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## CHAPTER - 2

### REVIEW OF RELATED LITERATURE

Review of related literature is very important and is very much helpful to the researcher to delve in to the study deeper and to get a better and clear picture of the study to be carried out. It gives an insight to the researcher to comprehend the important and relevant problems and to find out appropriate solutions to these problems. The design and development of tools and questionnaires can be effectively administered only if the researcher has proper knowledge about the literature behind the subject.

Every piece of ongoing research needs to be connected with the work already done to attain an overall relevance and purpose. The review of related literature thus becomes a link between the research proposal and the studies already done. Methodological review of past literature is a crucial endeavour for any type of academic research. (Webster & Watson, 2002)

#### **Purpose of the Review:**

Every investigator must know what sources are available in the field of Research and how many of them are worthy to be used. As in other field, in the field of education also, the research worker needs up-to-date information regarding the problem i.e. what has been thought and done in the particular area.

The purpose of research review can be summarised as follows:

- To show whether the evidence already available solves the probed quietly without further investigation and thus to avoid the risk of duplication.
- To provide idea, theories, explanations or hypotheses valuable in formulating the problem.
- To suggest methods of research appropriate to the problem.
- To locate data useful in the interpretation of result.
- To contribute the general scholarship of the investigator.

When the researcher makes a careful review of the related studies, it will increase the awareness of the important and unimportant variables in the concerned area of research. A careful review also helps the investigator in selecting the variables lying within the scope of his interest, in defining and operationalizing variables and identifying variables which are conceptually and practically important. Thus, a review of the related

studies, on the whole, prepares the investigator to formulate a research problem in which conceptually and practically important variables are selected.

For the present study, the review of related literature is carried out under two main headings, Theoretical Overview and Review of Related Studies

## **2.1 Theoretical Overview**

### **2.1.1 Science Teaching**

The aims of Science teaching includes many concepts such as eradication of superstitions, development and the improvement of scientific literacy, acceptance and adaptability to novel technologies, health and hygiene awareness and a sustainable development and lifestyle. The primary education will not be complete if science concepts are not taught at the school level itself. The fundamentals of science concepts should be clear right from the childhood itself. The role of science in agriculture, industry, medical science, defence and all other societal progress can be clearly seen by everyone. Along with these mentioned areas, science teaching also helps the process of inquiry, questioning and inquisitiveness in the minds of student.

The aims of teaching Science also include the long-term goals that cannot be realised in just a few hours or days. The objectives whereas it includes the short-term goals and the learning outcomes which can be measured will help the teacher to understand the changes in behaviour of the learner. Educational objectives are the explicit formulations of the ways in which the students are expected to be changed by the educative process. (Bloom, 1956)

### **2.1.2 Learning from experience**

The behaviourist theories advocate verbal explanations rather than practical experiences and all the activities and experiments are verbally explained in this theory. Apart from this, a new technique of learning through experiences and activities was advocated by the gestalt psychologists who paved the way towards constructivist learning theories. The constructivist learning theories advocates that the learner constructs the knowledge and the teacher is a mere facilitator or a scaffold that support in the process of learning. Words and verbal explanations can never initiate learning experience in learner. This will make the learning passive and one directional. Hence the students have very less interest in the learning process which in turn affects their achievement and progress.

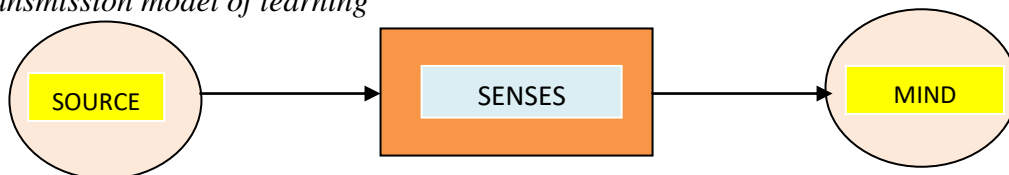
In order to change this system of passive verbalism, the learning process must be active, interactive and curious. This can be achieved through providing rich experiences to the learner. The root word Experience is ‘*experi*’ meaning to ‘try out’. Experience is a word combined with sensation and meaning. It has an aim, objective, method, procedure and a conclusion that helps in the formation of scientific concepts in children through experience and experiments.

### **2.1.3 Constructivist Teaching Methodology**

Constructivism, the theory of knowledge construction cannot be considered as a novel idea of thought. It can be viewed as a theory that make up a meaning and which provides a description about the fundamental nature of knowledge and how human beings adopt certain procedures to learn something. In such a model teacher has only limited means to know what is going on inside the minds of the learners. The teacher could only monitor through an assessment whether the learning has occurred or not and thus the emphasis here solely lies on the subject material and learning is just the transmission of information from source to mind.

**Figure 2.1**

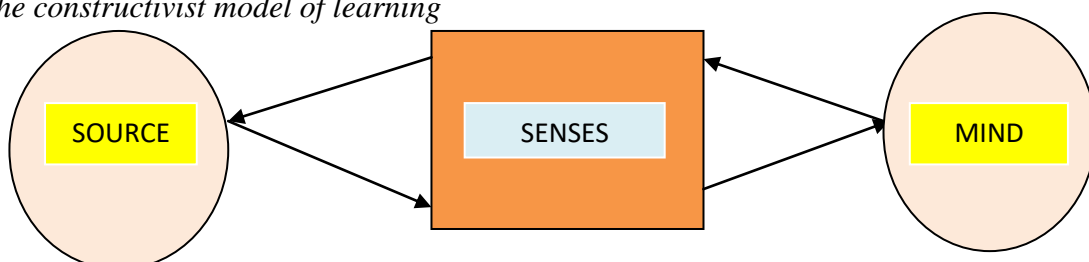
*The transmission model of learning*



Apart from this, the constructivist model of teaching advocates a two way interaction between the source and mind. The transmission model of learning stresses the passivity of the mind. The constructivist model describes and explains the active representation and reinterpretation of experiences. Knowledge is considered as actively constructed by the learners as they interpret their learning experiences. This is the constructivist model of learning.

**Figure 2.2**

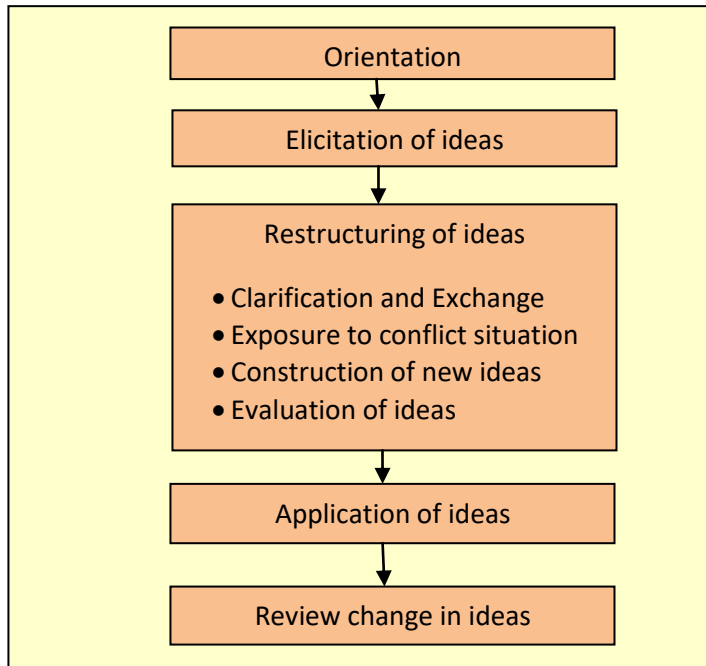
*The constructivist model of learning*



Driver and colleagues (1989) suggested a popular constructivist teaching sequence that offers a means of restructuring children's idea.

**Figure 2.3**

*A constructivist teaching approach (Source: Driver 1989)*



Trowbridge and Bybee (1996) presented a lesson structure similar to the constructivist approach as proposed by Driver. The lesson structure is based on the 7 E principle presented in a particular sequence.

- **Elicit:** Structure activities to find out about the children's ideas about the concepts and skills about to explore
- **Engage:** Use a series of classroom activities that will engage student's interest and curiosity
- **Explore:** Provide activities to explore particular phenomena and generate their own explanations of these phenomena
- **Encounter:** Any misconceptions about these should be challenged. This can be achieved by setting up a series of activities that promote alternative conceptions and demonstrate the weaknesses in pupil's current understanding
- **Explain:** Pupils should be provided with opportunities to explain their understanding and should be encouraged to explain concepts in their own words.
- **Elaborate:** This is the application phase. Classroom activities should be provided for pupils to apply their new ideas in different contexts and to different situations.

- **Evaluate:** Pupils should be given opportunity to evaluate their own learning. They should be given a chance to explore why they have changed their ideas and the strengths of their new ideas when compared with their old ideas.

Constructivism as a method of study has improved the status of the students from just passive receptors to active thinkers. Many educationists and psychologists had worked together to bring about this holistic change. From the ancient principles of idealism, this method opened up the doors to a free open concept of naturalism where in which the nature of the learner and the learning material is also considered in the teaching learning process. The major contributions of some educationists who worked for the evolving of constructivism as a method of teaching learning process can be summed up together. This will help throw light on the progress and the success of the method over a period of time.

**Table 2.1**

*Famous constructivist thinkers and their contribution to constructivist approach*

Sl.No	Constructivist thinkers	Contribution towards Constructivist Approach
1	John Dewey (1859-1952)	Proved the importance of previous knowledge and previous experiences that will influence learning
2	Jean Piaget (1896-1980)	Introduced the concept of Cognitive constructivism and the principles of development that affect cognition.
3	Lev. S. Vygotsky (1896-1934)	Proposed the theory of social constructivism. The idea of scaffolding, reciprocal teaching and the zone of proximal development was unfolded by the theory.
4	Robert Gagne (1916- 2002)	Introduced the stages of learning as a result of the individual's construction of new knowledge according to age and intellect.
5	Jerome. S. Bruner (1915- 2016)	Importance of scaffolding, process oriented approach, discovery learning and spiral curriculum was emphasized
6	Albert Bandura (1925- 2021)	Initiated the social learning theory. Stressed about the observational learning, modelling and learning through social interactions and cognitive development
7	Rosalind Driver (1941-1997)	The foundation of the constructivist model of teaching was laid. Scientific explanation about knowledge construction was put forward in the approach.
8	David Ausubel (1918-2008)	Introduced the concept of reception learning, meaningful learning that is a result of prior experiences and previous knowledge
9	Ernst Von Glaserfeld (1917-2010)	Proposed radical constructivism and explained the concept of constructivism through knowledge construction by self-organization
10	Joseph D Novak (1932-	Proponent of Human Constructivism. The concept of conceptual understanding was introduced

#### **2.1.4 Experiential Education**

*"I hear and I forget*

*I see and I remember*

*I do and I understand*

*Confucius (B.C. 551 to B.V. 479)"*

Experiential education is conceived as an idea that incorporates experience into practice of learning and knowledge construction. Experience has a very important and significant role in experiential education. The learning experiences selected for the learning process determines the success of learning process

The Association for Experiential Education regards experiential education as "a philosophy that informs many methodologies, in which educators purposefully engage with learners in direct experience and focused reflection in order to increase knowledge, develop skills, clarify values, and develop people's capacity to contribute to their communities". Mitzel (1982) described experiential education involves not merely observing what is being studied but also doing something with it, such as testing the dynamics of the phenomenon or applying the theory to achieve some desired results. The uses of experiential component are to test a theory, to improve the skills, to seek clues to a new theory, to achieve a social objective by applying a theory.

#### **2.1.5 Experiential Learning**

Experiential learning is a process by which a student develops knowledge, skills and values from direct experiences. Experiential learning incorporates a broad range of concepts from highly theoretical ones to the simplicity of "learning by doing". The concept is based on traditional apprenticeship model. The encyclopaedic dictionary of education defines experiential learning as in theories of learning and educational philosophy; one major mode of acquiring knowledge is through experience. (Mamta, 1997). Experiential learning is defined as the learning in which the learner is in direct touch with the realities being studied and it is contrasted with the learning in which the learner reads, hears, talks or writes about those references or realities but never comes in to contact with them as a part of the learning process (Keeton and Tate, 1978). UNESCO publication "Learning to be" (Faure, 1972) suggested that life-long learning is the pre requisite for establishing a knowledge society. In order to follow the principle of life-long education, the learners should include their own personal experiences and previous

knowledge to construct new knowledge and proceed with further higher aspects of learning.

**2.1.5.1 Kurt Lewin on Experiential Learning**

Lewin (1951) is best known for his work in the field of organisational behaviour and group dynamics. The principal concern for Lewin was the integration of theory and practice. Lewin’s research reveals that learning is maximised when there is dialectic tension between the immediate, concrete experience and analytic detachment. Lewin’s model is the precursor to the Kolb Cycle (Shields; Aaron, & Wall; 2002)

**Figure: 2.4**

*Lewin’s model of experiential learning*

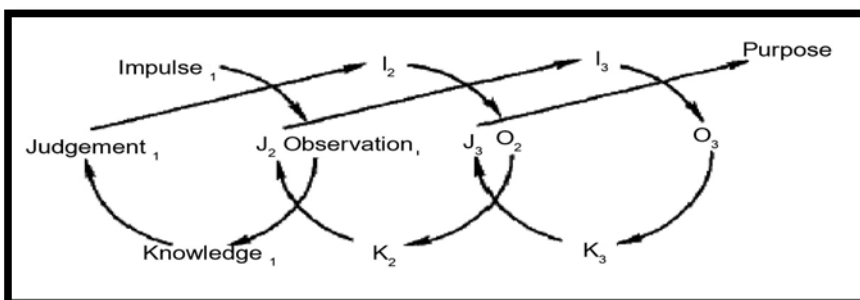


**2.1.5.2 Dewey’s Model of Experiential Learning**

Dewey’s Model of experiential learning is remarkably similar to the Lewinian model, although he makes more explicit, the developmental nature of learning implied in Lewin’s conception of it as a feedback process by describing how learning transforms the impulses, feelings, and desires of concrete experience into higher order purposeful action. Dewey’s model of experiential learning is graphically portrayed diagrammatically.

**Figure: 2.5**

*Dewey’s model of experiential learning*



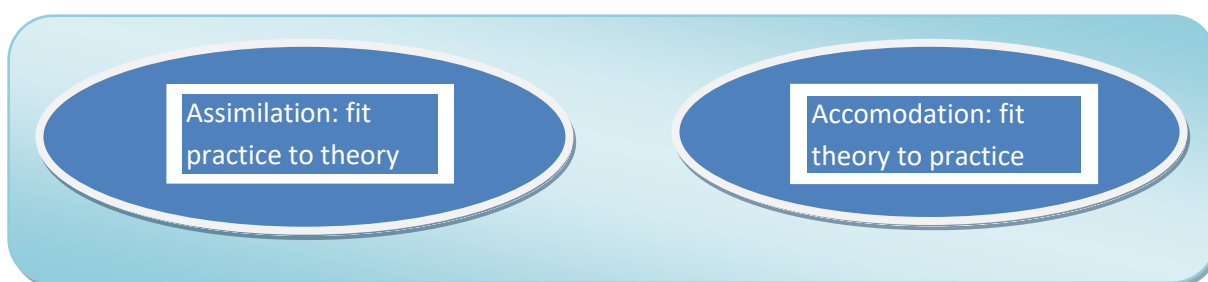
In this description of learning, a similarity with Lewin, is about the emphasis on learning as a dialectic process integrating experience and concepts, observations and actions. The impulse of experience gives ideas to their moving force, and ideas give direction to impulse. Postponement of immediate action is essential for observation and judgment to intervene, and action is essential for achievement of purpose. It is through the integration of this opposing but symbiotically related processor that sophisticated, mature purpose develops from blind impulse.

### **2.1.5.3 Piaget's Model of Experiential Learning**

For Piaget (1970) the dimensions of experience and concept, reflection, and action form the basic continuum for the development of adult thought. Development from infancy to adulthood moves from a concrete phenomenal view of the world to an abstract constructionist view to a reflective interlined mode of knowing. In Piaget's framework, the twin process of accommodation of ideas to the external world and assimilation of experience into existing conceptual structures on the moving force of cognitive development.

#### **Figure: 2.6**

*Piaget's model of experiential learning*



### **2.1.5.4 Carl Roger's on Experiential Learning**

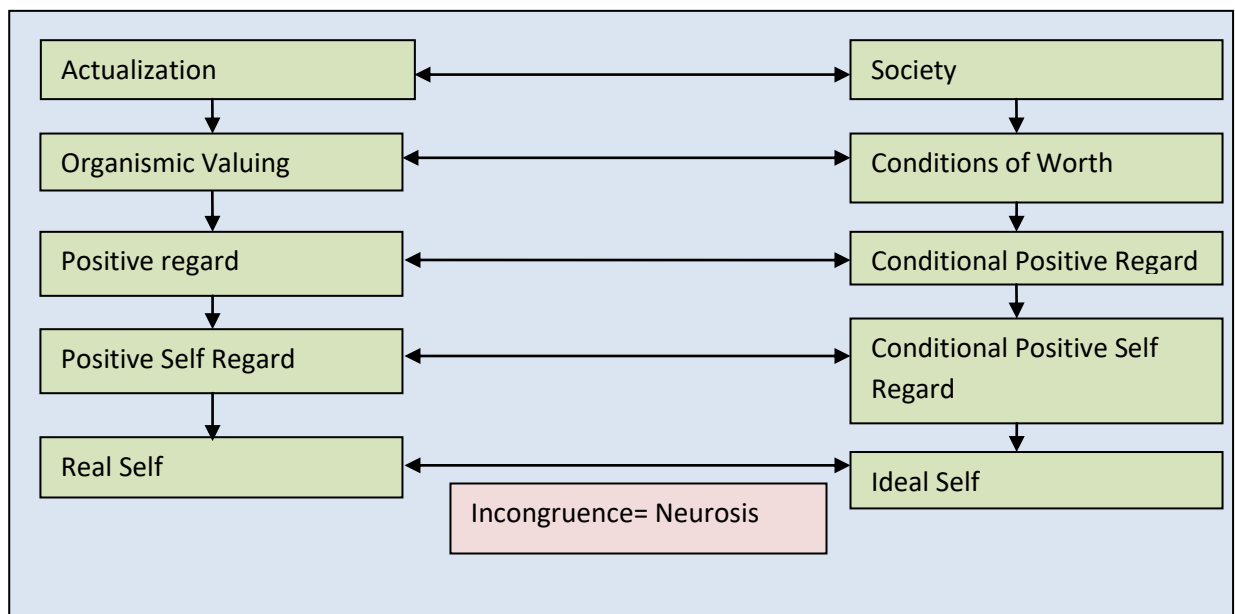
Rogers (1969) distinguished two types of learning: cognitive (meaningless) and experiential (significant). The former corresponds to academic knowledge such as learning vocabulary or multiplication tables and the latter refers to applied knowledge such as learning about engines in order to repair car. The key to the distinction is that experiential learning addresses the needs and wants of the learner. Rogers lists these qualities of experiential learning: personal involvement, self-initiated, evaluated by learner, and pervasive effects on learner.

According to Roger, learning is facilitated when:

- the student participates completely in the learning process and has control over its nature and direction,
- it is primarily based upon direct confrontation with practical, social, personal or research problems, and
- self-evaluation is the principal method of assessing progress or success. Rogers also emphasises the importance of learning to learn and an openness to change.

**Figure 2.7**

*Carl Roger’s model of experiential learning*

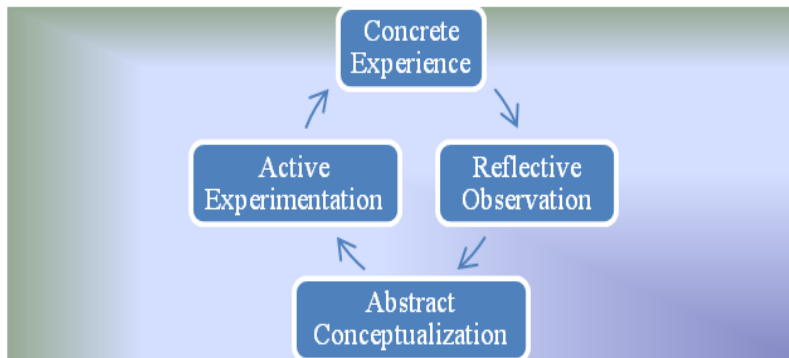


### 2.1.6 Kolb’s theory of experiential learning

Kolb states that learning involves the acquisition of abstract concepts that can be applied flexibly in a range of situations. In Kolb’s theory, the impetus for the development of new concepts is provided by new experiences. “Learning is the process whereby knowledge is created through the transformation of experience.” Kolb’s experiential learning style theory is typically represented by a four stage learning cycle in which the learner ‘touches all the bases’. Kolb’s experiential learning cycle can be depicted by a flow diagram comprising of all the four stages mentioned in experiential education suggested by him.

**Figure 2.8**

*Kolb's experiential learning model*



According to Kolb (1984), “learning is the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping experience and transforming it.”

In summary, the particular strengths of Kolb's theory are that it:

- provides ready pointers to application;
- directs us to ensure that a range of teaching methods are used in a course; provides a theoretical rationale for what many of us already do as teachers and then points us as to how to improve on that practice (in particular ensuring effective links between theory and application);
- makes explicit the importance of encouraging our students to reflect and providing them with feedback to reinforce their learning;
- support us in developing a diverse aware classroom;
- makes us aware of the way in which different learning styles have to be combined for effective learning;
- can be readily applied to all areas of the discipline, from a GIS laboratory exercise to a feminist analysis of a landscape;
- can be used by individuals and course teams;
- can be applied widely from a single classroom session to a whole degree programme.

Kolb proposes that the experiential learning has six main characteristics:

- Learning is best conceived as a process, not in terms of outcomes.
- Learning is a continuous process grounded in experience

- Learning requires the resolution of conflicts between dialectically opposed models of adaptation to the world
- Learning is a holistic process of adaptation to the world
- Learning involves transactions between the person and the environment
- Learning is the process of creating knowledge that is the result of the transaction between social knowledge and personal knowledge

**Figure 2.9**

*Basic idea of Kolb's experiential learning model*



### **2.1.6.1 Experiential Learning Cycle Models**

Experiential learning cycles (ELC) is models for understanding how the process of learning works. They are distinct from other models of learning such as behavioural models or social learning models.

#### **One stage model**

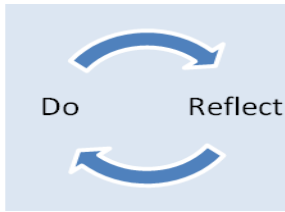
The first model, one stage model (experience) is simply that experience alone is sufficient for learning.

“Tell me and I will forget. Show me and I may remember. Involve me and I will understand.”

The goal of education from this point of view then would be structure and organise learning activities in which experiences themselves facilitate learning (Neill, 2002)

**Figure 2.10**

*1 stage learning cycle model*

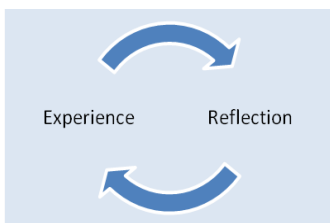


**Two stage model**

The second model, two stage model (experience - reflection), is that the experiences followed by periods of reflection are an effective way to structure and facilitate experiential education which is explained by Bacon (1987) and Neill (2002)

**Figure 2.11**

*2 stage learning cycle model*



**Three stage model**

Two important three stage models exist. The simplest is experience – reflection – plan, which suggests that following an experience and reflection, a plan is needed for future experience.

The second three stage model involves “observation surrounding conditions- knowledge obtained by recollection- judgement, which put together what is observed and what is recalled to see what they signify. (Dewey, 1939/1997, Priest & Gass, 1997, p.145)

**Figure 2.12**

*3 stage model*



### Four stage model

The four stage model (experience- reflection- abstraction-experimentation), is Kolb's (1984) classic "Experiential Learning Cycle." Kolb drew on Dewey's philosophy in proposing a four stage experiential learning cycle.

**Figure 2.13**

*4 stage model*



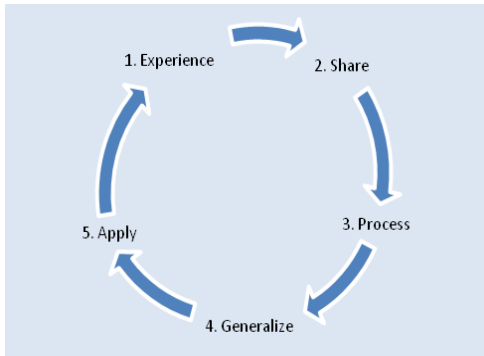
Experiential learning cycle (Exeter, 2001) suggests that a participant has concrete experience, followed by reflective observation, then the formation of abstract conceptualisations before finally conducting active experimentation to test out the newly developed principles. Whilst attributed to Kolb, the stages of experience were derived from the work of Kurt Lewin (Atherton, 2002; Priest & Gass, 2005).

The Kolbian 4 stage model is widely used in education and training circles.

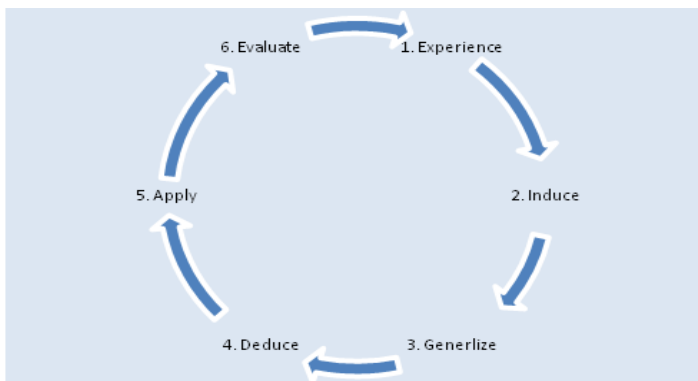
- Concrete Experience
- Reflective Observation
- Active Experimentation
- Abstract Conceptualisation

### Five Stage model

Many number of five stage Experiential learning cycle models have been proposed, including Joplin (1981). It includes the model; focus- action – support- feedback- debriefing (Priest & Gass; 2005). Pfeiffer & Jones (1975) gave the following five stage model.

**Figure 2.14***5 stage model***Six stage model**

Priest (1990) describes a 6 stage model, called the *Experiential Learning and judgment Paradigm*, consisting of experience-induce-generalise-deduce-apply-evaluate. This model is developed by Priest (1990) who was inspired by Dewey's belief that the judgement plays an important essential role in experiential learning (Priest & Gass, 1997). Due to the cycle, the learning occurs over periods of time in which experiences and reflections are repeated.

**Figure 2.15***6 stage model***2.1.7 Kolb's Experiential Learning Cycle Model**

The International Encyclopaedia of Education (Husen, 1992) described the best known model for experiential learning is that developed by Kolb (1984), which depicts learning as a four stage cycle. The learner first undergoes a concrete personal experience; second re-examines and reflects on that experience; third formulates abstract concepts and generalisations; and fourth, tests these in new situations. Individuals have different learning styles and person may have different styles for different tasks. Hence the learning

cycle can be entered at any of the four stages. Whereas the traditional learning models typically start with abstractions which may or may not bear any relationship to the student's experiences. Although Kolb's (1984) theory of the learning cycle seems relevant in particular for designing learning environments for adults, it does not yet have an adequate empirical basis in research.

Kolb's learning theory sets out four distinct learning styles, which are based on a four stage learning cycle of Concrete Experience, Reflective Observation, Abstract Conceptualisation and Active Experimentation.

*Concrete Experience (feeling):* Learning from specific experiences and relating to people.

*Reflective Observation (watching):* Observing before making a judgement by viewing the environment from different perspectives.

*Abstract Conceptualisation (thinking):* Logical analysis of ideas and acting on intellectual understanding of a situation.

*Active Experimentation (doing):* Ability to get things done by influencing people and events through action.

Kolb views the learning process as a context of people moving between the modes of concrete experience (CE), abstract conceptualisation (AC), reflective observation (RO) and active experimentation (AE). Thus, the effectiveness of learning relies on the ability to balance these modes, which Kolb sees as opposite activities that best promote learning.

#### ***Learning to solve numerical problems in physics***

- *Reflective Observation:* Watching one solve and trying to imagine the doing process
- *Abstract Conceptualisation:* Understanding about the formulae in numerical problems
- *Concrete Experience:* Doing practically by receiving tips from an expert
- *Active Experimentation:* Experimenting with more numerical problems and formulae

#### ***Learning to draw ray diagrams***

- *Reflective Observation:* Seeing one draw and imagining the drawing process
- *Abstract Conceptualisation:* Understanding the theory and principle of ray diagrams

- *Concrete Experience:* Receiving practical training from an optics experiment by an expert
- *Active Experimentation:* Experimenting with mirrors and lenses of different focal lengths and drawing ray diagrams

Kolb and Fry (1975) argue that the learning cycle can begin at any one of the four points and it should really be approached as a continuous spiral. However it is often suggested that the learning process often begins with a person carrying out a particular action and then seeing the effect of the action in the situation. Following this, the second step is to understand these effects in a particular instance so that if the same action was taken in the same circumstance it would be possible to anticipate what would follow from the action. In this pattern the third step would understand the general principle under which the particular instance falls.

#### ***Learning to use a scientific measuring balance***

- *Abstract Conceptualisation:* Listening to explanations on what it is
- *Concrete Experience:* Step by step learning through practice
- *Active Experimentation:* Experimenting with small weights and practicing to measure accurately
- *Reflective Observation:* Practical examples through different experiments and measurement

#### **2.1.7.1 Learning Styles**

Every one prefers different learning styles and techniques. Everyone has a different mix of learning styles. Some people have a dominant learning style with less use of other styles. Through the learning styles, these less dominant styles can be developed, and also the existing learning style can be enhanced and developed.

According to Keefe (1982), learning style refers to “cognitive, affective and psychological traits that serve as relative indicators of how learners perceive, interact with and respond to learning environment.” By understanding the individual’s learning styles, better teaching learning techniques and practices can be adopted. This type of practice will surely improve the speed and the quality of learning. Kolb’s learning style model shows four distinct learning styles and these are identified with the help of a learning style inventory devised by Kolb himself.

### 2.1.8 Kolb's Learning Style Model

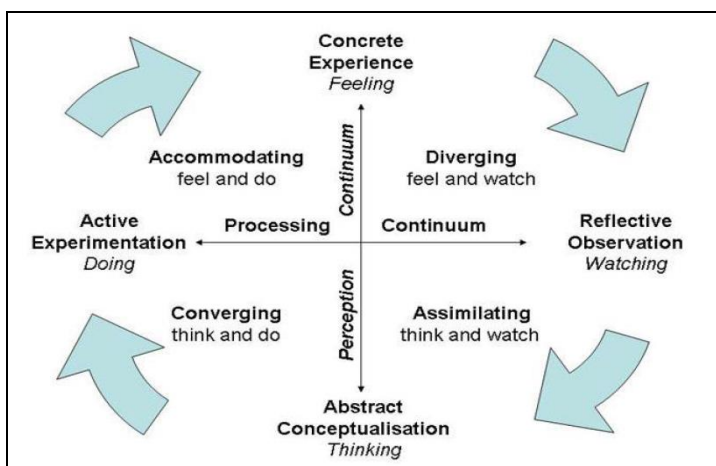
David S Kolb explains that people vary differently in their learning styles and cognition. According to Kolb, the four particular combinations of Perception and Processing continuum determine one's learning style. This learning style can belong to one of the four learning styles devised by him. The four learning styles devised by Kolb is:

- Diverging (feeling and watching)
- Assimilating (watching and thinking)
- Converging (thinking and doing)
- Accomodating (doing and feeling)

Kolb has identified these four cycle stages as an entry point to any learner who is practising experiential pedagogy. A learner can enter any of these four stages but should then follow the cycle stages sequentially till he completes the learning cycle. He also set a matrix designing the various types of learners based on their learning styles.

**Figure 2.16**

*Kolb's learning style grid*



Source: Kolb 2005

Each learning style is located in a different quadrant in the cycle of learning. A person's preferred learning style is influenced by a number of factors. The learning style itself is a product of two variables or two separate pair of choices which Kolb represented as the line of axis each with conflicting modes at either end. The two continuums are represented respectively by: Processing continuum (how we approach a task) and the Perception continuum (our emotional response, or how we think or feel about it).

Kolb revealed that we cannot perform both variables on a single axis at the same time (e.g. think and feel). Our learning style is a product of these two choice decisions. Kolb’s learning style is represented by a two by two matrix where in each learning style represents a combination of two preferred styles. (Kolb and Fry, 1970)

This is represented in matrix form as shown.

**Figure 2.17**

*Learning style matrix*

	Processing continuum	<b>Doing (Active Experimentation- AE)</b>	<b>Watching (Reflective Observation- RO)</b>
Perception continuum			
<b>Feeling (Concrete Experience- CE)</b>		Accommodating (CE/AE)	Diverging (CE/RO)
<b>Thinking (Abstract Conceptualization- AC)</b>		Converging (AC/AE)	Assimilating (AC/RO)

**2.1.9 Kolb’s Learning Style Inventory**

The Kolb’s Learning Style Inventory (KLSI) is designed to understand how one learn best in educational settings and the everyday life. It differs from the other learning style tests and the other personality tests used in the field of education and psychology as it is purely based on the concept and theory of experiential learning.

The KLSI was designed in order to fulfil two purposes:

- To serve as an educational tool to increase the understanding of the individual in the area of learning from experience and the individual approach towards learning
- To work as a research tool for researching Experiential Learning Theory (ELT) and individual learning characteristics.

The KLSI is conducted as a self assessment exercise and a tool for identifying the preferred learning style of the individual in order to provide good learning activities and assignments that foster academic achievement of the individuals. Five versions of KLSI have been published over the last 40 years.

- **Kolb Learning Style Inventory – Version 1 (Kolb, 1971)**

The original learning style Inventory (LSI) was created in 1979 as part of an MIT curriculum development project (Kolb, Rubin, & McIntyre; 1971). It was originally developed as an experiential education exercise designed to help learners understand the

process of experiential learning and their unique individual style of learning from experience items for the inventory were selected from a long list of words and phrases developed for each learning mode by a panel of four behavioural scientists familiar with ELT. The final version of the LSI version 1 comprises of 9 items.

- **Kolb learning style Inventory -Version 2 (Kolb; 1985)**

Low reliability coefficients and other concerns about the KLSI version I led to revision of the inventory in 1985. Six new items chosen to increase internal reliability (Alpha) were added to each scale, making 12 scored items on each scale.

- **Kolb learning style Inventory -Version 2a (Kolb; 1996)**

After analysing the review studies of Kolb learning style inventory-version 2a, a research version of the random format inventory (LSI-2a) was published in 1993.

- **Kolb learning style Inventory- Version 3 (Kolb; 1999)**

In 1999 the randomised format was adopted in a revised self-scoring and interpretation booklet (LSI3) that included a colour-coded scoring sheet to simplify scoring.

- **Kolb learning style Inventory-Version 3.1 (Kolb2005)**

The revision includes new norms that are based on a larger, more diverse and representative sample. The format items scoring and interpretative booklet remain identical to KLSI-3. The only change in the norm charts used to convert raw LSI Scorer.

The researcher has tried to trace the origin and the historical development of experiential learning and the learning style. The theoretical framework of the Kolb's experiential learning and learning style was examined that helped the researcher to work on the objectives and to adopt a suitable procedure to carry out the research in an effective manner.

## **2.1.10 Instructional Package**

### **2.1.10.1 Definition and steps in an instructional package**

Instructional package is a program that has the ability to create instructional events by participating with the user. This makes the learning sequential, graded in continual steps.

The instructional package is formed from the following items:

- Title which represents the title of the package.
- Introduction that shows the idea of the contents.
- Target community identification.

- Instructional target which can be measured and observed by the learner to expect what he will do during his study of the package.
- Help about using the package.
- Contents of the package units show the units inside the package.
- Pre-test to know the skills of the learner.
- Instructional activities and alternatives which are suitable for learner characteristics and take into consideration the personal differences.
- Exercise show the range of the package benefit, which contains feedback.
- Post-test which is the final test used after finishing from all units to determine that the aims of the package are achieved.

#### **2.1.10.2 Instructional design models**

Perhaps the most common model used for creating instructional materials is the ADDIE Model. This acronym stands for the 5 phases contained in the model (Analyze, Design, Develop, Implement, and Evaluate). Florida State University initially developed the ADDIE framework in 1975 (Branson et al. 1975). The five phases are listed and explained below:

Analyze – The first phase of content development begins with Analysis. Analysis refers to the gathering of information about one’s audience, the tasks to be completed, and the project’s overall goals. The instructional designer then classifies the information to make the content more applicable and successful.

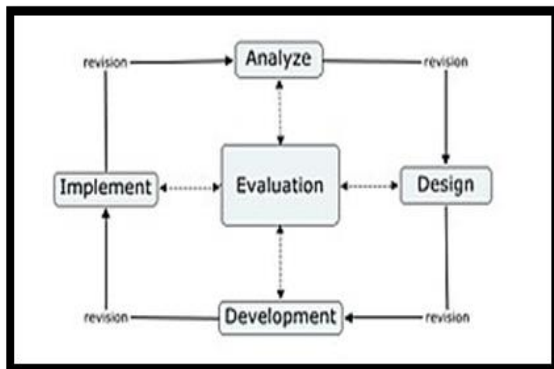
Design – The second phase is the Design phase. In this phase, instructional designers begin to create their project. Information gathered from the analysis phase, in conjunction with the theories and models of instructional design, is meant to explain how the learning will be acquired.

Develop – The third phase, Develop, relates to the creation of the activities being implemented. This stage is where the blueprints in the design phase are assembled.

Implement – After the content is developed, it is then implemented. This stage allows the instructional designer to test all materials to identify if they are functional and appropriate for the intended audience.

Evaluate – The final phase, Evaluate, ensures whether the materials achieved the desired goals.

Figure 2.18

*ADDIE Model*

Source: Branson et al. (1975)

### 2.1.10.3 Features of Instructional Package

- Self contained pack with prologue, outcomes and pre activity and post activity assessments.
- A large number of illustrations, schematics, tables for visual appeal.
- Adequate examples that help for clarifying the concepts.
- Assignments for classrooms.
- Practical task.
- Reference to appropriate video programs, answer key to all questions.
- Recommended equipments and audiovisual items.

### 2.1.10.4 Components of Instructional Package

The instructional package contains some important specified components. The major components of instructional package are given below.

**Introduction:** It consists of title, objectives, duration and content. it gives a brief description how to use the package and what should be the outcome.

**Instructional activities:** This is the major part of the package. In this part learners are engaged with learning activities for the solution of problem. Each instructional activity begins with materials required followed by the method in which the activity is to be carried out . The instructional package consist various activities that the students to follow.

**Self assessment:** To the self assessment and self correction of the students the answers of key concept and criterion of evaluation are given through package. Self assessment consists of pre activity assessment, post activity assessment and evaluation.

**Presentation of Instructional Package:** When presenting the instructional package, start by giving a brief synopsis of the package lessons. A written report outlining the package lesson and describing the instructional activity will be handed in for instructor review.

**Written Report:** Following each presentation, the student will write down some features or details that they liked about the packed lesson, instructional activity and presentation. This information will be given to the instructor in the final step.

### **2.1.11 Science Process Skills**

The science process skills are the foundation stone of learning science. The process skills in science help the children in developing curiosity and interest towards the subject. Whenever the children interact with the environment in a scientific manner, process skills are developed in them. They form as the building block of inquiry based science learning.

Renner and Marek (1990) suggest that the activities in Science that are achieved with the help of these process skills lead the children to facts, concepts, principles, laws and generalizations. However to apply the process skills the children have to learn, re learn and master them continuously by practising them.

These type of skills known as Science Process Skills have been defined as a set of broadly transferrable abilities appropriate to many Science disciplines and reflective of the behaviour of the Scientists (Padilla, 1990). Science, A Process Approach (SAPA), a programme of American Association for the Advancement of Science (AAAS), grouped Science Process Skills into two types- basic and integrated (Livermore, 1964). The basic skills provide a foundation for learning the integrated process skills.

According to Lind (1998), Science Process Skills (SPS) are skills used while considering problems and in formulation of conclusions. These skills are used by scientists during their work. It can be used to assist students in gaining these important skills, thus enabling them to understand and learn the world in which they live. These skills are the basis for scientific thinking and research. According to Abruscato (2000), discoveries of scientists arise from a group of very different and important abilities referred to as their scientific process skills. As the goal is for each individual to be scientifically literate, process skills occupy a significant role. Science Process Skills are based on scientific inquiry and associated with cognitive and investigative skills. Science Process Skills are scientific activities that facilitate the meaningful understanding of ideas.

According to Ayas (2007), SPS are classified as basic (observation, testing, classification, relating number with space, and recording data), causal (prediction, determination of variables, and drawing a conclusion) and experimental (making a hypothesis, modeling, doing the experiment, changing and testing the variables, and making a decision). Gagne (1965) implies that Science Process Skills are involved in scientific inquiry and they are seen as the foundation of scientific inquiry. The efficiency of education could be increased through getting learners adopt a habit of Science Process Skills.

### **2.1.12 Dimensions in Science Process Skills**

#### **Basic Science Process Skills**

##### **Observation**

Observation is the fundamental aspect of scientific inquiry. Observation is the use of one's senses to perceive objects and events, their properties and their behaviour.

##### **Comparing and contrasting**

Comparing involves assessing different objects, events, or outcomes for similarities. This skill allows students to recognize any commonality that exists between seemingly different situations.

##### **Communicating**

Communication goes hand in hand with observation. 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.

##### **Measuring**

The additional Science Process Skill of measuring is really just a special case of observing and communicating. 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.

##### **Quantifying**

This begins with identifying sets and their numbers and progress through ordering, counting, adding, multiplying, dividing, finding average, using decimals etc.(Rao,2008).

## **Classifying**

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.

## **Using space time relations**

This begins with the identification of shapes, movement and direction. It continues with the learning of rules applicable to straight and curved paths, direction at an angle, changes in position and determination of angular and linear speeds (Rao,2008).

## **Making inferences**

Inference is the act of making statements that attempt to explain or interpret objects or events that are based on observations. When we are able to make inferences, and interpret and explain events around us, we have a better appreciation of the environment around us.

## **Making predictions**

Making predictions is making educated guesses about the outcomes of future events. The ability to make predictions about future events allows us to successfully interact with the environment around us.

## **Integrated Science Process Skills**

### **Controlling variables**

It is the ability to identify variables that can affect an experimental outcome, keeping most constant while manipulating only the independent variable. Controlling variables involves the process of deciding which variables or factors will influence the outcome of an experiment, situation, or event, and deliberately controlling all recognized variables in a systematic manner.

### **Defining operationally**

It is stating how to measure a variable in an experiment. It is creating a definition by describing what is done and observed. Defining is to be done in the language of the students. Definitions are in context of students' experiences-not from glossary, not to be memorized.

### **Formulating hypotheses**

Formulating hypotheses involves stating the expected outcome of an experiment. Hypothesizing is an “educated guess” made about an expected relationship between two variables in an attempt to explain a cause-and-effect relationship.

### **Interpreting data**

Interpreting data involves organizing data and drawing conclusions from it. It is usually a direct response to the problem under investigation and therefore includes judgments about the interpretation to fit with the proposed hypotheses, and the limitation of the new knowledge.

### **Experimenting**

An experiment is a series of observations carried out under special conditions. Experimenting is the ability to conduct an experiment, including asking an appropriate question, stating a hypothesis, identifying and controlling variables, operationally defining those variables, designing a “fair” experiment, conducting the experiment, and interpreting the results of the experiment.

### **Formulating models**

It is creating a mental or physical model of a process or event. This process involves the use of physical or mental models to describe the behaviour of something that is unfamiliar.

### **Process Skills and Age**

Science Process Skills acquisition is also influenced by the age of the people. Based on age, Longfield (2002) classified process skills into three-Basic, Intermediate and Advanced. He revised the list proposed by Koch (1999). Detailed description of Longfield’s classification that are age dependent was found to be the most suitable and the same was selected for the study for developing the science process skills for Class VIII students. The detailed classification of the Longfield’s classification is given below.

**Table 2.2***Longfield's classification of Science Process Skills*

<b>Science Process Skills</b>	<b>Interpretation</b>
<b>Basic Process Skills</b>	<b>Developmentally appropriate for age 5 and above</b>
Observing	Using the senses to collect information.
Comparing & Contrasting	Discovering similarities and differences between objects and events
Classifying	Sorting or ordering objects or ideas into groups or categories based on their properties
Measuring	Determining dimensions (length/ area), volume, mass/weight, or time of objects or events by using instruments that measure these properties
Communicating	Using pictorial, written or oral language to describe an event, action or object
Making models	Make a pictorial, written or physical representation to explain an idea, event or object
Recording data	Writing down the results of an observation of an object or event using pictures, words or numbers
<b>Intermediate Skills</b>	<b>Developmentally appropriate for ages 9-11 and above</b>
Inferring	Making statements about an observation that provide a reasonable explanation
Predicting	Guessing what the outcome of an event will be based on observations and usually prior knowledge of similar events
<b>Advanced Skills</b>	<b>Developmentally appropriate for age 12 and above</b>
Hypothesizing	Stating a problem to be solved as a question
Planning Investigations	Determining a reasonable procedure that could be followed to test an idea or hypothesis, defining and controlling variables
Interpreting data	Creating or using tables, graphs or diagrams to organise and explain information.

### 2.1.13 Development of Scientific Attitude

Scientific attitudes can be regarded as a complex of "values and norms" which is held to be binding on the man of science. The norms are expressed in the forms of prescriptions, proscriptions, preferences and permissions. "They are legitimized in terms of institutional values (Barnes & Dolby, 1970)".

The scientific attitude includes the following traits:

- curiosity or inquisitiveness

- objectivity
- open-mindedness
- perseverance
- humility
- ability to accept failure
- scepticism

Rao (1989) stated that the most useful scientific attitude are open mindedness, critical mindedness, respect for evidence, suspended judgment, intellectual honesty, willingness to change opinion, search for truth, curiosity and rational thinking.

The current set of scientific attitudes of objectivity, open-mindedness, unbiased nature, curiosity, suspended judgment, critical mindedness, and rationality has evolved from a systematic identification of scientific norms and values. According to Paul (1993), "The success of science has more to do with scientific attitude and this attitude is one of inquiry, experimentation and humility before the facts". This attitude is one of the key objectives of science teaching and is also one of the major outcomes. It makes the people live as efficient citizens in the present scientific society.

The scientific attitude encourages one to look at the universe without the distorting blinkers of superstition. Such a person can intelligently appreciate the wonders of nature with a sense of awe blended with humility, and yet understand that in the midst of incredible harmony and beauty in the universe, there is heart-rending ugliness and evil as natural by-products of cosmic evolution.

The scientific attitude encourages truthfulness, because science is, at bottom, the quest for unraveling the truth about how nature works; it also inspires humility, together with a healthy dose of skepticism and open-mindedness, because science has shown that we are fallible beings without guarantees anywhere that our best epistemic efforts will yield true theories.

#### **2.1.14 Tribal Demographic System: ‘Kadar’, ‘Kurumbar’, ‘Kattunayakar’, ‘Cholanaickar’**

The tribal communities in Kerala can be divided into 36 notified tribal communities, that is numbering to 484,839. All the communities are entirely different in terms of culture, beliefs, livelihood strategies, social organisation, economy and total

developmental perspectives. The notable communities in Kerala include Paniya, Kurichchya, Kuruma, Kattunayakans, Uralies etc of Wayanad, Irulas of Attapadi, Muthuvans, Malayarayan and Uralies of Idukki and Kottayam and Kanikkar of Thiruvananthapuram. There are 5 major tribal communities that are identified as primitive considering the stage of transition into modern society. They are named as Kattunayakans of Wayanad, Koragas of Kasargod, Cholanaickans of Nilambur Valley and Malappuram district, Kurumbar of Attapadi and Palakkad districts and Kadars of Cochin. The sex ratio among them is 1000:1010. (KIRTADS)

The primitive tribal groups in Kerala are categorised into five tribes namely; Kadar, Kattunayakan, Koraga, Kurumbar (Kurumbas) and Chokanaickan. (KIRTADS 2016) They have been identified as PVTG or particularly vulnerable tribal groups as categorised by Ministry of Tribal affairs, Honourable Government of India. (Chaudhuri, S.K., & Chaudhuri, S.N. 2005). 6771 families have been identified with a total population numbering to 26273 that is consisting of 13073 males and 13200 females. (*Census of India Report, GOI, 2001*) (Ministry of tribal affairs, GOI. Particularly Vulnerable Tribal Groups (PVTG's) 2020) (Scheduled Tribes of Kerala: Report on the Socio Economic Status)

The community wise details of PVTG are discussed below:

- **Kadar**

The Kadar population are mainly located in thrissur, palakkad districts and their main job is hunting and food gathering. Kadar have 545 families with a population of 1974. As there are 967 males and 1007 females, the sex ratio is seen as 1000:1041. (Scheduled Tribes of Kerala: Report on the Socio Economic Status)

- **Kattunayakan**

Kattunayakans are mainly seen in Wayanad, Kozhikode, Malappuram and Palakkad districts. They are also found in the neighbouring States of Karnataka and Tamil Nadu but a vast majority of this tribal group population is centred in Wayanad. The Kattunayakans mainly depend upon the forest produce and hence their social and economic life is mainly depending on forest and its products. They are the best honey collectors and their honey collecting techniques are really different from the conventional practices that are followed by others. They are excellent mahouts and they are thus engaged in elephant capture from forests as well. As is common, they rely mainly on

hunting and cultivation in and around their living settlements. They are also food gatherers. Kattunayakan is a community with the largest population among PVTG in Kerala. Kattunayakan constitute 4.69 per cent of the population of Scheduled Tribes in the State. They have 5137 families and majority of them are in Wayanad District (4369). Malappuram (517 families) and Palakkad (218 families) are two other districts which have representation of Kattunayakan. (Scheduled Tribes of Kerala: Report on the Socio Economic Status)

- **Koraga**

Koragas are seen and is located only in Kasargod District and in the adjoining area of Karnataka State. The main job and living constitute mainly of basketry and weaving a variety of items like winnowing fans, cradles and baskets. They also are collecting the raw materials like bamboos, canes and creepers available from the nearby forests and making a living out of them.

- **Kurumbar (Kurumbar, Kurumban)**

Kurumbar are located in Attappady Block Panchayat of Palakkad District. They are the native primary inhabitants of Attappady area and are called 'Palu Kurumba' to distinguish them from the 'Alu Kurumba' of Nilgiris in Tamil Nadu State. As the conventional practices of all tribes Kurumbas too were once engaged themselves as hunters and gatherers and shifting cultivators of Attappady Valley. However it is to be noted that the Kurumbar are showing more interest towards education and their younger generation are all leading an organised life and getting them educated. Kurumba community is settled in Agali and Pudur Grama Panchayats of Palakkad District. There are 543 families with a population of 2251. (Scheduled Tribes of Kerala : Report on the Socio Economic Status)

- **Cholanaickan**

Cholanaickans are mainly located in the lush green valleys of the forests of the Ghat section of Karulai and Vazhikkadavu forest ranges of Nilambur Valley of Malappuram District. As is the case with the Koraga community they are also seen as living in isolation from the rest of the society and leading a life completely dependent on the dense and tropical rain forest environments where they have established their dwelling and settlement. Their primary job is non timber forest produce collection for their

consumption, exchange and sale through which they make a living. There are 101 Cholanaickan families with the population of 409 and all are settled in 3 Grama Panchayats (Scheduled Tribes of Kerala: Report on the Socio Economic Status) in Kerala. The state has a literacy rate of 94 percent and also it has the lowest school dropout rates when compared with other states of India. The dropout percentage is found to be 0.53% in the country. But it has been recorded that Wayanad is a district in India with a high overall dropout rate in the state and also a considerable high rate of tribal population. When compared to the total dropout in the district, the tribal dropout was 61.11% in 2007-08 and 5 years later in 2011-12 it rose to 77.23%. This shows the increase of 16.12% of drop out in district's tribal sector alone (Jobin and Srihari ,2014).

#### **2.1.14.1 Literacy rate of Tribal community**

Literacy rate of Scheduled Tribes in the state is worked out at 74.44 per cent, which is lower than the State average literacy of 93.91 per cent (2011). The highest literacy rate is noted in Kottayam district which stands as 94.31 per cent followed by Thiruvananthapuram (89.85 %) and Pathanamthitta (88.50%) districts. The literacy rate of Scheduled Tribes in Palakkad is reported as 57.63 per cent which is the lowest among the districts in the State. (Scheduled Tribes of Kerala: Report on Socio Economic Status)

#### **2.1.14.2 Literacy rate among PVTG communities**

Among the PVTG, the literacy rate of Cholanaickan community is 39.63 percent which is the lowest among the Scheduled Tribal Communities. The literacy rate of all other PVTG communities, viz; Kadars, Kurumbas, Kattunayakkans and Cholanaickans except the Koraga community are very far below than the State Literacy average. It is seen that as 56.36 per cent for Kurumbar, 58.74 per cent for Kadar and 59.37 per cent for Kattunayakan. Illiterates among the PVTG is 9127. They constitute 9.28 per cent of the total illiterates. The illiterates among PVTG together are 64759 and they constitute 65.82 per cent of the total illiterates. The persons with the educational qualification below SSLC are only 5.22 per cent of the total. Therefore, PVTG need special encouragement for education starting from primary stage.

The details on the general educational status of Scheduled Tribes are given in Table 2.3

**Table 2.3***Educational Attainments of Scheduled Tribes*

Sl.No:	Course	Number of persons
1	Primary Education	127344
2	Below SSLC	92349
3	SSLC	30342
4	PDC/+2	16374
5	Graduates	4475
6	Post Graduates	822
7	Others	328
TOTAL		272034

Source: Scheduled Tribes of Kerala: Report on Socio Economic Status

The number of persons with SSLC and +2 certificates are 46716. They represent 12.13 per cent of the total population above 5 years. Many communities have not attained the level of education at the state average. The level of secondary and higher secondary education of the PVTG is below the State average. There are 4475 graduates and 822 post graduates among Scheduled Tribes. However, the status has not been fairly reflected among the communities according to the proportion of their population. The PVTG constitutes 5.93 per cent of the tribal population, their representation among the graduates and post graduates is 0.86 per cent and 0.73 per cent respectively. (Scheduled Tribes of Kerala: Report on socio economic status)

**2.1.14.3 Educational attainment of the Scheduled Tribes**

The community wise literacy rate of the PVTG community is given below in Table 2.4 and the community wise educational attainment of the scheduled tribes are shown in Table 2.5.

**Table 2.4***Community wise data on literacy rate of PVTG*

Sl.No:	PVTG	Population	Literacy rate
1.	Kadar	1704	58.74
2.	Kattunayakan	17436	59.37
3.	Koraga	1483	78.35
4.	Kurumba	1888	56.36
5.	Cholanaickan	323	39.63
TOTAL		22834	60.02
State average on all Scheduled Tribes		384978	74.44

**Table 2.5***Community wise educational attainment of the scheduled tribes*

Sl.no:	Community	Population	Below SSLC	SSLC	Plus 2	Diploma	Graduation	Post Graduation	Professional (Engg/ Med/Others)
1.	Other ST	359389	206494	29164	15828	3581	4378	809	613
2.	Kadar	1704	821	63	44	10	3	-	-
3.	Kattunayakan	17436	8857	515	234	38	16	5	2
4.	Koraga	1483	909	77	43	6	7	-	1
5.	Kurumba	1888	783	117	73	17	12	1	1
6.	Cholanaickan	323	104	9	3	-	-	-	-
	Others	2755	1725	397	149	34	59	7	7
	TOTAL	384978	219693	30342	16374	3686	4475	822	468

Source: "Scheduled tribes of Kerala: Report on the socio economic status, STDD, Gov. of Kerala 2014"

The table 2.6 shows the class wise dropout/discontinuance of tribal students

**Table 2.6***Class-wise data on dropout/discontinuance rate of ST students*

Sl. No:	Class/Course	Students enrolled	Dropout	Percentage(%)
1	Primary	64216	15364	23.93
2	Secondary	13552	12874	95.00
3	Higher Secondary	6805	1475	21.68
4	Graduation	3198	492	15.38
5	Post Graduation	268	194	72.39
6	Certificate	629	825	131.16
7	Diploma	517	1196	231.33
8	Professional	321	44	13.71
9	Others	1396	923	66.12
	TOTAL	90902	33387	36.73

The table 2.7 shows the community wise dropout rate of school students belonging to Scheduled Tribe groups of Kerala as of the report given by the scheduled tribe development department (STDD), Government of Kerala in the year 2013. Table 2.8

shows the community wise dropout percent of school students belonging to Scheduled Castes (SC) and Scheduled Tribes (ST) given by DPI Kerala, Govt. of Kerala in the year 2014.

**Table 2.7**

*Community-wise dropout rate of school students belonging to ST in Kerala*

Sl. No:	Community	Dropouts/Discontinuance								Total
		Primary	Secondary	Higher Secondary	Certificate	Diploma	Graduation	Post Graduation	Professional	
1.	Other ST	13904	12074	1376	776	1121	476	184	935	30486
2.	Kadar	64	74	-	-	-	2	-	5	145
3.	Kattunayakan	1308	569	73	29	44	4	-	11	2038
4.	Koraga	19	50	10	15	28	5	9	1	137
5.	Kurumbar	38	32	2	2	-	3	-	11	88
6.	Cholanaickan	10	16	-	-	-	-	-	-	26

**Table 2.8**

*Community wise dropout percent of school students belonging to Scheduled Castes (SC) and Scheduled Tribes (ST)*

Period of study	General	SC	ST
2007-2008	0.83%	0.96%	4.54%
2008-2009	0.66%	0.72%	3.54%
2008-2010	0.51%	0.58%	2.36%
2010-2011	0.53%	0.55%	2.52%
2011-2012	1.05%	0.61%	3.71%

“Source: DPI-Kerala, (2014)”

It can be thus comprehended from the above data that the dropout ratio of the students belonging to the Schedule tribe population is higher when compared with the

Scheduled caste students in Kerala. It can also be seen that the Scheduled tribe students quit their schools at very early stages that they even are not completing their basic education.

**“Particularly vulnerable tribal group (PVTG)** (previously: Primitive tribal group) is a unique and distinct classification made by the honourable Government of India that was made with the sole reason of enhancing the progress and suggesting modifications in the prevailing conditions of certain specific tribal communities with particularly very low development indices so that their conditions can be improved further in terms of development and social status.”

As stated by the Dhebar Commission (1960-1961), a big drop in the rate of development was observed within Scheduled Tribes when compared with the other population outside their community. Therefore as its recommendation, in the implementation phase of the fourth Five Year Plan a completely new sub-category was identified within the community of Scheduled Tribes in order to distinguish certain particular communities inside the Scheduled Tribes that were believed to be at a considerably very lower state of development. This was developed as per the recommendations put forward by the Dhebar commission and related studies. “The name of this sub category was fixed as "Primitive tribal group". The characteristic features of this group included a native-agricultural and very primitive system of survival and existence which solely relied on the practice of hunting and food-gathering, zero or negative population growth and extremely lower levels of literacy and education when compared to other groups belonged in the tribal community.”

Groups which agreed to either of the aforesaid conditions mentioned above were considered as PTG. Hence 52 communities were selected and identified after the implementation phase of the Fifth Five year plan. They were included in the list called as PTG group or a "primitive tribal group". The honourable Government of India renamed the else existing "Primitive tribal group" as Particularly vulnerable tribal group" or as PVTG from 2006 onwards. PTG has then since been referred to as *Particularly vulnerable tribal group* (PVTG) by the honourable Government of India. Now 75 groups are coming under PVTG.

The present study focuses on four different particular primitive tribes of Kerala residing in Palakkad and Malappuram districts namely, “Kadar”, “Kurumbar”, “Kattunayakar” and “Cholanaickar”.

The theoretical overview has helped the researcher in designing the research and methods in a sequential arranged and organised manner. It has helped the researcher to know in detail about the changing trends in education and teaching learning practices. A strong focus on the experiential learning theory put forward by David S Kolb has formed the basis of the research and further lesson transcripts and activities were arranged accordingly. It also directed the researcher towards science process skills and helped the researcher in the design of module that focuses on science learning through activities, experiments and locally relevant experiences. Thus the theoretical overview has helped the researcher in giving light to the methods and techniques adopted in the present research with the evidence of proven theories and concepts.

## **2.2 Review of related studies**

Review of studies is presented under the following heads:

- 2.2.1 Experiential Learning
- 2.2.2 Learning Style
- 2.2.3 Instructional Package
- 2.2.4 Science Process Skills
- 2.2.5 Scientific Attitude
- 2.2.6 Achievement in Science
- 2.2.7 Education among Tribal people

### **2.2.1 Studies Related to Literature of Experiential Learning**

Dsouza (2022) in the research paper entitled ‘*Experiential Learning-Based Service-Learning Pedagogy for Civic Engagement of Pre-service Teachers*’ presented in the Proceedings of the International Conference on Best Innovative Teaching Strategies have suggested that experiential education in the form of service-learning enables the students to engage in activities that address community needs together with structured opportunities for reflection designed to achieve desired learning outcomes. This study had aimed to use a transformative pedagogy that linked the classroom with the real world and theory with practice. This experimental study consisted of a post-test only control group design involving a sample of 64 pre-service teachers pursuing their two-year Bachelors of

Education programme. The post-test results indicated significant differences in the civic engagement of pre-service teachers.

Wickline et al. (2021) in their article entitled ‘Increasing intercultural competence among psychology students using experiential learning activities with international student partners’ have found that Intercultural competence, with its three domains (knowledge, skills, and awareness), is an important priority for international and domestic college students and the institutions they represent. With a total sample of 207 college students, they determined that student knowledge and identity scores were significantly higher after the semester-long program than before, with increases in complexity of knowing for White students and those who had never studied abroad and additional increases in social interactions for White students.

Bhatia and Bhatia (2020) in their research paper entitled ‘*Assiduous Study On Experiential Learning In Entrepreneurship Education With Reference To Higher Education In India*’ elucidate the role of experiential learning in Higher Education in India, specifically entrepreneurship education. The paper recommends that experiential learning is best expedited as a result of the learner’s participation in practical events, thus supporting the creation of understanding and their subsequent reflection on these experiences. The key findings enumerate that by providing suitable experiential learning opportunities, educators can develop entrepreneurial capabilities in the students and aid in promoting an entrepreneurial ecosystem.

The National Education Policy (NEP) 2020 outlines the vision of India’s new education system. It provides a comprehensive framework to address the ‘learning crisis’ by making education accessible, equitable and inclusive. An important objective of the NEP is to foster ‘experiential learning and critical thinking’ among students. Skill development has been a major concern in India. Experiential learning is the method of learning by doing or ‘experience’. It is distinct from traditional learning which is primarily based on passive one-way communication and rote methodology. Experiential learning involves hands-on learning whereby students develop the capability of reflecting on their experiences. It moves beyond the boundaries of the classroom and involves students more actively and closely into the learning process.

Jeyaraj (2019) concluded in his paper entitled ‘*Traditional learning Vs Experiential learning*’ that experiential learning is the foundation for adult learning even

though experience has not been valued as much as it should have been. Though experience-based learning is elusive for want of solid methods and techniques, it can be translated into reality with proper in-service training to teachers. Students should be given ample opportunities to use English in the class by way of reflecting over experience that they derive from learning so that real learning can be measured. Cooperation and collaboration should become the norm rather than passive listening to prepared lectures on the prescribed themes. Experiential learning is preferred for it facilitates participation, interaction, and application.

Parahakaran (2017) discusses in the paper entitled '*An Analysis of Theories Related to Experiential Learning for Practical Ethics in Science and Technology*' the different theories of experiential learning which will contribute to implementation of ethical behaviours in science and technology towards citizenship learning. The paper focused on the theoretical aspects of the conceptions of learning, cultural implications of learning, how different types of knowledge contributes to learning and analyses why such knowledge and learning is insufficient to meet long term sustenance in life.

Kolb and Kolb (2010) proposed an experiential learning framework for understanding how play can potentially create a unique ludic learning space conducive to deep learning. The case study suggests that play in a ludic learning space can promote deep learning in the intellectual, physical, spiritual, and moral realms. Learners can chart their path on the learning way by developing their meta-cognitive learning capacities, and educators can pave the way by placing learning about learning on the agenda of their educational programs. The metacognitive model is used to describe how fundamental concepts of experiential learning theory-a learning self-identity, the learning spiral, learning style, and learning spaces-can guide metacognitive monitoring and control of learning. Meta-cognitive strategies to help individuals improve their learning effectiveness are outlined.

### **2.2.2 Studies related to Learning Style**

Awaru et al. (2020), in their study entitled '*Mapping Student Learning Styles Achieving Using Kolb's Learning Style Inventory in Sinjai Regency*' tried to map the learning styles of high school students in Sinjai Regency. The type of research was a quantitative descriptive study. The population consisted of 240 outstanding students from 4 schools in Sinjai Regency and the sample selected was 62 people or 25 percent of the

study population. The data collection techniques used was questionnaires and documentation. The results of this study found the learning styles of high school achievement students in Sinjai Regency, namely the Converger learning style type as many as 35 students or 56.5 percent, the accommodator learning style type were 16 students or 25.8 percent, the assimilator learning type was 7 students or 11.3 percent and the type of learning diverger as many as 4 people or 6.5 percent of the 62 respondents who are outstanding students or are ranked 1-3 in the study group. From the research results, it appears that the type of learning style that dominates or excels the respondent is the convergent learning style, which is a quadrant combination of thinking and doing.

Shamsuddin and Kaur (2020), in their study on '*Student's learning style and its effect on blended learning, does it matter?*', in their study investigated about learning styles among the students and their relationship with perceptions of blended learning. The study involved 119 students taking the course of Diploma in Information Technology at a private university. The learning style of the students was determined by using Kolb's Learning Style Inventory, while perceptions of blended learning were investigated using elements of process, content, and usability. Student perceptions on blended learning were assessed using a one-way ANOVA to determine the correlation with the learning style of the students. Majority of the students belong to the Convergent category, followed by Divergent, Accommodator, and Assimilator. The outcomes of this study showed no meaningful difference between students' learning styles and their perceptions towards blended learning.

Sudriya et al. (2018) in their study aimed to examine the effect of Kolb's learning styles on chemical learning activities and achievement of reaction rate taught by inductive guided inquiry learning. The population was eleventh grade Science students of a senior secondary school having relatively good academic input based on national testing results in Bali, Indonesia. Samples involved the entire students of five classes taken by cluster sampling from the whole nine classes of the population. Data were collected by Kolb's learning style inventory for the learning styles, observation and document recording for learning performances, post-test for the cognitive achievement, and questionnaires for student's perceptions. Data analyses were conducted qualitatively in assigning the learning styles, and describing learning performances and perceptions, and used ANOVA followed by Scheffé's post hoc test for the effect of learning styles on the cognitive achievement. The results showed: (1) the student learning styles were 35.8% Convergents, 30.0%

Assimilators, 17.5% Divergers, and 16.7% Accommodators; (2) learning styles significantly affected the achievement with only superiority of the Convergers over the accommodators; and (3) the inductive guided-inquiry learning of chemical topic which involves concrete evidences via laboratory work was fruitful for all learners of all learning styles.

Holtbrugee, D. & Mohr, A.T. (2017) in their study, investigated the relationship between cultural values and the learning style preferences of students of business administration. By linking Kolb's (1984) model of learning style preferences to the cultural values of learners they developed hypotheses that were tested against data collected from 939 individuals studying at universities in Germany, the UK, the USA, Russia, Ireland, Spain, the Netherlands, Poland, China, and the United Arab Emirates. The findings showed that the learning style preferences vary with individuals' cultural values. They also found out that study level, exchange student status, and gender are related to individuals' learning style preferences.

Duman (2010), investigated the effects of Brain-based learning (BBL) on the academic achievement of students with different learning styles. The study group consisted of students from the department of Social Sciences Teacher Education in the Faculty of Education at Mugla University (N=68). In the study, a pre-test-post-test experimental design was used. Data were collected by using academic achievement tests and the Kolb's Experiential Learning Style questionnaire. The findings of the study revealed that the BBL approach used in the experimental group was more effective in increasing student achievement than the traditional approach used in the control group. However, no significant difference was observed among the achievement levels of the experimental group students with different learning styles.

Yenilmez (2007) studied the relationship among the learning styles, Math anxieties and math attitudes of the secondary school teacher training students. The results show that math anxiety and math attitude are efficient in predicting preferred learning styles of secondary school students in learning Mathematics.

Kayes (2005) in his study explored the internal validity and reliability of Kolb's revised Learning Style Inventory (LSI-2A and LSI-3). This study largely supports prior research supporting the internal reliability of scales. Principal Component Analysis provides evidence for a 2 factor structure as hypothesized by Kolb.

### **2.2.3 Studies related to instructional package**

Adelana, et.al (2021) attempted to develop an instructional package and also surveyed the extent to which it is adequate for instructional delivery. The Instrumentation design describes the processes of package development based on the Waterfall Model. The package was validated by thirty (30) Biology teachers who were randomly selected from ten schools in Ijebu-Ode Local Government Area, Ogun State, Nigeria. "Package Adequacy Scale (PAS)" was developed and used for validation purposes. The result showed that the package was adequate for instruction in Genetics due to its quality in terms of lesson contents, graphics, sound, and others. It was suggested, among others, that students should be supplied with modern instructional packages which can aid the teaching and learning of Genetics.

Yaki and Babagana (2016). examined the effects of a Technological Instructional Package (TIP) on secondary school students' performance in biology. The study adopted a pre- test, post- test experimental control group design. The sample size of the study was 80 students from Minna metropolis, Niger state, Nigeria; the samples were randomly assigned into treatment group 40 (male = 18 and female = 22) and control 40 (male = 20, female = 20). The researcher developed package was validated by experts. The data collection instrument was a Biology Achievement Test which yielded a reliability coefficient of .74. The treatment group was taught with TIP while the control group was taught with traditional teaching methods. The data obtained were analyzed using split- plot Analysis of Variance (SPANOVA) and t- test. The results of data analysis revealed there was an interaction effect, treatment was effective in significantly improving students' performance in the experimental group than the control group ( $F(1,78) = 29.89$ ,  $p < 0.05$ ). Based on the finding, it was recommended that teachers should be trained and encouraged to employ technological resources in their classroom practices.

Thomson (2012) evaluated a Self-Instructional Package for Teaching Tutors to Conduct Discrete-Trials Teaching with Children with Autism. The results were very positive, and they indicate that the training package is a practical, economical and efficient method of instructing newly hired tutors in ABA programs for children with autism.

Abdulwahed et al. (2010), introduced a model based on recent advances in ICT and implements three access modes to the laboratory experiences (virtual, hands- on and remote) in one software package. The novel model of laboratory education is named Tri

Lab: the review of the three modes is provided with highlights of advantages and disadvantages of each mode.

Zisimopoulos and Dimitrios (2010), studied the effectiveness of instructional package that included an adapted version of peg word mnemonics paired with a picture fading technique in teaching two students with moderate intellectual disabilities to recall 28 single digit multiple base line design across students. Result indicated that instruction produced substantial and immediate effects in that both students increased their accuracy at recalling basic multiplication facts, maintained the newly acquired skill, and were able to generalize it across material and another trainer.

Hamilton and Robert (2009), developed an instructional package, relating to the students assignment work which provided immediate formative feed back with sufficient indicators for the students to identify that they had made an error and provided encouragement for the students to take appropriate corrective actions until they were satisfied that their answer was correct. Once the student was satisfied with their work, their submission was automatically marked by the assessment package according to the pre-set marking scheme.

#### **2.2.4 Studies related to Science Process Skills**

Gultekin and Altun (2022), examined the impact of activities based on scientific process skills on problem-solving skills of 4th grade students in science lessons. In the study a non-equivalent control group pre-test and post-test design type of quasi-experimental method was used. The research study group was composed of 30 students with 15 each in the experimental study group and control group. In the experimental and control groups, for scientific process skills, the “Scientific Process Skills Test (SPS)”, and for problem-solving skills, the “Problem Solving Inventory for Children at Elementary Education Level (PSIC)” were used as pre-test and post-tests. Activities including scientific process skills in the experimental group were applied for 8 weeks and 16 lesson hours, while no intervention was made to the control group. In the data analysis process, the Mann-Whitney U test and Wilcoxon Signed-Rank test were used. According to the data obtained from the research, it was observed that there was a significant difference in the post-test scores in the Scientific Process Skills Test (SPST) and the Problem-Solving Inventory for Children (PSIC) of the students in the experimental group compared to the students in the control group. According to these findings, it can be stated that activities

including scientific process skills develop problem-solving skills of students in primary science education.

Hayati and Ami (2022), determined the effectiveness of the Group Investigation(GI) learning model in practicing students' learning activities and science process skills on additives material at grade VIII. This research was a classroom action research which consists of two cycles. Each cycle consisted of planning, implementing, observing and reflecting stages. The research subjects consisted of 30 students. The instrument used was the observation sheet of student activities and science process skills. Data analysis was carried out descriptively and qualitatively. The results of this study indicated that student learning activity in the cycle I is 73.3% ("active" category) and in the cycle II is 80.68% ("very active" category). Meanwhile, students' science process skills in the cycle I is 73.03% ("skilled" category) and in the cycle II is 82.36% ("very skilled" category). It can be concluded that GI learning model was effective to practice students' learning activities and science process skills.

Rediani et al. (2021) analysed the effect of project-based assessment based on local culture on students' scientific attitudes and science process skills in science learning in elementary schools. This research was a quasi-experimental study with a non-equivalent post-test-only control group design. The population in this study was 151 participants, while the sample selected through random sampling technique was 61 participants divided into two classes. The data collection methods in this research were test and non-test methods. The instruments used were scientific attitude questionnaires and performance tests, and observation sheets. A validation process measured the validity and reliability of the instrument. The data obtained were analyzed using the MANOVA test assisted by the IBM SPSS Statistics 21.0 application. Thus, it concluded that there are simultaneous effects in scientific attitudes and science process skills between students' learning with local culture-based Project-based Assessment and students' learning with conventional assessment applied.

Uluhan and Fatih (2021), compared the effects of using different teaching methods in "Cell and Division" and "Force and Energy" units on students' engagement in the lesson and scientific process skills. In each of the five randomly selected groups, the lessons were taught with Multiple Intelligence, Problem Based Learning, Peer Instruction, Combined and the method proposed by MONE (2017). In the research, quasi-experimental method,

one of the quantitative research approaches, was used. The sample of the study consisted of 185 seventh grade students studying in two secondary schools in Yakutiye district of Erzurum province. As a data collection tool in the research; Student Engagement Scale and Scientific Process Skills Test were used. As a result of the analysis, statistical difference was determined in the engagement levels and scientific process skills of students studying in different groups. In terms of the variable of engagement to the lesson, a significant difference was statistically determined in favour of the groups in which Peer Instruction and Combined Method were used. Also in this study in terms of scientific process skills, a statistically significant difference was found in favour of Problem Based Learning and Combined Method groups.

Yildiz and Yildiz (2021), explored the relationship between creative thinking and scientific process skills of preschool children. Possible relations were also sought between home environment quality, preschool education duration, gender, and parents' educational backgrounds and the children's creative thinking and scientific process skills. The study was carried out based on a correlational research model, one of the quantitative methods. The participants included 70 children aged between 60 and 66 months who were attending preschool. The data collection tools included a demographic information form, Torrance Tests of Creative Thinking Figural Form A, the Scientific Concepts and Scientific Process Skills Instrument for Preschool Students, and the Home Screening Questionnaire for children of 3–6 years of age. It was determined in this study that there was a moderately positive significant relationship between the children's creative thinking and scientific process skills scores.

Martiningsih et al. (2019) studied about increase in learning outcomes and science process skills of students using modules based on scientific contextual approach. This was a type of research and development (R&D) with the development procedure of Sugiyono's model with the pre-experimental design method with the form of one group pretest posttest design. Increased student learning outcomes and science process skills was explored through the observation sheet, then analyzed using N-gain. The results showed that modules based on scientific contextual could increase student learning outcomes with N-gains of 0.481 (medium) in class VIII 6 and 0.446 (medium) in class VIII 7. Science process skills of students experienced an increase in each aspect namely observing, classification, interpreting, and communication with N-gain acquisition amounting to 0.08 (low); 0.05 (low); 0.25 (low); and 0.07 (low) for class VIII 6, while science process skills

in class VIII 7 experienced an increase in each aspect with N-gain acquisition equal to 0.3 (medium); 0.3 (medium); 0.5 (medium); and 0.5 (medium). Based on the results of the analysis, it can be concluded that the development of modules based on scientific contextual effectively increasing student learning outcomes and science process skills.

Gurses et al. (2014) attempted to determine the relation between Undergraduate student's awareness levels regarding their Scientific Process Skills and application potentials. The test consisted of 26 questions which covers identifying and checking Basic Skills and variables such as Observation, Classification, Measurement, Communication, Prediction, Using Space-Time Relationships, and Integrated Process Skills, viz. Inference, Operational definition, Making the interpretation of data and Hypotheses and conducting experiments. It is based on Bloom's taxonomy of cognitive development, questions on knowledge, comprehension, application, analysis, synthesis, and evaluation aspects. This study was conducted with 165 undergraduate students to determine the relationship between undergraduate students' awareness levels regarding Scientific Process Skills and application potential, using survey method which is an implementation of non-experimental quantitative research methods. The results of the study concluded that the difference in levels of awareness of the students lead to significant differences in terms of Science Process Skills and application potential, however, other variables and demographic characteristics do not lead to significant differences.

Ongowo and Indoshi (2013) conducted a study to determine the Science Process Skills included in the Kenya Certificate of Secondary Education (KCSE) biology practical examinations in Kenya for a period of 10 years (2002- 2012). Expost facto design was adopted for the study. The study identified five most common Science Process Skills which were observation (32.24%), communication (14.63%), inference (13.13%), experimentation (12.21%) and interpretation of data (11.94%). The results also revealed a high percentage of basic Science Process Skills at 73.73% compared to the integrated Science Process Skills at 26.27%. It was recommended that the Kenya National Examination Council should include more integrated Science Process Skills into the KCSE biology practical examinations to enable the students to develop problem solving abilities and creativity which are important tools for biotechnology.

The study by Ilhan & Pinar (2013) was an Experimental study which determined the Scientific Process Skills of teacher candidates of Science, and explored how their skills

vary depending on the level of their classes and branch. The participants of the research were 125 teacher candidates and Survey method was employed. The data was obtained using the Scientific Process Skills Test. It was found that the Scientific Process Skills of teacher candidates were at a medium level, and that there is no meaningful difference in the Scientific Process Skills of teacher candidates in the various levels of classes and branches.

Zorlu, Zorlu and Sezek (2013) examined the Scientific Process Skills of 7th Grade students' in terms of their demographic features. The Scientific Process Skills Test was used to gather data. It was found that Female Students are better than Male Students in Observation, Classification, Measurement and Model Formation.

Kaya et al. (2012) explored the relationship between Scientific Literacy and Scientific Process Skills of Primary School Students. The study was carried out on 24 students of 6th Grade, 21 students of 7th Grade and 25 students of 8th Grade, aggregating to a total of 70 students participating in the research. It was found that, Scientific Literacy and Scientific Process Skills of 7th Grade students' were more positive than that of the other Grades. There was no significant difference between Scientific Literacy and Scientific Process Skills of the students. Furthermore, a highly positive and meaningful relationship between the scores of Scientific Literacy and Scientific Process Skills has been registered.

Lati et al. (2012) carried out a study to improve Student's achievement records and Integrated Science Process Skills through 12 hours of Science Inquiry activities. High School Students, who had low learning achievement in Chemistry, especially in the area of chemical reaction rates, also had low levels of Integrated Science Process Skills due to lack of experience in Inquiry activities. Sixty-three Grade 11 Students participated in this study. The paired 't' test analysis showed that the Post-achievement of the students scores were statistically higher than their Pre-achievement scores at 0.01 level. They also obtained an average of 74.52% in Integrated Science Process Skills. Science Inquiry activities effectively enhanced achievements and Integrated Science Process Skills of the students.

Aydinli et al. (2011) conducted a study to determine the level of performance on Integrated Science Process Skills of the students in terms of their Gender, grade level, economic background, the education background of their mother, the number of family.

The test comprised 12 items related to Integrated Science Process Skills. The results showed that there was a positive relationship between their performance and their Gender, grade level, economic background, the education background of their mother and the number of family.

Ergul et al. (2011) conducted a study to determine Turkish elementary school students' level of success on Science Process Skills and science attitudes through inquiry science methods. Results of the study showed that the use of inquiry based teaching methods significantly enhance students' Science Process Skills and attitude.

Remziye et al. (2011) found that use of Inquiry based teaching methods significantly enhances students' Science Process Skills and attitudes. For this purpose, Pre-Test Post-Test Control Group and Experimental Group design was used. The data were collected using Basic Science Process Skills Test, Integrated Science Process Skills Test and Science Attitude Scale. The study was conducted during two semesters.

Vebrianto and Osaman (2011) took up an Experimental study to investigate the effectiveness of various constructive teaching media in the Science teaching and learning process to improve students' Science Process Skills and Science achievement. Four modules were developed and eight Multimedia teaching were carried out. The research employed Quasi-Experiment method with Non-equivalent Control Group design. Two Experimental Groups and one Control Group were involved in the research. The first Experimental Group used ICT module while the second Experimental Group used environmental module. The Control Group on the other hand used conventional teaching approaches. The study was conducted on 96 Students. The instruments used were Science Process Skills Test and Science Achievement Test. The findings revealed that there were significant differences on the knowledge of Science Process Skills and Science Achievement between students who underwent the ICT and environmental modules with the Students who underwent conventional teaching strategies. Based on the findings, it can be concluded that the teaching and learning process using various constructive teaching media has significantly improved the Science Process Skills and Science Achievement among students.

Akinbobola (2010) analysed the Science Process Skills in West African Senior Secondary School certificate Physics practical examinations in Nigeria for a period of 10 years (1998-2007). Ex-post facto design was adopted for the study. The 5 prominent

Science Process Skills identified out of the 15 used in the study were: Manipulating (17%), Calculating (14%), Recording (14%), Observing (12%) and Communicating (11%). The results showed high percentage rate of Basic Science Process Skills (63%) as compared to the Integrated Science Process Skills (37%). The results also indicated that the number of Basic Process Skills was significantly higher than the Integrated Process Skills.

Aktamis and Yenice (2010) tried to determine the Science Process Skill (SPS) and Critical Thinking Skill (CTS) levels of the 8th Grade Elementary School Students. The sample comprised 308 students from each of high, middle, and low socioeconomic level schools in a randomly selected province of Aegean region. At the end of the research, it can be said that the students who completed elementary education have developed middle level SPS and CTS. The research findings also suggest that, it is important to perform more comprehensive instruction by using different measurement tools.

Bati et al. (2010) assessed the Science Process Skill attainments in the cognitive domain and the awareness levels of the Pre School teachers regarding Science Process Skills. An Interview Form was prepared for this purpose. Qualitative research techniques, content analysis and descriptive analysis were applied to the interview forms. It is concluded that awareness levels of teachers regarding Science Process Skills are remarkably low.

Cakır & Sarıkaya (2010) used a survey to examine whether there are statistically significant differences between the Science Process Skills of Science Teaching majors from different Genders, Universities, and High Schools. The sample for the study consisted of 355 Senior Science Teaching majors from four different faculties of education. The analysis conducted show that the Science Process Skills of Science Teaching majors differ significantly from each other on the basis of Gender, University attended, and High School graduated from.

### **2.2.5 Studies related to Scientific Attitude**

Afridah, A., Iswari, R., &Lisdiana, L. (2022) developed a guided inquiry-based digestive system teaching materials as a source of student learning to improve student's critical thinking and scientific attitude. The results showed that teaching material effectively improved the learning outcomes of student's critical thinking and scientific attitude. Based on the results of the study, they concluded that the digestive system

teaching materials developed have characteristics based on the guided inquiry syntax, including: formulate the problem, make a hypothesis, planning an experiment, collecting data and conclusion, very valid and effective teaching materials improve critical thinking and scientific attitude of students.

Fathayati, S., Isnaeni, W., & Marianti, A. (2021), used the ADDIE development model in their research study. The purpose of this study was to analyze the validity of the instrument, the practicality of the instrument, and the effectiveness of the developed scientific attitude assessment instrument by using self and peer assessment in project-based learning. The sample used in this study was 48 students. The lesson taught was about environmental pollution. The results of the validity of the instrument analyzed using the CVR obtained 0.9. This means that the instrument validity was good. The assessment used in this study was only self-assessment because of the limited learning activities due to the COVID-19 pandemic. The first learning step was having a scientific attitude of critical thinking, responsibility, and care for the environment. The second was having curiosity, perseverance, and responsibility. The third was having curiosity, critical thinking, and being objective. In the fourth learning step, the scientific attitudes that had excellent criteria were the attitude of being curious, objective, and persevering. The fifth learning step was being disciplined, caring for the environment, and having a critical thinking attitude. The sixth was an attitude of curiosity, perseverance, and responsibility.

Kanli, E. (2017) examined the relations between scientific creativity, gender and scientific attitudes. Descriptive research methodology was used in the study and fifty-six gifted eight graders were included in the study group. Creative Scientific Associations Test (C-SAT) and Scientific Attitude Scale (Moore & Foy, 1997) were applied as data collection tools. Data were analyzed by independent groups t-test, correlation and regression analysis. The results of the study revealed that, there were no significant differences either in scientific creativity or scientific attitude with respect to gender. Moreover it was found that scientific creativity and scientific attitude correlated significantly and scientific attitude predicts scientific creativity.

Kristiani, N. et.al. (2015) performed a correlational research designed to investigate the contribution of metacognitive skills and scientific attitudes towards academic achievements of higher secondary school students in Malang, Indonesia. Twenty-three students participated in this correlational study. The students' metacognitive

skills were measured by an essay test integrated with academic achievement measurement. The students' scientific attitudes were measured with a questionnaire. The research results showed that metacognitive skills and scientific attitudes contributed 71.42% to students' academic achievements. The contribution of metacognitive skills towards students' academic achievements was much greater (61.93%) than that of scientific attitude (9.49%). Teachers should consider implementing a learning strategy which can empower students' metacognitive skills.

Srivastava (2013) investigated the relationship between environmental moral reasoning and scientific attitude among secondary students; to compare the environmental moral reasoning and scientific attitude between grade 9 and grade 11 (arts) students, to compare the environmental moral reasoning and scientific attitude between grade 9 and grade 11 (science) students; to compare the environmental moral reasoning and scientific attitude between grade 11 (science) and grade 11 (arts) students. Sample consisted of 154 students of Allahabad city. 69 students of class 9 general, 56 and 29 students of class 11 (science) and class 11 (arts) respectively (science) students do not differ from those of class 11 (arts). This study reveals that exposure to science education from lower secondary to higher secondary tend to develop scientific attitude among students but not environmental moral reasoning ability. There must be inclusion of environment- related topics in subjects of higher secondary curriculum.

Pillai (2012) conducted a study about the Scientific Attitude of Higher Secondary School students in Virudhunagar District, Tamil Nadu, India. The result revealed that Male and Female students had no significant difference in respect of their Scientific Attitude. Government and Private school students, Rural and Urban area students showed significant difference in respect of their Scientific Attitude and that the Urban area students showed better scientific attitude.

Patil (2011) in her study "A comparative study of Scientific Attitude about secondary and higher secondary level students" found difference in the Scientific Attitude between male and female students of secondary level found that the Scientific Attitude of female students of secondary level is more than male students of secondary level.

Simsek and Kabapinar (2010), in their study investigated the effects of Inquiry-Based Learning (IBL) environments, on students' conceptual understanding of matter,

scientific process skills and attitudes towards science. A teaching intervention was designed on the basis of IBL principles, which was put into practice in a 5th grade science class (n=20). Instruction lasted 8 weeks in total as provided by normal science curriculum. The success of teaching intervention was tested via concept test, scientific process skills test and attitude scale. The findings indicated that IBL had a positive impact on students' conceptual understanding and scientific process skills, but did not make any difference on their attitudes towards science.

### **2.2.6 Studies related to Achievement in Science**

Funa et al. (2021) in their research paper entitled '*Effectiveness of Problem-Based Learning on Secondary Students' Achievement in Science: A Meta-Analysis*' is of the view that preparing students for the real challenges in life is one of the most important goals in education. They reported that constructivism is an approach that uses real-life experiences to construct knowledge and Problem-Based Learning (PBL), has been the most innovative constructivist pedagogy used worldwide which has led the researchers to do a meta-analysis to analyse the effectiveness of PBL on secondary students' achievement in different scientific disciplines. Following the set of inclusion and exclusion criteria, 11 studies in Eurasia, Africa, and America conducted from 2016 to 2020 have qualified for this study. Six of which focused on JHS (n = 1047) and five on SHS (n = 375). Studies were obtained from various meta-search engines including Google, ERIC, and JSTOR. Further, the researchers used Harzing's Publish and Perish software to exhaust the search process. Sample size, mean, and standard deviation were analysed using the Comprehensive MetaAnalysis version 3 to determine the effect sizes (Hedge's g) and the results of moderator analysis, forest plot, funnel plot, and Begg-Mazumdar test. Findings have shown that PBL, as an approach to teaching science, had a large and positive effect (ES = .871) on the achievement of secondary students. However, grade levels and various scientific disciplines did not influence students' learning achievement. The conduct of more studies on the different factors affecting PBL implementation and specific effects of PBL on various student domains is recommended to facilitate comparative educational research in the future.

Xhomara and Bara (2020), in their research study '*The Effect of Student-Centered Teaching and Problem-Based Learning on Academic Achievement in Science*' had aimed to investigate the relationships between student-centered teaching approach, problem-

based learning, and academic achievement in science teaching. The quantitative quasi-experimental research approach was adopted in this study. The data of the study was collected by a structured questionnaire. The sample of the study consisted an experimental group students (N= 215) and a control group students (N=204) by cluster random sampling. The results showed a significant difference in the student-centered teaching approach, problem- based learning, and academic achievement scores for experimental and control group of students. It is found that there is a low positive correlation between student-centered teaching approach and academic achievement, although there are significant differences between the experimental and control group. The study revealed that there is a medium positive correlation between problem- based learning and academic achievement, although there are significant differences between the experimental and control group. At the same time, it is revealed that the total variance of academic achievement levels explained by the student-centered teaching approach and problem-based learning is relatively a high percentage.

Hwang et al. (2019), in their article entitled *'Improving learning achievement in Science education for elementary school students via blended learning'* have reported that blended learning combines online learning with traditional face-to-face classroom instruction and is currently held in high regard. Also, in elementary schools, science and technology education aims to help children use technology tools and to learn how disciplines such as math and science are relevant to engineering. The authors in their study examined what type of learning profile contributes to higher achievement in science and technology in a blended learning environment. The participants consisted of 106 elementary school students (grades three to six) from two different schools. The authors adapted the Online Technologies Self-Efficacy Scale (OTSES) and the Motivated Strategies for Learning Questionnaire (MSLQ) to measure students' computer skills and learning motivation, respectively, and to understand how the blended learning environment affected their learning achievement. The results were that Computer skills significantly improved for all students except sixth-graders, the blended learning environment had no significant effect on learning motivation, in grades four and five, students in the experimental group improved more in learning achievement than students in the control group, as reflected by their higher MSLQ and OTSES scores.

Saputro et al. (2019) in their research paper entitled *'The Impact of Problem Solving Instruction on Academic Achievement and Science Process Skills among*

*Prospective Elementary Teachers'*, aims in improving students' academic achievement and Science Process Skills (SPS) through Problem Solving Instruction (PSI), and analyzing the correlation between both dependent variables. A quasi-experimental design was conducted for six weeks at Muhammadiyah University of Ponorogo, Indonesia. Forty-eight prospective elementary teachers completed Academic Achievement Test (AAT) and SPS Test (SPST). The reliability coefficient Cronbach's alpha of both tests was .81 and .86, respectively. Data were analyzed by using N-gain score, Mann-Whitney U test and Spearman's rho correlation at significance level .05. The findings indicated that there is significant difference on academic achievement and science process skills between experimental and control groups in favour of experimental group students, and there is a high positive and significant correlation between both dependent variables. They recommended to the lecturers to use PSI as a tool to promote students' scientific skills and abilities to satisfactory performance in order to respond fast changes in 21st century learning.

Abdi (2014), in the research paper entitled *The Effect of Inquiry-Based Learning Method on Students' Academic Achievement in Science Course*, investigated the effects of inquiry-based learning method on students' academic achievement in sciences lesson. A total of 40 fifth grade students from two different classes were involved in the study. They were selected through purposive sampling method. The group which was assigned as experimental group was instructed through inquiry-based learning method whereas the other group was traditionally instructed. This experimental study lasted eight weeks. To determine the effectiveness of inquiry-based learning method over traditional instruction, an achievement test about sciences which consisted of 30 items was administered as pre-test and post-test to students both in the experimental and control groups. For the statistical analysis, Analysis of Covariance (ANCOVA) was used. The results showed that students who were instructed through inquiry-based learning achieved higher score than the ones which were instructed through the traditional method.

Mohammadpour (2012) investigated variations in science achievement for secondary school students across the Trends in International Mathematics and Science Study (TIMSS) assessments. It was concluded that the variation in science achievement at both student and school levels was greatly increased in TIMSS 2007 compared to the two previous studies conducted in 1999 and 2003.

Udeani (2012) conducted a study to determine the relationship if any among the variables of study habits, facilitating anxiety and debilitating anxiety on achievement in secondary school science. It was found that the students exhibited fairly adequate study habit patterns. There was significant positive correlation between study habits and science achievement while significant negative correlation between debilitating anxiety, and science achievement. The relationship among study habits, facilitating anxiety and debilitating anxiety was not significant.

Sun et al. (2012) conducted a study to investigate the factors that influence the science achievement of 15-year-old students. The results indicated that student gender, self efficacy, socio economic status of family, school SES composition, and instruction time per week influenced science achievement. Delen (2011) examined the effects of information and communication technologies (ICT) on students' math and science achievement. The sample included 4996 fifteen year old students in Turkey. The results indicated that students' familiarity with ICT and their exposure to technology helped to explain math and science achievement gaps between individuals and schools. The study concluded that ICT is an important factor that should be taken into consideration when designing classroom environments.

### **2.2.7 Studies related to Education among Tribal people**

Reddy, P (2021) in his research paper entitled "*A brief review on tribal education in India*" has concluded that education is the key to tribal development and that tribal children have very low levels of participation in education. Though the development of the tribes is taking place in India, but the pace of development has been found rather very slow. If Government do not take some drastic steps for the development of tribal education, the status of education among tribes will be a story of distress, despair and death. Hence the paper suggests that a time has come to think it seriously about tribal education and their inclusive growth. So, there is an urgent need for various govt. interventions, planners and policy makers to address this problem and allocate more funds in the central and state budgets for tribal education. Easy access and more opportunities should be provided to the tribal children in order to bring them to the mainstream of economic development.

Vinu (2021) in the research paper entitled '*Tribal education and quality of life: issues & challenges*' reported that the tribes have a different way of living with a distinct

cultural pattern. Some states have maximum number of tribal communities like Biagha, Bhil and Kol in Madhya Pradesh and Mundas in Bihar, Orissa and West Bengal. They live a miserable life without enough resources and have a lot of issues and problem such as economic problem, illiteracy, unemployment, housing and nutrition problem. A lot of educational problems are faced by tribal communities; hence government is trying the best to resolve all these problems by implementing specific laws. The paper mainly discussed major issues and problems faced by tribal communities in India with special reference to their educational problem. Further the researcher focused on the laws made by the government for upliftment of the tribes and discusses the major challenges to solve the educational problem. This study has found out that a wide range of issues and problems are being faced by the tribal people in India. They live a challenging life and face problems related to their residence, economic, transport, less basic amenities, indebtedness, unemployment and educational problem. Education is basic root to overcome all these problems. But to achieve education they have to face a lot of problems like lack of money, because of which they can't enrol their children in school and also in tribal area school, there exists problem of communication and dearth of untrained teachers which are big barriers of education among tribes.

Dar and Najar (2017) in their research paper entitled '*Problems of teaching tribal children- a study on tribal schools of khanshaib*' reported that the teachers engaged in teaching tribal children face unique set of challenges, which emerge primarily from the unique cultural patterns of tribals. This study was conducted in the tribal areas of khanshaib, a hilly area of district Budgam of Kashmir valley. Gujjar and Bakkarwal constitute the major proportion of total population of the area, mostly sedentarized. Interview of teachers was conducted in order to get valuable data for understanding the research problem. Data was subjected to rigorous content analysis to unveil the major themes and patterns in the interview data. The finding reveals that, the biggest issue with teaching tribal children is the lack of adaptability of tribal children to nontribal conditions. The study also reveals that that there is a gap between school culture and family culture of children, creating a situation of cultural mismatch, resulting into creating discipline problems, management problems and poor responsiveness of tribal children towards academic activities.

Upmanyu (2016) in his article entitled '*The tribal education in India, Status, Challenges and Issues*' provides a conceptual frame work and understanding related to

tribal education in India. The present structure of the society and its diversity within the cave of caste system in India was projected in the article through critical analysis. The first hand experience of different social reformers, educators and the researcher perceptions were also critically examined with statement forms in the article. Suggestions regarding the need based education as mentioned as a provision in Indian Constitution were stressed in the article so as to strengthen the need based education to Tribal Education system in India. Lastly the suggestions were also given for the uplift of the tribal education of India. However, based on the analysis of the factors contributing to non enrolment and/or dropout and descriptions of case studies, it was concluded that there needs to be more philanthropic investment outside the classroom too. This would provide a solid foundation that leverages these assets and develops stronger individual potential that can transcend the barriers experienced by tribal people today.

KabitaKumariSahu (2014) in her paper entitled Challenging Issues of Tribal Education in India analysed the educational status of the tribes in India. The objective of the paper was to analyse the status of tribal education with literacy rate, gross enrolment ratio, dropout rates and Gender Parity Index in India. The analysis was based on secondary data of Census of India, 2011. The percentage of literacy of tribes was only 8.54 per cent in 1961 which had increased to 63.1 per cent in 2011. The gross enrolment ratio was higher in class I to V which was 137.2 for ST boys and 136.7 for ST girls. The Gender Parity Index for ST children was almost same as all categories of children except for class XI to XII

Sahani and Nandy (2013) in their article entitled Particularly Vulnerable Tribal Groups (PVTG) in India: An Overview identified the socio economic status of the PVTG population in India. There are 75 groups who have been given the status of particularly vulnerable tribal groups and have little access to resource besides low rate of literacy, small population, and some of the groups are at the verge of extinction. They are distributed in various ecological zones beyond the state boundaries with immense variation in subsistence pattern and world views. Lots of problems relating to drop out issues from basic education, health related issues and economical issues are faced by them and in most of the areas and that they are unable to cope the situations. In this paper attempt is made to explore the major problems and the factors responsible for their present conditions along with suggestions to improve their status.

The situation of underdevelopment of tribes analysed by Rajasenan and Abraham (2013) is much more a kind of descriptive research. They focussed on education, employment livelihood and variables indicating basic amenities of the household. The study signifies the need for such a descriptive and exhaustive study in the context of Kerala acclaimed as ‘model’ for human and social development despite the basic reality that the STs remain excluded from robust central tendency of the ‘model’ State.

Paul (2013) discusses education of tribes in a study primarily carried out on income, livelihood and education of tribal communities in Kerala which can be viewed as a comprehensive work in this field. The coverage of the study is limited to 9 major tribal groups six from Wayanad, two from Idukki, and one from Palakkad. A snapshot of tribal literacy, enrolment and dropout situation is visible in the study and it highlights the familial aspects such as poverty, looking after youngster, adverse family environment as major impediments to tribal education. The most significant contribution of the study can be the classification of tribal groups into forward and backward based on standard of living index.

The government has implemented single teacher schools in tribal areas to supplement primary schools education among them. An analytical study on these single teacher schools done by Menon (2013) which gives a detailed account on the curriculum, pedagogy and teacher training aspects of single teacher schools. The problems faced at primary schooling by the tribes also were covered in the study. Kakkoth (2012) conducted a significant study on perception of tribal school drop out with particular reference to Ashram schools. The study observes subjective experience of Ashram school dropout children from an anthropological and sociological perspective. School dropout reasons were analysed from the perspectives of headmaster, teachers and staff by carrying out a Case study on Indira Gandhi Memorial Model Residential School, Nilambur. The researcher observed that the percentage of students coming back after vacation/holidays to the school is very low, nearly 30 percent comes back and rest 70 percent returns weeks or months of reopening of the school, gradually leading to dropout. The study also observed that the non tribal teachers have less experience to tribal way of life or their value system which creates problems to the students.

Centre for Study of Social Exclusion and Inclusive Policy (CSSEIP), Cochin prepared a Human Development Report (2009) for Scheduled Tribes in Kerala (2009).

The report covers human development indices across the nine tribal communities considered for the study. The report points out that the tribal community in Kerala are facing less accessibility to seek higher levels of education. In the State, there are about 189 Arts and Science colleges which include 39 government colleges and 150 private colleges. Among them, the least number of colleges is situated in tribal populated districts such as Wayanad, Idukki and Kasaragode causing inaccessibility to higher education for tribal students.

Davis and Sunitha (2009) found that the ST population stands far behind the general population in literacy rates, average years of schooling, retention rates and pass percentage at higher secondary exam levels in Kerala. The percentage point of difference on average years of schooling is high (i.e; more than 50 percent) in the tribal concentrated districts. The study identifies the dialect used by the community coupled with economic backwardness and socio cultural reasons as barriers to enrolment at schools.

A qualitative research by Bagai and Nundi (2009) on tribal education in India draws insights into reality of present situation of tribes. The study discussed about the educational backwardness of tribal areas and tried to find out the reasons for the same. Bagai and Nundi identify that the language of instruction in State language as a major problem faced by the ST students. The tribal children have limited contact with the State language and tend to speak in their own dialect. Their unfamiliarity with the State language creates hurdles in understanding lessons at pre-primary and primary levels. However Kerala has developed bilingual materials at district levels in Kasaragod, Wayanad, Malappuram and Palakkad (Gautam, 2003). A few other problems identified by Bagai and Nundi are the continuing problem of teacher absenteeism in Tribal Schools and seasonal migration of tribes. As a result the education of these children is seriously affected.

The audit report on 'Educational Development of Scheduled Castes and Scheduled Tribes' (2007) points to many issues such as underutilization of funds, non-availing of central assistance, diversion of funds etc. This indicates inefficient financial management by the authorities with respect to the implementation of schemes. Besides, delayed/ non/short release of funds creates problems in educational development of ST students.

### **2.2.8 Conclusion**

Review of related literature helped the investigator to collect varied evidences on the past researches done in the field of Experiential education, Learning styles, Science Process skills, Scientific Attitude, Achievement in Science, and Education among Tribal people.

Regarding Science Process skills, it was found out that a number of studies have been conducted abroad but very few studies have been conducted in India. It was evident from these studies that gender, school location and school type does not influence students' attitude, laboratory adequacy and class size influences their acquisition of Science Process Skills. Inspired by the previous research findings, it was taken into consideration that the learning environment and the teaching methodology have a significant role in enhancing the acquisition of Science Process Skills.

Studies related to learning styles reviewed the trends of the learning styles and the impact of them on the achievement or the academic performance of the sample involved in the study. Four studies were directly linked with Kolb's learning style inventory and others were mostly lined with constructivist learning styles devised by the educationists.

Studies related to Achievement in Science and Scientific Attitude revealed a need for ongoing assessment in Science. Most of the studies on achievement in Science deal with the factors that help in enhancing and the promoting of the achievement of the learners Akers (2012), Secker (2002). As the achievement is a key factor determining the effectiveness of instruction and performance of students, investigator realised that more stress is needed in this area and therefore selected it as one of the variables for the study. Koutsantoni (2004) studied that attitude towards science is dependent on school set up, familial status etc. and is dependent on the achievement of the students across many subjects. Thus the investigator felt the strong need to research the variable and determine the factors affecting the scientific attitude of the students.

Studies made on the tribal children stressed the importance of education need among the children. Many studies found out that the dropout issue is highly prevalent among the scheduled tribes and it is the major cause of lesser literacy rates and education status among the tribes. The language also acts as a barrier among the children to learn and acquire education (Bagai&Nundi, 2009).

Hence the researcher felt a great need to incorporate a study among the tribal children specifically the students belonging particularly vulnerable tribal group (PVTG) since there is a dearth of studies in that area and to adopt an appropriate methodology that can enhance the achievement in science and also the scientific attitude of the tribal students belonging to PVTG and studying in residential schools of Kerala.