education has become predominantly child centered, valuing the individual child. Now, in the present era individualized approach is more emphasized. In such an approach significance of individual differences among learners is taken into account. The main goal of individualized instruction is that each child’s learning is self initiated and self directed and he/she should learn to learn at their own pace.

The learning through self-learning modules is one such technique which gives consideration to individual differences. The differences in study habits, intellectual ability, academic background and cognitive styles of the learners have a great impact on the rate of learning. Thus it is obvious that people differ greatly in the way they perceive things. The students having good study habits learn better than those having poor or bad study habits, similarly it has
been found that field independent persons, being intrinsically motivated prefer individualized learning and field dependent who are extrinsically motivated and enjoy cooperative learning. Thus, if we want to give new dimensions to the field of education we must develop some alternate self-learning modules suiting to the individual cognitive styles and study habits.

These are some factors, which motivated the investigator to undertake the present study. Moreover, very few researches have been done in the field of self-learning modules to determine their effectiveness. The present study was undertaken to develop self-learning modules in science for IX class students and thereby determine its effectiveness in acquisition of process skills in relation to their cognitive styles and study habits.

1.6 STATEMENT OF THE PROBLEM

The problem reads as “Effectiveness of Self-Learning Modules In Acquisition of Process Skills In Relation To Cognitive Styles And Study Habits of IX Class Students.”

1.7 OBJECTIVES OF THE STUDY

Following are the major objectives of the study:

1. To develop and standardize a process skill test specifically for class IX students

2. To develop self learning modules in selected topics of science for class IX students
3. To find out whether self-learning modules result in better acquisition of process skills as compared to lecture method.

4. Whether cognitive styles have any effect on acquisition of process skills irrespective of teaching strategy.

5. Whether the students with different study habits differ in acquisition of process skills irrespective of teaching strategy.

6. To study the interactional effects of teaching strategies and study habits on acquisition of process skills

7. To study the interactional effects of teaching strategies and cognitive styles on acquisition of process skills

8. To study the interactional effects of study habits and cognitive styles on acquisition of process skills

9. To study the interactional effects of teaching strategies, study habits and cognitive styles on acquisition of process skills

1.8 HYPOTHESES

The present study was conducted to test the following hypotheses:

1. There will be no significant difference in acquisition of process skills between the groups with regards to teaching method.

2. There will be no significant difference in acquisition of process skills with regard to study habits.
3. There will be no significant difference in acquisition of process skills of groups having different cognitive styles.

4. There will not be any significant interaction between instructional strategies and study habits.

5. There will not be any significant interaction between instructional strategies and cognitive styles.

6. There will not be any significant interaction between level of cognitive style and study habits.

7. There will not be any significant among teaching strategies x cognitive styles x study habits.

1.9 DELIMITATIONS OF THE STUDY

1. The population of the present study was limited to the students studying in schools located in Chandigarh only and affiliated with central board of secondary education

2. The study was limited to the sample of students of class IX only.

3. The self-learning modules were prepared on some selected topics from IX class science syllabus of central board of secondary Education.

4. The study was limited to the schools having English as medium of instruction.