# CHAPTER I

## INTRODUCTION

### 1.0.0 INTRODUCTION

Learning is a process through which child acquire new modes of behavior or change in the existing mode of behavior. Changes in behavior that are brought by physical maturation or growth do not fall under learning. Learning is what we acquire through efforts after birth. We know, we feel and we do and in three domains (cognitive, affective and psychomotor) of behavior, change occur due to learning. In other words, we can get new knowledge, form attitude and master in skill through learning. In essence of learning, three basic assumptions are held to be true. First, learning can visualize by a change in behavior. Second, the environment shapes behavior. And third, the cause and reinforcement are central to explaining the learning process.

From these three assumptions it is easy to say that teaching is facilitating learning. It (teaching) is a help given to student to acquire factual knowledge, desirable attitude and required skills. Teaching is a scientific process and its major components are content of the subject presented by the teacher, learning style of the learner and feedback given by the teacher. These three components are related to the teaching. It means content is what we teaching – subject/teacher related factor, learning style is a characteristic that the way student learns, and feedback is a process - part of teaching selected by the teacher.

Thus, there is a close relationship between teaching and learning. The goal of teaching is learning. Learning is information processing. The process is facilitating by teaching. Learning involves (1) reception, (2) perception, (3) encoding, (4) storing and (5) retrieving of knowledge as outcomes/effects of teaching. Certain teaching technologies facilitate these five learning events and instruction should be so arranged as to satisfy these conditions.

From the above discussion leads us to the characteristics of learning. (1) Learning as a quantitative increase in knowledge, learning is acquiring information or 'knowing a lot'. (2) Learning as memorizing, learning is storing information that can be reproduced. (3) Learning as acquiring facts, skills and methods that can be retained and used as necessary. (4) Learning as making sense or abstracting meaning, learning involves relating parts of the subject matter to each other and to the real world. (5) Learning as interpreting and understanding reality in a different way, learning involves comprehending the world by reinterpreting knowledge.

## 1.1.0 LEARNING PROGRESSION

The term learning progression refers to the purposeful sequencing of teaching and learning expectations across multiple developmental stages, ages, or grade levels. The term is most commonly used in reference to learning standards concise, clearly articulated descriptions of what students should know and be able to do at a specific stage of their education.

Learning progressions are typically categorized and organized by subject area, such as mathematics or science, and they map out a specific sequence of knowledge and skills that students are expected to learn as they progress through their education. There are two main characteristics of learning progressions:

1. the standards described at each level are intended to address the specific learning needs and abilities of students at a particular stage of their intellectual, emotional, social, and physical development.
2. the standards reflect clearly articulated sequences—i.e., the learning expectations for each grade level build upon previous expectations while preparing students for more challenging concepts and more sophisticated coursework at the next level.

The basic idea is to make sure that students are learning age-appropriate material (knowledge and skills that are neither too advanced nor too rudimentary), and that teachers are sequencing learning effectively and avoiding the inadvertent repetition of material that was taught in earlier grades. Learning progressions (LPs) are a relatively recent approach that aim to support three aspects of education: teaching and learning, assessment, and curriculum design. According to the effectiveness of these three aspects of education may be increased by better coherence, and the LP approach claims to improve coherence by providing frameworks of knowledge and skills called "LP models". these frameworks describe the progression that can be expected of learners through their education. Learning progression approaches are popular and influential across the fields of curriculum development, with discussion being carried out across a number of international contexts suggests that the consideration of the approach is topical. Education is complex and the implementation of the LP approach to teaching and learning, assessment, or curriculum design may have unintended consequences when implemented without consideration of other possible approaches.

### 1.1.1 COMPONENTS OF LEARNING PROGRESSION

According to some research learning progressions have essential components:

1. Learning targets or clear end points that are defined by societal aspirations and analysis of the central concepts and themes in a discipline.
2. Progress variables that identify the critical dimensions of understanding and skill that are being developed over time.
3. Levels of achievement or stages of progress that define significant intermediate steps in conceptual/skill development that most children might be expected to pass through on the path to attaining the desired proficiency.
4. Learning performances which are the operational definitions of what children's understanding and skills would look like at each of these stages of progress, and which provide the specifications for the development of assessments and activities which would locate where students are in their progress.
5. Assessments that measure student understanding of the key concepts or practices and can track their developmental progress over time.

At one level, the idea of progressions is simple and obvious. Kids learn. They start out by knowing and being able to do little, and over time they know and can do more, lots more. Their thinking becomes more and more sophisticated. Correspondingly, most curricula are based on some rationale, or choice of scope and sequence, considered appropriate for determining the order in which topics within a subject should be taught over time. But my review of the work on progressions and trajectories found that their serious proponents believe that they are doing something more than traditional curriculum development. Traditional curriculum is based primarily on the logic of the discipline or school subject, the practical wisdom and typical approaches of teachers, and sometimes on the convictions of one side or another in the various philosophical debates about curriculum. Curriculum developers pay attention to what, when, and how concepts and skills should be taught. Proponents of progressions and trajectories argue that their work differs from this traditional approach to curriculum development because it is grounded in empirically tested and testable hypotheses about the ways children's thinking actually develops in interaction with experience and instruction. They focus not only on what the teachers and curriculum are trying to teach—they also try to look closely at what the students are actually attending to and learning, and at the ways their thinking is becoming organized in their minds.

Ideally, in some of the examples I saw, they attempt to improve these outcomes by redesigning the experiences provided for children. They proceed in an iterative, experimental fashion until they believe they have found an efficient sequence. The result is a description of an empirically tested pathway that can be called a learning progression What the new emphasis on progressions brings to the table is an even more explicit emphasis on the ways students' thinking becomes more sophisticated over time in terms of interactions between their growing understanding of content in science and mathematics and their ability to use that understanding in reasoning and solving problems. Really the contrast is with curricula that take a simple focus on facts and specific skills rather than with more recent and ambitious curriculum development work. Some of the discussion of progressions seems to imply that they have a kind of developmental or maturational character—that there are characteristic steps or levels that children's thinking tends to go through somewhat independently of experience, or that experience may change the timing or rate of growth, but not the order of these steps.

### 1.1.2 DEVELOPMENT OF LEARNING PROGRESSION

In part because we lack longitudinal data tracking how student understanding of science concepts evolves in different curricular environments; the development of a learning progression is necessarily an iterative process. We learn more about patterns in students' thinking as we attempt to assess their understanding, which in turn influences the learning progression itself. Thus, development of the learning progression is part of an iterative process of revision, involving changes to both the learning progression and its associated items. To inform the development of learning progressions in other areas of the science curriculum, this process will be laid out generally here and then illustrated through discussion of the force and motion learning progression later in this paper. The development process starts with a definition of the construct of the learning progression. For example, standards documents or cognitive science research may be used to define what students can be expected to understand about a scientific concept. This understanding defines the top level of the learning progression. Lower levels of the learning progression can be defined through a review of the research literature on students' understanding of the identified construct, including "misconceptions" as well as productive ideas that may support development of full understanding.

The definition of levels involves both laying out an ordered progression for the ideas identified in the research literature and grouping similar sets of ideas together into a single level. It is important to note that this is typically a logical, rather than an evidence-driven process. Depending upon the construct of the learning progression, there may be more or less information about how the ideas at a given level "hang together," but research has typically focused on describing single ideas, rather than the relationships between them. Thus, the learning progression represents a hypothesis about student thinking, rather than a description. As such, it expresses a current idea about how student understanding develops, which can—and should—be revised in response to new information about student thinking. Starting with a preliminary learning progression, sets of items can be developed to assess students' levels on the progression. Data obtained from administering these items to students can inform not only item revision but also consideration of the learning progression itself. Student thinking, as revealed by their responses to the items, may lead to new ideas being added to the learning progression or even to a reorganization of the ideas it contains.

### 1.1.3 USES OF LEARNING PROGRESSION

- Standards Development
- Curriculum Development
- Large-Scale Summative Assessment
- Formative Assessment and Instruction
- Teacher Development

## 1.2.0 LEARNING ANALYTICS

In the increasingly competitive and changing world, efficient education system that drives the human development in the country is the key to a nation's progress. The education providers – schools and higher learning institutions must focus on student success and design instruction that considers the individual differences of the learners. In recent years, learning analytics has emerged as a promising area of research that extracts useful information from educational databases to understand students' progress and performance. The term Learning Analytics is defined as the measurement, collection, analysis and reporting of information about learners and their contexts for the purposes of understanding and optimizing learning. As the amount of data collected from the teaching-learning process increases, potential benefits of learning analytics can be far reaching to all stakeholders in education including students, teachers, leaders and policy makers. Educators firmly believe that if properly leveraged, learning analytics can be an indispensable tool to narrow the achievement gap, increase student success and improve the quality of education in the digital era. A number of investigations have been conducted and reported the strategies, techniques, and approaches of learning analytics in the literature. The term Learning Analytics has emerged to describe the process in understanding the behaviours of learning process from the data gathered from the interactions between the learners and contents. The term can be defined as the measurement, collection, analysis and reporting of information about learners and their contexts for the purposes of understanding and optimizing learning.

Learning analytics is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs, as defined back in 2011, this general definition still holds true even as the field has grown. Learning analytics is both an academic field and commercial marketplace which have taken rapid shape over the last decade. As a research and teaching field, Learning Analytics sits at the convergence of Learning (e.g. educational research, learning and assessment sciences, educational technology), Analytics (e.g. statistics, visualization, computer/data sciences, artificial intelligence), and Human-Centered Design (e.g. usability, participatory design, sociotechnical systems thinking).

### 1.2.1 KEY USES OF LEARNING ANALYTICS

Historically, some of the most common uses of learning analytics is prediction of student academic success, and more specifically, the identification of students who are at risk of failing a course or dropping out of their studies. While it is reasonable that these two problems attracted a lot of attention, learning analytics are far more powerful. The evidence from research and practice shows that there are far more productive and potent ways of using analytics for supporting teaching and learning.

Some of the most popular goal of learning analytics include:

1. Supporting student development of lifelong learning skills and strategies
2. Provision of personalised and timely feedback to students regarding their learning
3. Supporting development of important skills such as collaboration, critical thinking, communication and creativity
4. Develop student awareness by supporting self-reflection
5. Support quality learning and teaching by providing empirical evidence on the success of pedagogical innovations

### 1.2.2 METHODOLOGIES OF LEARNING ANALYTICS

**Descriptive Analytics: insight into the past**: Uses data aggregation and data mining to understand trends and evaluative metrics over time. The majority of statistics use falls into this category which is limited to past data and includes:

- ❖ Student feedback gathered from student satisfaction and graduate surveys
- ❖ Analysis of data at all stages of the student lifecycle starting from admissions process, to student orientation, enrolments, pastoral care, study support, exams and graduations.

**Diagnostic Analytics: why did it happen:** This form of advanced analytics is characterised by techniques such as drill-down, data discovery, data mining and correlations to examine data or content to answer the question - "Why did it happen?" and includes:

- ❖ Analysis of data to inform and uplift key performance indicators across the organization
- ❖ Analysis of patterns to design appropriate metrics
- ❖ Equity access reporting and analysis of effective strategies to support students
- ❖ Learning management system metrics to improve student engagement

**Predictive Analytics: understanding the future:** Combines historical data to identify patterns in the data and applies statistical models and algorithms to capture relationships between various data sets to forecast trends and includes:

- ❖ Development of Staff Dashboards to help predict student numbers and cohort mobility through programs to assist in identifying areas for improvement

**Prescriptive Analytics: advise on possible outcomes:** Goes beyond descriptive and predictive by recommending one or more choices using a combination of machine learning, algorithms, business rules and computational modelling such as:

- Focusing on subject/courses where small changes could have a big impact on improving student engagement, feedback and outcomes
- Data visualisation via specific tools to provide program/degree level metrics on student enrolments, program stage, results and survey feedback to give teaching staff visual snapshots of students in their programs

### 1.2.3 BENEFITS OF LEARNING ANALYTICS

Learning Analytics provides researchers with exciting new tools to study teaching and learning. Moreover, as data infrastructures improve — from data capture and analysis, to visualization and recommendation — we can close the feedback loop to learners, offering more timely, precise, actionable feedback. In addition, educators, instructional designers and institutional leaders gain new insights once the learning process is persistent and visible.

### 1.2.4 ETHICS OF DATA, ANALYTICS & AI.

There is rightly much public and professional debate around the ethics of 'Big Data' and AI, including privacy, the problem of opaque 'black box' algorithms, the risk of training machine learning classifiers on biased datasets, and the dangers of incorrectly predicting someone's behaviour. These concerns are just as relevant in education, so the ethics of educational data, analytics and AI are front and centre, with a very active stream in our events and publications. Some other benefits or application of Learning Analytics are follows-

(i) Improving student retention
(ii) Supporting informed decision making
(iii)Increasing cost-effectiveness
(iv)Understanding students' learning behaviour
(v) Arranging personalized assistance to students
(vi)Providing timely feedback and intervention

## 1.3.0 CONSTRUCTIVIST LEARNING

Constructivist Learning Constructivist learning has emerged as a prominent approach to teaching during past decade. The work of Dewey, Montessori, Piaget, Bruner, and Vygotsky among others provides historical precedents to constructivist learning theory. Constructivism represents a paradigm shift from education based on behaviourism to education based on cognitive theory. Behaviourist epistemology focuses on intelligence, domains of objectives, levels of knowledge, and reinforcement. Constructivist epistemology assumes that learners construct their own knowledge on the basis of interaction with their environment. Four epistemological assumptions are at the heart of what we refer to as "constructivist learning".

1. Knowledge is physically constructed by learners who are involved in active learning.
2. Knowledge is symbolically constructed by learners who are making their own representations of action.
3. Knowledge is socially constructed by learners who convey their meaning making to others.
4. Knowledge is theoretically constructed by learners who try to explain things they don't completely understand.

Constructivism is very simple, it actually says we never learn anything absolutely from a scratch, when we have a new idea, we see how it relates to something already we got in our brain and then construct bigger frame work. Successful learners are the persons who start up with pool of idea they really understand then come to a new idea then bag the new idea in to old idea and he is going on and on. Constructivism never sees anything objectively and everything is subjective. Constructivism refers to a collection of educational practices that are student focused, meaning-based, process-oriented, interactive, and responsive to student personal interests and needs. A constructivist perspective views learners as actively engaged in making meaning, and teaching with that approach looks for what students can analyse, investigate, collaborate, share, build and generate based on what they already know, rather than what facts, skills, and processes they can parrot. To do this effectively, a teacher needs to be a learner and a researcher, to strive for greater awareness of the environments and the participants in a given teaching situation in order to continually adjust their actions to engage students in learning, using constructivism as a referent. ICT has the potential for creating powerful learning environments that support distributed, interactive, collaborative and constructive learning and its assessment and since the use of computer technology by youngsters is on the rise. This trend needs to be harnessed for providing education.

### 1.3.1 IMPORTANCE OF CONSTRUCTIVISM IN SCIENCE

Constructivism is a relatively new paradigm which takes into account the subjective, contextual and pluralistic nature of knowledge. The latest catch word in educational circle is "Constructivism" applied both to learning theory and epistemology-both to how people learn and the nature of knowledge. "Constructivism" the term refers to the idea that individuals, through their interaction with the environment construct their own knowledge and meaning. Constructivism is an epistemology, a learning theory which offers an explanation of the nature of knowledge and how human beings learn. It maintains that individuals create or construct their own new understandings or knowledge through interactions of what they already know and believe and ideas, events and activities with which they come in contact.

Constructivist learning is based on student's active participation where they are "constructing" their own knowledge by testing ideas and approaches based on their prior knowledge and experience, applying these to new situations and integrating the new knowledge gained with pre-existing intellectual constructs.

The central principles of this approach are that learners can only make sense of new situations in terms of their existing understanding. Learning involves an active process in which learner's construct meaning by linking new ideas with their existing knowledge. The Biological Science Curriculum Study (BSCS), a team whose principal investigator is Roger Bybee developed an instructional, called the five "Es". They are

- Engage,
- Explore,
- Explain,
- Elaborate,
- Evaluate.

The Constructivist revolution offers a new vision of the learner as an active sense-maker and suggests new method of instruction. It facilitates presentations of materials in a constructivist way and engages students in an active explorative learning. The new approach allows the learners to have more control over their own learning, to think analytically, critically and to work collaboratively. Constructivist approach is an effort at educational reform and particularly a revolutionary vision of instructional strategies. Research on instructional strategies, particularly in the areas of cognitive processing, teacher effects, and teaching of cognitive strategies, suggests specific instructional principles that can be of great use to create constructive learning environment in the classroom.

In contrast, constructivist or student-centred learning poses a question to the students, who then work together in small groups to discover one or more solutions. Students play an active role in carrying out experiments and reaching their own conclusions. Teachers assist the students in developing new insights and connecting them with previous knowledge, but leave the discovery and discussion to the student groups. Questions are posed to the class and students learn to work together to discuss and reach agreement on their own answers, which are then shared with the entire class.

Therefore, the teaching–learning method also influences a greater extent in transacting the content to be learned. This type of methods definitely increases the curiosity to know new and new things, also children develop the skills, sense experiences, attitude towards science and finally they try to lead a systematic and scientific way of understanding and applying knowledge in the required situation.

### 1.3.2 CONSTRUCTIVISM AND SCIENCE TEACHING

Constructivism is not a new concept. It is learning or meaning making theory. It suggests that individuals create their own understanding, based upon the interaction of what they already know and believe and the phenomena or ideas with which they come into contact. According to Crowther, constructivism means that, "as we experience something new, we internalize it through our past experiences or knowledge constructs that we have previously established." Constructivism bristles with philosophical questions: it explicitly assumes positions in the philosophy of science, the philosophy of mind, and the philosophy of education. It is at once a theory of science, of human learning and of teaching.

Constructivism according to Piaget (1971) is a system of explanations of how learners, as individuals adapt and refine knowledge. Learners actively restructure knowledge in highly individualized ways, basing fluid intellectual configurations on existing knowledge and formal instructional experiences. Piaget focused that the individual is the sole agent in the process of constructing and reconstructing meaning. Psychological constructivism is based on Jean Piaget's model of development of the individual. The process focuses learning as a personal, individual, intellectual construction based on experiences of one in the world. Learning by doing and forming ideas from exploration is the underlying theory behind psychological constructivism.

The child is viewed like a scientist who possesses insights, questions, problem solving strategies and new ideas that will be used in experimentation. The scientific process of puzzling, probing, testing is incorporated into the approach. The child develops his picture or understanding of the physical world through manipulation and seeing relationships between objects and learning centrally determined names and labels for the ideas, items and activities involved through experience. Key to the theory is fostering independence in the child, not dependence on adults so that activities, curriculum, environment are based on risk-taking, self-direction, guided or totally free discovery type experimentation through social interaction and problem solving. The teacher acts as a facilitator of the educational context. The teacher provides opportunities for observation, interaction of students with each other and with the teacher through questioning techniques, modifying the environment, and support during conflicts and planning and creating curriculum.

### 1.3.3 ROLE OF CONSTRUCTIVIST APPROACH IN SCIENCE CLASS

A constructivist learning setting differs from the one based on the traditional model. In a constructivist classroom, learning outcomes not only depend on the learning environment but also on the knowledge of the learner. Learning involving the construction of meanings by students from what they see or hear may or may not be those intended. It is a continuous and an active process, which is influenced to a large extent by existing knowledge. Firstly, current ideas of pupils are elicited using several strategies. These include pupils writing, expressing orally, presenting pupils with descriptions of events and asking them to decide whether they are true or false, analysing why and how ideas are true and false and pupils producing posters on a particular idea.

characteristics of a constructivist classroom are as follows:

- the learners are actively involved
- the environment is democratic
- the activities are interactive and student-centred
- the teacher facilitates a process of learning in which students are encouraged to be responsible and autonomous

### 1.4.0 ATTITUDE

An attitude is more than a state of mind. It is a generalised tendency to think or act in a certain way in respect to some objects or situations, often accompanied by feeling. It is an enduring predisposition or readiness to behave in a particular way towards a given object or situation. Attitude has been defined by others in the following ways:

Young defined Attitude as "an essentially a form of anticipatory response, a beginning of action not necessarily completed".

According to Britt "An Attitude is a mental and neutral state of readiness, exerting directive or dynamics influence upon the individual's response to all objects and situation with which it is related."

Kerch and Crutchfield defined Attitude as an enduring organisation of motivational, perceptual and cognitive processes with reference to some aspect or the individual's world. In this way attitudes are to a great extent responsible for a particular behaviour of a person towards an object, idea or a person. But by this it should not be concluded that one's behaviour is an absolute function of one's attitude. Behaviour by all means is a function of both characteristics of behaving person and the situations in which he behaves. Hence a person may hold strong attitude and yet under circumstances, may behave in quite contradiction to those attitudes.

### 1.4.1 SCIENTIFIC ATTITUDE

Scientific attitude can be defined as, "open mindedness, a desire for accurate knowledge, confidence in procedures for seeking knowledge and the expectation that the solution of the problem will come through the use of verified knowledge". Scientific attitude are the most important outcomes of science teaching. Though some people view the scientific attitude as the by-product of teaching science, yet a majority of the people consider them as equally important as the knowledge aspect. Science should be taught directly and systematically because developing scientific attitude has a number of characteristics features which distinguish it from other attitudes.

### 1.4.2 THE CHARACTERISTICS OF SCIENTIFIC ATTITUDE

A man with scientific attitude has following qualities-

1) Is critical in observation and thought,
2) Respects other's point of views and is ready to change his decision on presentation of new and convincing evidence,
3) Is curious to know more about the things around him wants to know whys, what's and how's of things he observes,
4) Does not believe in superstitions and false beliefs4,
5) Suspends judgments until suitable support is obtained,
6) Believes in cause-and-effect relationship,
7) Accepts no conclusions as final or ultimate,
8) Seeks to adopt various techniques and procedures to solve the problem and
9) Seeks the facts and avoids exaggeration.

### 1.4.3 DEVELOPMENT OF SCIENTIFIC ATTITUDE

The sole responsibility of developing scientific attitude among the students lies on the teacher who can manipulate all the situations to instil in pupils the characteristic features of scientific attitude and at the same time present himself as an example to the students for his intellectual honesty, respect for the other points of views, unbiased and impartial behaviour in his dealings and the like. This will create a favourable and permanent impression on the students to adopt the same attitude which their teacher has.

### 1.4.4 ATTITUDE TOWARDS SCIENCE

It refers to the mental state of readiness to respond. Science is one of the important subjects taught in schools. The use of science as the object or the stimulus of these feelings delineates that a set of attitudes known as attitude towards science (Rao, 2004). Attitudes are mental predisposition toward people, objects, subjects and events. In science, attitudes are important because of three primary factors (Martin, 1984). First a child's attitude carries a mental state of readiness with it. With a positive attitude, a child will perceive science objects, topics, activities and people positively. A child, who is unready or hesitant, for whatever reason, will be less willing to interact with people and things associated with science. This readiness factor occurs unconsciously in a child, without prior thought or overt consent. Second attitudes are not innate or inborn. Contemporary psychologists maintain that attitudes are learned and are organized through experiences as children develop. Furthermore, a child's attitude can be changed through experience. Third, attitudes are dynamic results of experiences that act as directive factors when a child enters in to new experiences. As a result, attitudes carry an emotional and an intellectual tone, both of which lead to making decisions and forming evaluations. These decisions and evaluations can cause a child to set priorities and hold different preferences.

### 1.4.5 CHARACTERISTICS OF A PERSON WITH ATTITUDE TOWARDS SCIENCE

Science teaching directly inculcates the scientific attitudes among the students. So, the students should teach directly and systematically, every individual should be paid heed to ascertain that they develop the desired attitudes and practices in them. An individual with attitude towards science are,

i. Critical in observation and thought.
ii. Open-mindedness.
iii. Respect others points of view and is ready to change his direction on presentation of new and convincing evidence.
iv. Objective in their approach to problems.
v. Does not believe in superstitions and false beliefs.
vi. Believes in cause-and-effect relationship.
vii. Adopts a planned procedure in solving a problem.

### 1.4.6 IMPORTANCE OF SCIENCE ATTITUDE

Science attitude are important because of three important factors. First a child attitude carries a mental state of readiness with it. With a positive attitude, a child will perceive science object, topics, activities and positively. A child, who is unready or hesitant for whatever reason, will be less willing to interact with people and things associated with science. Second, attitudes are not innate or inborn. Contemporary psychologists maintain that attitudes are learned and organised through experience as child develop.

Furthermore, a child attitude can be change through experience. Teacher and parents have the greatest influence on science attitude. Thirdly attitudes are dynamics result of experiences that act as directive factors, when a child enters into a new experience. As a result, attitude carries an emotional and an intellectual tone, both of which lead to making decision and forming evaluations. These decision and evaluation can cause a child to set up priorities and hold different preferences.

### 1.4.7 RELATIONSHIP BETWEEN SCIENTIFIC ATTITUDE AND ATTITUDE TOWARDS SCIENCE

According to Bennett (2003), Attitude towards science is linked with the views and images that the individual develops about science as a result of interaction with different situations while scientific attitude is related to the ways of thinking or scientific method, which covers the skills and understanding of practical works.

### 1.5.0 SCIENCE EDUCATION AT SECONDARY LEVEL

Science literacy has become a vital necessity for anyone living in a world full of scientific research with each passing day. Anyone who lives in this rapidly evolving world should be involved in the discussions about the important technological and scientific activities of society and develop skills to apply them in the day-to-day life, in what sense it applies.

The need to include science education in the secondary school curriculum is mainly to enable students develop scientific knowledge, skills and positive attitudes and scientific temper towards science and technology. This would enable them understand the role and value of science and technology to society and the interaction between science, technology and society. Science education creates awareness on the effect of scientific knowledge in everyday life, for example, its applications in society, the management and conservation of the environment, the utilization of resources and production of goods. The other reason for having science education at secondary school is to address the challenges of scientific literacy, so that students are encouraged to understand the scientific enterprise and how to benefit from it. Science as a practical subject provides students with an opportunity to interact with science process skills that can be used to solve problems in everyday life and contribute to national development and human welfare.

### 1.5.1 ROLE OF SCIENCE AT SECONDARY LEVEL

The processes and ideas of science are of great importance to everybody in three ways. The first is in their personal lives, for example so that they can validly identify the components of a healthy life-style. The second is in their civic lives, so that they take an informed part in social decisions, for example on future options for electricity supply. The third is in their economic lives, where they need to be able to respond positively to changes in the science-related aspects of their employment. If the major purpose of science education is to increase the flow of specialist scientists, technologists and engineers, it could be argued that young people with a special talent in science should be identified as early as possible and provided with a separate, specialised, and highly focused science education. We do not agree. Such people share the general need for a broad science education and should not be cut off from it. In any case, there are no valid and reliable ways in which such young people may be identified. Some who show early, unless school science explicitly engages with the enthusiasms and concerns of the many groupings that make up today's students, it will lose their interest. Accordingly, it needs to grapple with how it can respond positively to the wide diversity of student concerns. It must think how to better address women, those who hold strong religious views, those who have little cultural capital, and those whose current or recent roots lie outside Western societies. All too little is known systematically about these issues.

A conundrum for science educators is that school students are being turned off school science lessons, yet the students are often engaged by science outside the classroom. Science in science museums, hands-on centres, zoos and botanical gardens is often seen as exciting, challenging and uplifting. Newspapers and magazines offer rich sources of science information including debates about controversial current issues. Multichannel television and the internet have spawned sources of high-quality and attractively packaged information about science and issues of relevance to young people. We are also living in a golden age of popular science book publishing, with a wealth of high-quality science books for children as well as adults. Students of school age spend about two-thirds of their waking lives outside formal schooling. Yet science educators tend to ignore the crucial influences that experiences outside school have on students' beliefs, attitudes and motivation to learn. They often see these influences only as a source of misconceptions. Out of classroom contexts can add to and improve the learning of science in several ways. They can promote the understanding and integration of science concepts. Falk and Dierking have reviewed studies that show that science museum visits can lead to improved understanding of such classic school science concepts as force and motion, an improvement measured by tests of knowledge before and after visits. They are also an opportunity to engage in science activities that would not be possible in the school laboratory either because of safety considerations or because they are too complex. Examples include launching rockets, performing ecological surveys, observing the night sky, and large-scale experiments with combustion. How these activities contribute to students' knowledge of the processes of science is still not clear. And they can provide access to rare material and to 'big' science. Science museums, botanic gardens, zoos and science industries provide opportunities for students to see yesterdays and today's science in use. Artifacts and collections, and the stories associated with them, help teach about the ways in which scientific and technological knowledge has been generated and about the social enterprise in which those who engage in this work operate. Here too, the exact contribution to school science is unclear. Such activities also provide opportunities for science activities which are less constrained by school bells and lesson times. Work can be more extensive and there are more opportunities for students to take responsibility for themselves and others, to work in teams and to consider their effects on the environment.

### 1.5.2 RECOMMENDATIONS OF COMMITTEE AND COMISSIONS ON SCIENCE EDUCATION

- **The Education Commission (1964-66)**

Major recommendations of the Commission included emphasis on Science and Mathematics, introduction of work experience as an integral part of school curriculum, introduction of common school system, educational structure with 12 years of schooling, free text-books at primary stage, provision of mid-day-meals, promotion of education of handicapped and special measures for ensuring equality of educational opportunities (regional, tribal and gender imbalances to be addressed), establishment of school complexes, neighbourhood school, three language formula etc. (two of its major recommendations for democratising school education have been discussed in detail later in this Unit). The Commission emphasized the need of alternative channels of education to eradicate illiteracy and provide adult education. By laying more focus on Mathematics and Science rather than Social Science or Arts, the Commission reinforced the notion that India's development needs are better met by scientists than social scientists.

- **National Policy on Education 1968**

The Policy also emphasized enrichment of curricula and improvement of textbooks and teaching methods. It advocated the strengthening of science education at the school level and stepping up of scholarship schemes for backward sections of the society. The key legacies of the 1986 policy were the promotion of privatisation and the continued emphasis on secularism and Science.

- **National Policy on Education 1986**

The NPE, 1986 also advocated developing consciousness about environment. The Policy had some important features like common school curriculum, minimum levels of learning, value education, role of media and education technology, work experience, emphasis on teaching

of Mathematics and Science, Sports and Physical Education and education for international understanding.

- **National Curriculum Framework 2005**

Science teaching should engage the learners in acquiring methods and processes that will nurture their curiosity and creativity, particularly in relation to the environment. Awareness of environmental concerns must permeate the entire school curriculum.

## 1.6.0 ROLE OF LEARNING PROGRESSION IN SCIENCE

Science education reform has emphasized increasing students' engagement in disciplinary science practices, like designing investigations, modelling, and analysing and interpreting data. This focus on practices in science education has emerged from interdisciplinary research in science studies. Empirical investigations of scientific communities offer insights about how science is conducted and thus provide models for expanding notions about what counts as disciplinary knowledge in science. From the many science education studies that attend to science studies, important lines of research have emerged, including those that prioritize students' development of and engagement in science practices. In science education research, this practice turn requires careful consideration of the ways that students can be situated in social contexts to support the appropriation and transformation of disciplinary knowledge and practices. In order to facilitate the design of learning environments that support students in developing disciplinary practices and epistemologies, researchers have proposed learning progressions for science practices. For example, the Next Generation Science Standards offer developmental trajectories for each of their eight Science and Engineering Practices. Learning progressions represent overarching aggregate arcs in the curriculum, which are rarely replicated in individual students' context dependent and non-linear learning trajectories. Rather, research suggests that students' ideas, and in turn, the practices that they identify as relevant, shift in response to their task, the classroom environment, and their interactions with the teacher and their peers. Learning progressions for complex practices, like modelling, do not represent fixed linear pathways through which all students learn; rather, a student may exhibit practices at multiple points along the progression at any given time across different contexts.

Some of the articles illustrate the ways that sequential or concept-oriented learning progressions can fall short in terms of describing or designing for learning in practice-oriented contexts, and they offer new perspectives about how science practices and epistemic aims might be systematically supported or analysed over time. Some of the articles explore the ways that learning progressions could be adapted to better fit practice-oriented learning contexts. Each of these approaches is useful for considering how learning progressions fit with the evolving landscape of science education research. In what follows, we draw on the insights developed in the articles to consider directions for future work.

## 1.7.0 NEED AND JUSTIFICATION OF THE STUDY

**Khan, S. H. (2014)** said cognitive constructivism-based strategy in science developed and tried out by the investigator could help the students in their understanding the science concepts with better clarity. The incorporation of cognitive constructivists views in the development of the strategy material enhances the students' skills like reading, thinking, questioning, sharing, understanding and reproduction. The cognitive constructivism-based learning strategy in science helps teachers also to apply the same in their day-to-day teaching process and also enable them to prepare the learning packages in other topics of science. The text book writers, curriculum planners and policy makers in education in general could be benefited much from the findings of this research. The newly developed cognitive constructivism-based learning strategy maximizes the chances for learning by doing. This strategy enhances the science process skills and as an effect of that the scientific way of thinking is promoted among the learners. The strategy gives technological orientation to the learners.

**Alicia c. Alonzo & jeffrey t. Steedle (2008).** was made to study the effectiveness Learning Progression through constructivist approach in Indian context at secondary school level to find out whether this method would improve the students understanding of nature of science, demonstrate a superior understanding of basic science concepts, use and understand basic processes of science better, can apply science concepts and processes in new situations, have more positive attitudes of science, science study and science teachers, develop better science process skill including observing, reasoning, inferring, interpreting, proposing solutions, and predicting consequences, have more complete views of the nature of science.

Attitude towards science, according to **Sekar and Mani (2013)** refers to the "disposition of mind for or against scientists, scientific activity and learning of science" and has predominantly affective orientation. On the other hand, scientific attitude is "the cognitive attitude or belief about thinking and has also affective and behavioural aspects" **Freeman (1997)**. Around 20 scientific attitudes namely; empiricism, determinism, a belief that problems have solutions, parsimony, scientific manipulation, skepticism, precision, respect for paradigm, a respect for power of theoretical structure, willingness to change opinion, loyalty to reality, aversion to superstition and an automatic preference for scientific explanation, a thirst for knowledge, an "intellectual drive", suspended judgment, awareness of assumptions, ability to separate fundamental concepts from the irrelevant or unimportant, respect for quantification and appreciation of mathematics, an appreciation of probability and statistics, an understanding that knowledge has tolerance limit and empathy for the human condition by **Lamar (2014).**

So, the present study has a great need and significance for the development of students with the help of ICT integration in the classroom. It helps both the teacher and student in preparation for teaching and learning. It enables to apply different strategies and tools for the development of teaching learning outcomes. This study will enable us to know how Learning Progression helps to enhance the learning outcomes of students in biological science classroom. It will also help to know about the effectiveness of teaching with Constructivism in achieving students learning competencies and capabilities. To the researcher's knowledge there are limited number of studies focused on Learning Progression at secondary level and if done not in investigator's area. So, the investigator decided to undertake the study.

## 1.8.0 STATEMENT OF THE PROBLEM

A study of learning progression in science of class IX grade students of Balangir district, Odisha.

## 1.9.0 OBJECTIVES OF THE STUDY

The present study has the following objectives

1. To study the learning progression in science of class ix students of Balangir district.
2. To study the attitude towards science of class ix students of Balangir district.
3. To study effect of treatment, gender and their interaction on achievement in science of class ix students of Balangir district by taking their previous year achievement score in science as covariate.

## 1.10.0 HYPOTHESIS OF THE STUDY

1. There will be no significant effect of Treatment on Achievement in Science of Class IX students when their previous year score of Achievement in Science was taken as covariate
2. There will be no significant effect of Gender on Achievement in Science of class IX students when previous years' Science score is taken as covariate
3. There will be no significant interaction of Treatment and Gender on Achievement in Science of class IX students when previous years' Science score is taken as covariate

## 1.11.0 OPERATIONAL DEFINITIONS OF THE TERMS USED

**EFFECTIVENESS:** The ability to be successful and produce the intended results.

**LEARNING OUTCOMES:** They are the statements that describes the knowledge or skills students should acquire by the end of a particular course or program.

**ATTITUDE TOWARDS SCIENCE:** This is an aspect of a personality that requires rationality, inquisitiveness, and a need to investigate results.

**SECONDARY LEVEL:** Students belonging to 14 years to 16 years generally of class IX and $10^{th}$.

## 1.12.0 SCOPE OF THE STUDY

Learning Progression through Learning Analytics are powerful tool in this 21st century for training and developing the abilities as well as bringing up the human talents in a suitable mechanism to create educational opportunities. Thus, study will helpful to understand the Learning Progression through the effectiveness of Constructivism in students learning outcomes in biological science at class IX level. Constructivism will enable a wide range of experience and knowledge so that students can relate biological science to their own and other world of experience.

## 1.13.0 DELIMITATIONS OF THE STUDY

The study will be conducted under the following constraints-

1. The students were selected randomly from the selected one school of Balangir District.
2. The study particularly framed in one location only
3. Only 45 days treatment was provided
4. Self-made tool is used for the achievement test