CHAPTER: I

INTRODUCTION
1. INTRODUCTION

Today as we focus our attention on giving quality education to million of children in our schools, we find a paradigm shift taking place in the basic process of education—from ‘teaching to learning’ to helping to know. These days we quite often come across questions among the academics and educational researchers like: Are we justified in ‘loading’ the child’s head with tons of knowledge? Are we doing right thing by giving the learner what we know? Apart from the issues like correctness of what we know and the transmission losses in giving and does teaching mean depositing the knowledge, if so, what is self-life of such knowledge, how long such knowledge is relevant, how much can be received, contained and retained by the learner. This perplexity has reined the field of education and for a long period of time we were content with depositing the accumulated knowledge ignoring the burden of learning on the part of children. This has lead to high dropout-rate and increasing level of anxiety resultant to frustration among learners.

Therefore the educationists and the intellectuals have started thinking about such innovative educational practices that can make learning pleasant experiences worth having.

Even before aversion to learning has arisen in the minds of our young learners, it is augury that we have not only realized limits in bookish learning but started looking for better ways of ensuring learning through effective ways of teaching. If knowledge is not
to be seen as a ‘community’ to be acquired through transmission, but as a subjective experience then learning is required to take place within the individual. Learners are creating their own knowledge through the process of understanding during their encounters with reality-involving objects, person and events. It is not utopian or platonic ideal but experiencing the empirical reality through myriads of encounters resulting in schematizations of being and reorganization of being known, the process of assimilation and accommodation facilitate construction of reality as one’s own knowledge.

The child through his own encounters discovers and constructs his reality. Now if this is, what we think is required to happen in the life of a young learner then we are certainly looking for an alternative to depositing knowledge. The alternative apparently is found in the constructs of constructivism. The constructivism is an epistemology, a learning or meaning-making theory. Knowledge according to constructivist approach is acquired through involvement with content instead of imitation or repetition.

In traditional method of teaching-learning in our secondary schools, teacher is the provider of knowledge and students are required to memories their knowledge generally in the form of laws, formulae or theory and reproduce the same in examination. These methods are based on the objectives view of knowledge and ignore the inquisitiveness of learners and their ability to construct new knowledge.

Constructivism is a relatively new paradigm when taken into account the subjective, contextual and pluralistic nature of knowledge. According to constructivist, learners construct knowledge in social and cultural context in which they are embedded. The knowledge can be expressed in a numbers of language and symbol forms. A problem
can have a number of viable solutions. The constructivist thinking has been considered important to achieve the objective of learning to live together, learning to learn, learning to know and learning to be. (Delor’s commission 1996).

Constructivism is the term given to a range of theories about knowledge and learning which seek to explain what “knowing” is and how we ‘come to know’, based on work in psychology and anthropology. Constructivism views knowledge as temporary, developmental, internally constructed and socially and culturally agreed upon. Learning is viewed as a self regulating process of the struggle with the confusion between existing personal models of the world and conflicting new ideas new representations and models of reality are built or constructed as a human ‘meaning-making’ venture with culturally developed tools and symbols. Meaning is negotiated through cooperative social activity, discussion and debate. This explores the dimensions of Constructivism through a discussion of Jean Piaget and Lev Vygotsky.

There is a tradition of the teacher being at the top of hierarchical ladder in the unknowing, subject to study and learn. Using a Constructivist approach however, what teacher knows will begin to wane it influence as a teacher assume more of a facilitator’s role and the learner takes on more ownership of the ideas, independence, compatibility of social relations and empowerment are the goals within the constructivist classroom.

Constructivism, as developed by Jean Piaget differs from other theories of cognition in that, what we call knowledge, does not have purpose of producing representation of an independent reality, but intend has an adaptation function. This assessment of cognitive activity breaks away from the generally accepted ideas that individual must have knowledge to obtain a picture of the real world; Piaget theorized that adaptation opens
a path into knowledge. The concept of adaptation is derived from biology and suggests the relationship between living organism evolving and fitting in with their environment.

Piaget used his theory of Biological adaptation as the cornerstone of his research. He had realized from his studies of Biology that whatever knowledge was, it was not the copy of reality.

In Piaget's view what we see, hear and feel is the result of our own perceptual activities and is therefore, specific to our ways of perceiving and conceiving.

Knowledge, for Piaget arises from actions and the subject's reflection on them. When Piaget talks about interactions, he does not imply as organism that interacts with objects as their reality are but rather as a cognitive subject that is dealing with previously constructed perceptual and conceptual structure. The conceptual structures that constitute meaning or knowledge are not entities that could be used alternatively by different individuals. They are constructs that each user has to build up for him or herself. Because they are individual constructs, one can never say whether two people have produced the same construct.

What is Constructivism?

Constructivism is a view of learning based on the belief that knowledge isn't a thing that can be simply given by the teacher at the front of the room to students in their desks. Rather, knowledge is constructed by learners through an active, mental process of development; learners are the builders and creators of meaning and knowledge.

in an important way, depends on what we already know; new ideas occur as we adapt and change our old ideas; learning involves inventing ideas rather than mechanically accumulating facts; meaningful learning occurs through rethinking old ideas and coming to new conclusions about new ideas which conflict with our old ideas. A productive, constructivist classroom, then, consists of learner-centered, active instruction. In such a classroom, the teacher provides students with experiences that allow them to hypothesize, predict, manipulate objects, pose questions, research, investigate, imagine, and invent. The teacher's role is to facilitate this process.

According to Fosnot (1996) "Constructivism is not a theory of teaching, it is obvious that it is a completely different approach to instruction from that which is used in most school". Teachers who base their practice on Constructivism principles reject the notion that meaning can be passed onto learners via transmission or symbols, that learners can incorporate exact copies of teacher understanding for their own use, that whole concept can be taught out of context. A Constructivist view of learning suggests an approach to teaching that gives learners the opportunity for concrete meaningful experience within which they can search for patterns, devise their own questions and construct their own models, concept and strategies.

The classroom in their model is seen as a mini-society, a community of learners engaged in activity, discussion and reflection, it is in either small group or a whole classroom situation (Cobb, 1995).

The Constructivist view of knowledge: In Constructivist perspective knowledge is based on assumption that it is not a representation of world outside the human mind but it holds that knowledge is under all circumstances constructed by individual
thinker as an adaptation to subjective experience. (Glasersfeld, 2000). Knowledge is not simply transformed knowledge given to someone who lacks it. Knowledge cannot be simply given to another individual. Constructivism challenges the view that education is a process that can be characterized as “filling the empty heads of students”. Learning is an active knowledge construction process. The principle of an active knowledge, construction has fundamental consequences for pedagogical practice and the role of the teacher. The teacher is not the person who possess true knowledge, who has all the right answer and persuades the students to see think in his ways.

Constructivist view of learning. Piaget believed that learning is strongly influent by the learner’s developmental stage. Learners move through indefinable stage of physical intelligent emotional and social growth that determine what can be learned and with what depth of understanding. Learners learn best they are at their proximal stage of development. Learning involves metacognition, which reflects on one’s learning process. The nature of the learning task is crucial for learning to take place. The learning task of optional difficulty, authenticity and relevancy enhance learning. Challenging and novel task help students to stretch their effort. There are some basic characteristics of learning in Constructivist approach like:

- Learning is not a passive receptive process but is instead an active meaning-making process required to solve meaningful problems.
- New learning depends on learner’s previous knowledge, which may sometimes interfere with understanding of new information.
- Learning implies the reorganization of prior conceptual schemes.
- Learning is facilitated by social interaction.
• Meaningful learning occurs within authentic learning tasks.

Jacqueline Grennom Brooks and Martin G. Brooks offered five key principals of Constructivist learning theory;

• Pose problems of emerging relevance to students.
• Structure learning around primary concepts.
• Seek and value student’s point of view.
• Adapt instruction of address student supposition.
• Assess student learning in the context of teaching.

Constructivism is not a unified concept and different interpretations of it can be found, although the interpretation of construction differs from one-another (Phillips, 1995). Common benefits like focus on authentic tasks, embeddedness of task in challenging and complex task environment, are shared (Savery and Duffy, 2004).

**Constructivist view of teaching.** Constructivist is based on the belief that learners actively create, interpret and reorganize knowledge then the instructional strategy should be such in which students should participate in experience that accommodate these ways of learning. Such experiences include-inquiry activities, discovery, problem based learning, project learning and action learning discussion with peers and teachers, collecting and interpreting information from different sources, expressing their understanding in diverse ways etc.

**Why is Constructivism approach Important?**

Educational curricula and teaching methods are changing. One component of the current redevelopment of all subject area curricula is the change in focus of instruction from the transmission curriculum to a transactional curriculum. In a traditional
curriculum, a teacher transmits information to students who passively listen and acquire facts. In a transactional curriculum, students are actively involved in their learning to reach new understandings. Constructivist teaching fosters critical thinking and creates active and motivated learners. Zemelman, Daniels, and Hyde (1993) tell us that learning in all subject areas involves inventing and constructing new ideas. They suggest that constructivist theory be incorporated into the curriculum, and advocate that teachers create environments in which children can construct their own understandings. Twomey Fosnot (1989) recommends that a constructivist approach be used to create learners who are autonomous, inquisitive thinkers who question, investigate, and reason. A constructivist approach frees teachers to make decisions that will enhance and enrich students' development in these areas. These are goals that are consistent with those stated by Saskatchewan Education in the 1984 government report, Directions that launched the restructuring of Saskatchewan's curricula. This demonstrates that constructivism is evident in current educational change.

All the Research suggests that constructivist approach is an effective way to teach. It encourages active and meaningful learning and promotes responsibility and autonomy. Because constructivist teaching is beneficial in achieving desirable educational goals for students, it is important for teachers to grow professionally towards a constructivist practice.

The Constructivist Classroom:

Constructivist classrooms are structured so that learners are immersed in experiences within which they may engage in meaning-making inquiry, action, imagination.
invention, interaction, hypothesizing and personal reflection. Teachers need to recognize how people use their own experiences, prior knowledge and perceptions, as well as their physical and interpersonal environments to construct knowledge and meaning. The goal is to produce a democratic classroom environment that provides meaningful learning experiences for autonomous learners.

In a traditional classroom, an invisible and imposing, at times, impenetrable, barrier between student and teacher exists through power and practice. In a constructivist classroom, by contrast, the teacher and the student share responsibility and decision making and demonstrate mutual respect. The democratic and interactive process of a constructivist classroom allows students to be active and autonomous learners. Using constructivist strategies, teachers are more effective. They are able to promote communication and create flexibility so that the needs of all students can be met. The learning relationship in a constructivist classroom is mutually beneficial to both students and teachers.

Another quality of a constructivist class is its interactive nature. Authentic student-student and student-teacher dialogue is very important in a constructivist classroom. Belenky, Clinchy, Goldberger, and Tarule (1986) inform us that constructivists distinguish didactic talk, when participants report experiences but no new understanding occurs, from real.

In a constructivist classroom, teachers create situations in which the students will question their own and each other's assumptions. In a similar way, a constructivist teacher creates situations in which he or she is able to challenge the assumptions upon which traditional teaching and learning are based. Belenky, Clinchy, Goldberger, and
Tarule (1986) report that at the constructivist level of knowing and thinking, we continually reevaluate our assumptions about knowledge; our attitude towards "the expert" is transformed; we are not troubled by ambiguity but are enticed by complexity; and we take on a never-ending quest for truth and learning where truth is seen as a process of construction in which the knower participates. A constructivist teacher's perception of expertise in the classroom is based on the experience of his or her students in interaction with each other and with their teacher, and his or her ability to tolerate ambiguity is high as evidenced in the tendency to create complexity.

A Constructivist Classroom is Student-Centered

A constructivist student-centered approach places more focus on students learning than on teachers teaching. A traditional perspective focuses more on teaching. From a constructivist view, knowing occurs by a process of construction by the knower. Lindfors (1984) advises that how we teach should originate from how students learn. Constructivist activities in any subject area can range from very simple to sophisticated and complex depending on the teacher's learning objectives. If a teacher were to devise a constructivist activity, the first thing that she or he would have to do is establish an educational objective. The teacher would then need to think of a meaningful activity which would, at the same time, help students to reach the objective and to explore and construct knowledge based on what they're reading and what they already bring to the activity. The teacher would also need to reexamine the mechanics of how to run a class and would have to entrust a lot to the students.

Method of Transaction. Constructivism is not an educational fad; it is a major rethinking about the teaching and learning process that will have a lasting impact on
both curriculum and instruction. Constructivism provides a 'new theory of learning' and also a 'new theory of teaching'. This theory calls for a major shift from teacher-centered direct instruction towards students-centered understanding-based teaching.

The traditional methods of teaching consider teaching as transmission of facts to students who are considered passive receptors. In such classrooms, lecturer methods predominate and teacher stress on completing the voluminous syllabus. Teacher-student relationship are characterized as distant, where teacher is the authority figure. Teacher is also seen as authority of subject content, who has the 'right' knowledge.

In contrast to traditional conceptualization of teaching, constructivist teaching considers the students as an active learner and the teacher as a guide in the learning process. The theory of constructivist is based on the idea that children learn better by actively constructing knowledge and by reconciling new information with previous knowledge. The question of how curriculum can be transacted effectively is closely related to what curriculum should be taught and considered under the constructivist paradigm. This section discusses the curriculum and curriculum transaction practices in a constructivist classroom.

1.1 EMERGENCE OF THE PROBLEM

Over the last decade, constructivist as a theory of knowledge has been discussed as a new approach to education. Constructivism is one of the main themes in the educational discourse. However, there is little evidence that constructivist theory has been of significant relevance to pedagogical practice. The growing interest in constructivism has concentrated on the theory and has neglected to consider educational practice. Despite the fact that constructivists believe that the theory and...
practitioner are fundamentally interlinked (Mar and Watson, 2000), relative few attempts have been made to research constructivism in educational practice. Although some fundamental understanding of constructivism is critical for practitioners, it is equally important for practitioners to develop an epistemology of classroom learning that in congruent with constructivism. The epistemological assumptions underpinning Constructivism suggest that the word does not harbor unambiguous “truth” independent of human perception, revealed to us through instruction. Rather, the world is knowable only through the interaction of knower and experienced phenomena. There is very little literature that supports the claim that construction and rules should be a central focus for the enquiry. The following are some studies collected so far that are based on educational implication of Constructivist Approach.

Youl-Kwan Sung (2007) conducted a study that addressed the research question, how ‘pre-service teacher’ pedagogical philosophies are related to epistemological belief, attitude towards learning science and their perceptions of the future effectiveness as classroom teacher in the constructivist teacher education course (called STEP, Secondary Teacher Education Project). His study was conducted in Korea. The research outcomes enabled STEP researchers to empower pre-service teachers with constructivist pedagogical philosophy.

In his research paper, Mark Windschitl (2002) presented a theoretical analysis of constructivism in practice by building a framework of dilemmas that explicates the conceptual, pedagogical, cultural and political planes of the constructivist teaching experience. This analysis identified that “constructivism in practice” is a concept
situated in the ambiguities, tension and compromises that arises among stakeholders in the educational enterprise.

David Jonassen (1999) has described a model intended to provide guidelines for designing constructive learning environments (CLEs) to support constructive learning. He concluded that CLEs are to be designed in order to engage learners in personal and/or collaborative knowledge construction and problem solving outcomes.

Richard E. Mayer (1999) has advocated that it is possible to design instruction that promotes constructivist learning, even when the learner is not engaged in a behaviorally active learning episode.

Constructivist approach has relevance in teaching of different subjects. George E. Hein (1991) has given some guiding principles of constructivist thinking that must be kept in mind by an educator. He has also talked about the influence of these principles on museum education.

Jonassen (1991) noted that many educators and cognitive psychologists have applied constructivism to the development of learning environments. From these applications, he has isolated a number of design principles.

1. Create real-world environments that employ the context in which learning is relevant.

2. Focus on realistic approaches to solving real-world problem.

3. The instructor is a coach and analyzer of the strategies used to solve these problem.

4. Stress conceptual interrelatedness, providing multiple representation or perspective on the context.

5. International goals and objective should be negotiated and not imposed.

7. Provide tool and environments that help learners interpret the multiple perspective of world.

8. Learning should be internally controlled and mediated by learner.

Welson and Cale (1991) provide a description of cognitive teaching models which 'embody' constructivist concept. From these descriptions, we can isolate some concept central to constructivist design, teaching and learning,

1. Embed learning is a rich authentic problem-saving environment.

2. Provide for authentic verses academic context for teachings.

3. Provide for learner control.

4. Use error as a mechanism to provide feedback on learners understanding.

A study conducted by Jon Magoan (1977) reviewed that constructed words of teachers and pupils have been studied by several workers utilizing a wide variety of ethnographic procedures, and are generally claimed to show participants construction, such as roles played or roles followed, have a large effect on educational outcomes.

Dimitrios Thanasoulas had revealed that constructivism take an interdisciplinary perspective, inasmuch as it draws upon a diversity of psychological, sociological, philosophical and critical educational theories. On the whole, the issues in planning and management of Constructivism approach do not seem to have been found.

To transform the practice that can sustain progressive educational change, researchers, reformer and practitioners must jointly fashion a vision of constructivism that involves more than theories of learning and instruction. The vision should include a picture of schooling with all the players, the conflicts and tensions. The emerging theories of
instruction can evolve into more sophisticated and useful incarnations only when informed by the knowledge of constructivism in practice. Teachers as the central figures in the classroom and the principal agents of reform are the prime candidates for the examination of how this pedagogy will flourish or flounder in our nation’s school in teaching of different subjects.

Therefore this study aims to investigate, implication of the principles of constructivist approach in different educational practices of teaching Biology as researcher could not find evidence for constructivist pedagogy in teaching of this subject.

The problem is approached from two different angles; the students’ perspective and point of view of pupil teachers. The following research questions arise.

- To what extent the Constructivist approaches are applicable to teaching of biology content of class XI?
- Whether the teaching based on Constructivist approach is more effective than that of traditional classroom teaching?
- Is there a difference in the degree of Constructivist as perceived by student between educational settings?
- From the point of view of pupil teacher using Constructivist Approach, this question is formulate, is there any difference in the degree of reaction of pupil teachers oriented with and without the help of developed instructional material towards the implementation of Constructivist Approach in class room learning?
- Is there any difference in the degree of willingness of pupil teachers oriented with and without the help of developed instructional material towards the implementation of Constructivist Approach in class room learning?
1.2 STATEMENT OF THE PROBLEM

"DEVELOPMENT OF INSTRUCTIONAL MATERIAL BASED ON CONSTRUCTIVIST APPROACH IN TEACHING OF BIOLOGY AT SENIOR SECONDARY LEVEL."

1.3 JUSTIFICATION OF THE PROBLEM

It will be wrong to say that the present curriculum is not curriculum indeed. It is just a jumbling from different branches of science is an unorganized and unpsychological way. The subject centered curriculum of today has, no doubt been badly criticized but it is difficult to abandon it, because of some reasons, in comparison to experience – centered curriculum, the subject centered curriculum in simple, intelligible and can be easily evaluated, because of there and some others reasons the most defective curriculum still persists, the review of present curriculum shows that it suffers from the many gapes. The major gapes in present curriculum of Biology are as follows.

1-It is subjects centered and topical.
2-It is not in conformity with the aims and objectives
3-It is examination-ridden.
4-The concepts of general science is still foreign to curriculum
5-It is cut off from the real life outside.
6-The depth of subject is sacrificed at expense of vastness of range of topics.
7-It outfits the different age-group
8-It is devoid of scientific activities like biology.
According to secondary education commission reports.

The present biology curriculum is-
- Narrows in conception,
- Bookish and theoretical,
- Contents voluminous but not rich and significant
- Leads to lop-sided development of child 'personality
- Bereft of the technical and vocational subjects.
- Examination ridden and cut off from the life around.

So the present curriculum is most of states is “narrowly conceited unpsychological, planned and ineffectively executed”, it leads to intellectual development only at the cost of other dimensions of child’ personality.

The Indian Education commission Reports (1964–66) has pointed out that the school curriculum in a state of flux all over the world, even in developed countries. there is widespread dissatisfaction with the school curriculum which is due to many causes.

1-There is tremendous explosion of knowledge in recent years and the reformulation of the basic concepts in physical, biological and social sciences have brought into sharp relief the inadequacies of existing school programmers.

2-Due to the rapid advancement of biology, the gulf between the school and university in the major academic discipline has become wider.

3-With the necessity of including more and more significant items in an already over packed school curriculum, it is realized that there is a good deal of useless material in the school courses which can be safely discarded
The National policy of Education (1986) has stated for first time that there should be national curriculum framework which should contain a common core along with other components which are flexible according to National policy of Education; the biology curriculum will include the following—

- Biology curriculum will be strengthened so as to develop in the child will defined abilities and values such as spirit of inquiry, creativity objectivity the courage to question and aesthetic sensibility.
- Biology Education programmes will be designed to enable the learner to acquire problem solving and decision making skills and to discover the relationship of with health, agriculture, education to the vast humblers who have remained outside the pale of formal education.

This is in reference of what has been outlined in the forgoing pages. Earlier not a single study has been conducted to develop Instructional Material based on Constructivist Approach in teaching of Biology at Senior Secondary Level. The researcher of the present study can emphatically state that his attempts are novel in the sense that he has designed his study on an Indian sample with a number of variables which he presumes cortical in his attempt. The uniqueness may be visualized in the sense that the researcher selected two types of sample groups i.e. Controlled and Experimental group with a long range sample of pupil teachers who opted Biology teaching as their teaching subject and school students of class XI who are studying Biology as a major subject. The uniqueness of the present study may also be visualized in the sense that the researcher developed Instructional Material based on class XI Biology text book using Constructivist Approach. So the present study is therefore, novel in all aspects. Thus the
researcher felt that there is a significant need to undertake such research which can
guide pupil-teachers, school teachers, students, curriculum framers and book writers to
improve the state affairs in the field of Biology teaching and Learning at Senior
Secondary Level.

1.4 DEFINITION OF TERMS

Instructional material.

Instructional materials are kind of tools or equipments can help effectively the
instructor in theory teaching classroom or in practical assessment. Instructional
material in the present study, was consists of the lesson plans based on Constructivist
Approaches for teaching Biology subject at senior secondary level

Constructivist approach.

Constructivist theory posits that children build new information onto pre-existing
notion and modify their understanding in light of new data. In the process their ideas
gain in complexity and power. Constructivist theorists dismiss the idea that students
learn by absorbing information through lectures or repeated rate practice.

Biology.

The study of Biology helps students to understand the world in which they live, because Biology is the science of life; that branch of knowledge which treats of living
matter as distinct from matter which is not living; the study of living tissue. It has to do
with the origin, structure, development, function, and distribution of animals and
plants.
Senior Secondary level.

Senior secondary level is the two year education after 10th class i.e 11th and 12th class is called Senior Secondary levels.

1.5 OBJECTIVES OF THE STUDY

The objectives of the present study are as follows:

1. To make a content analysis of class XI Biology text book through Constructivist approach.

2. To develop instructional material for adopting constructivist approach in teaching of Biology

3. To experiment the effectiveness of constructivist approach as compared to traditional classroom lecture cum demonstration method.

4. To study the effect of developed instructional material on reactions of pupil teachers towards teaching and learning of Biology through constructivist approach as compared to traditional approach.

5. To study the effect of developed instructional material on willingness of pupil teachers to use constructivist approach for biology teaching.

1.6 HYPOTHESES OF THE STUDY

The hypotheses of the present study are as follows:

H₀₁ There will be no significant difference in mean gain achievement scores of the students taught through constructivist approach and traditional Lecture cum Demonstration Method.

H₀₂ There will be no significant difference between reaction of pupil teachers and student towards teaching and learning of biology through constructivist approach as compared to traditional approach.
H_{03} There will be no significant difference between scores on willingness scale for constructivist approach of experimental and controlled groups of pupil teachers.

1.7 VARIABLES OF THE STUDY

In the experimental phase of the study the following variables were taken into consideration:

(a) Independent variables.
Developed Instructional Material (for Teaching and Orientation).

(b) Dependent variables.
1. Academic Achievement
2. Willingness towards Constructivist Approach
3. Reaction towards Constructivist Approach

(c) Controlled variables.
Academic scores of High School marks of students, school/college, environment, subject, Content, and level of intelligence

1.8 DELIMITATIONS OF THE STUDY

In view of restricted time and resources, the study was limited to:

(1) Senior secondary school of Agra city which offers Biology at +2 levels.

(2) The school located in Agra city under Uttar Pradesh Madhyamic Shiksha Parishad Allahabad.

(3) The study is delimited to class XI Biology subject.

(4) B. Ed students were taken as pupil teachers.
1.9. METHOD, TOOLS AND TECHNIQUES

Method of the present study was based on experimental research which is the description and analysis of what will be, or what will occur, under carefully controlled conditions (John W. Best, 1984). Major steps of in experimental research are planning the experiment, conducting the experiment and reporting the result. Experimental research is of three types one group experiment equivalent or parallel group experiment and rotation group experiment, but in present study parallel group experimental design was used. The main advantage of this type of experimental design is that it is free from the weakness of the one group method. Both the controlled and experimental factor is applied simultaneously on different groups so that the difficulties due to maturation or practice effect, etc. do not arise.

1.10 SAMPLE

For the present study school students and pupil teachers were treated as sample. The number of sample units for school students is 60 and pupil teachers are 40. Both were divided into two equal half and one half was treated as experimental group and another as controlled group. The detailed distribution of sample is given below.

<table>
<thead>
<tr>
<th>Number of Samples</th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
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<tbody>
<tr>
<td>School students (N= 60)</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Pupil Teacher (N= 40)</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>
To overcome the personal life experiences of sampled subject (individual’s learner) in experimental and control group. The researcher intent to consider the following components;

(a) **Achievement test.**

It was administered when the researcher started his investigation in the school as per research design

(b) **High school marks of students.**

While dividing the students in experimental and controlled groups Mark obtained in high schools of students were also be considered.

(c) **School and Class level.**

The sample was selected from same schools and same class for experimental and controlled group.

(d) **General intelligence test.**

To make homogeneous groups (controlled and experimental) researcher administered intelligence test, and on the basis of I. Q , the group was divided in to two equal half.

1.11 **RESEARCH TOOLS**

The following research tools developed for collection of data

1. **Reaction Scale.**

The Reaction Scale was developed and employed to study the reactions of student and pupil teachers towards constructivist approach. The scale include the following aspects

- Students interests in teaching and learning through constructivist approach
- Classroom situations
- Comparison of constructivist approach to traditional approach.
- Use of audio-video aids
- Practicability of constructivist approach.

2. Achievement test.

This test was developed to study achievement level of student on the selected topics who were taught to by the traditional methods and constructivist approach. This test was being given to students at pre and post stage of theoretical exposure of constructivist approach and teaching through constructivist approach. Through this test the achievement level of students in biology was measured. This test was based on the topics on which the instructional material was developed.

3. Observation schedule.

This scheduled was developed and administered by researcher, when pupil teachers applied constructivist approach in their teaching practicing schools. This observation scheduled includes the following aspects:

- Introduction of lesson
- Classroom management
- Methods, techniques used in teaching
- Knowledge of teacher
- Teaching aids used in class
- Evaluation of lesson
- Teaching activities
- Students participation
- Blackboard work
- Supervision of class while teaching
4 Willingness scale.

After the orientation of constructivist approach with the help of developed instructional material willingness scale was administered on pupil teachers to study perception and interest in constructivist approach. This scale was basically five points rating scale covering mainly following aspects -

- Planning of lesson
- Classroom interaction
- Utility of developed instructional material
- Comparison of traditional and constructivist approach
- Interest of pupil teacher to apply constructivist approach
- Pupil teaching interest in constructivist classroom teachings
- Feasibility of constructivist approach for classroom teaching

1.12 PROCEDURE OF THE STUDY

Following procedure was adopted in the present study.

The study being multi dimensional requires comprehensive research approach. The procedures of the study are given below.
Fig. 1.1 Flow chart of procedure of study

The detail procedure of study is given below

1) **Content analysis.** Content analysis of class XI Biology text book was done to know which topic can be taught through the constructivist approach.
(2) **Survey of Constructivist Pedagogy.** Analytical survey was conducted to identify constructivist pedagogy in different educational settings. The researcher applied quantitative method to identify the essential features and instructional principles of constructivist approach.

(3) **Development of instructional material.** The researcher developed instructional material based on constructivist approach. The researcher followed the following steps in developing Instructional Material:

```
Content analysis
   ↓
Selection of topic appropriate for Constructivist Approach
   ↓
Preparation of lessons plan based on Constructivist Approach
   ↓
Preparation of lessons plan based on traditional Approach
   ↓
Review of lessons plan by subject experts
   ↓
Modification of lessons plan as per expert opinion
   ↓
Try out of some sample lesson plan
   ↓
Modification of lessons plan on the basis of experiments of try out
   ↓
Preparation of final drafts of the lesson
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Fig 1.2 Steps of development of instructional material

(4) **Field Based Experiment.** A quasi-experiment design was used to study the effectiveness of constructivism during a specific period in the phase of the research.
design; the researcher addresses the question. Can a pedagogical approach based upon a constructivist view of learning result in improved conceptual understanding?

The aim of the phase was to introduce on interventions with the experimental group of learners. The intervention was involved using a constructivist approach in learning of the biology subject. The outcome compared to that of control group of learners, taught the same topic, using the traditional approach. To this end, a quasi-experimental design allow for the control of as many variables as possible within the constraint of school system. It is important to note that although quasi-experimental design provides control of when and whom measurement is applied, the equivalence group is still not assured, because random assignment to experimental and control treatment has not applied. The design of the study as follows.

**Table 1.2-Research Design**—The design of study as follows

<table>
<thead>
<tr>
<th>Phase I Pre-active phase</th>
<th>Development of Instructional Material — The Instructional Material developed as per the steps mentioned on page no-27 of this Chapter</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Phase II Interactive phase—Implementation of developed Instructional Material in orientation of pupil teachers —</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experimental Group</strong></td>
</tr>
<tr>
<td><strong>Sample</strong></td>
</tr>
<tr>
<td>Pupil Teachers N-20</td>
</tr>
</tbody>
</table>

Amit Gautam
(5) Evaluation.

The constructivist approach evaluated on the bases of pre and post achievement test which developed by researcher based on the contents of Biology text of class XI.

1.13 STATISTICAL TECHNIQUES

The data was analyzed in the light of objectives of the study both qualitatively and quantitatively. Descriptive and inferential statistical techniques were used to analyses the data.

1.14 SIGNIFICANCE OF THE STUDY.

The findings of study significant in the following ways.

For Teachers.

It is a fact that teacher’s performance is most crucial input in the field of Education. The teacher can plan, develop and implement various student centered activities, so as to
promote positive attitude towards Biology. The better art of teaching can be achieved by teachers by adopting such innovative approaches of teaching.

**For Teacher training programmes.**

Both pre-service and in service training programmes, teachers can be empowered to plan and implement constructivist approach in particular Biology subject in classroom situations.

**For Text book writers.**

It will help text book writers to write text book in sequential order by keeping in mind constructivist approach.

**For Students.**

Constructivist principles based teaching will develop independent thinking and creativity among students. It will facilitate higher order thinking among them.