CHAPTER 1

CONCEPTUAL FRAMEWORK OF THE STUDY

I.1. Education:

Human life needs development and promotion. This is possible if one knows who he/she is and what he/she wants. Self-knowledge is, thus, a vital consideration for happy living. In order to have a harmonious adjustment and functioning of life, one has to discover reality in all its dimensions. The spiritual reality is not to be ignored along with the social, economic and other realities. He / She should march in search of wisdom which provides insight into the spiritual world. The mysteries of life have to be unfolded with the help of wisdom and education. Education is thus a means to happy and harmonious living.

The word education is derived from the Latin word “educare” which means, “to bring up”. There is yet another Latin word “educere” which means, “to bring forth”. Education, therefore, means both “to bring up” as well as “to bring forth”.

Some theorists gave a different explanation of the word “educate”. They say “e” means “out of” and “duco” means to lead i.e. “to educate” means “to lead forth” or “to extract out” the best in man.

Gandhiji speaks of education as, “By education, I mean an all – round drawing out of the best in the child and man- body, mind and spirit”.

According to Vivekanada, “Education is the manifestation of divine perfection already existing in man”.

According to Nunn, “Education is the complete development of the individual so that he/she can make an original contribution to human life to his/her best capacity”.

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I.1.a. Meaning and the Concept of Education:

In any system of education, the purpose or aims and objectives of education determine its other aspects such as its structure, curriculum, etc. Unless one is quite clear about what is wanted to achieve through educating children, he/she is likely to adopt wrong methods of teaching too. Gone are the days, when people thought that education is solely concerned with the imparting of knowledge alone. The importance of the development of the whole personality of the child is realized now. “Educating the whole child” is the aim now. What does it mean? Children are helped to grow, develop their body and mind, acquire practical skills, imbibe certain social values such as co-operation, tolerance, etc. and also develop their character. It is also considered necessary that every child should learn to appreciate and enjoy the beautiful things in life, know to spend his/her leisure and form attitudes towards work and also life in general. In short, in the education of the child, the development of its whole behavior is concerned along certain desirable lines. “Desirable” is a key word here. That desirable development of behavior is attempted through teaching of various subjects. Science is one among them.

I.1.b. Aims of Education:

Everything in life has a goal. Life has its function which aims the direction. Without direction, function will not be smooth. Therefore, aim is a must for the effective functioning.

Life and education are interwoven in a meaningful way. Dewey considers education as life itself. Every moment appears like dew drops and remains because it is transitory. Education provides with a sense of priority and perspective. It is also pragmatic as it changes with the ongoing life. Education is the process of realizing this truth and reaching the goal.
It is both an art as well as a science. It is the art of living and the science of doing. Human beings live to love and love to live with a view to enjoying the creation. The immortal self finds its way through education and culture. The Kothari Commission (1966) has also stressed that the education system should emphasize on the development of the fundamental social, moral and spiritual values. Education is a must to engender a new humanism, one that contains an essential ethical component and sets considerable store by knowledge of and respect for the cultures and spiritual values of different civilizations’ (UNESCO, 1996).

In the modern usage, the term “Education” has a threefold functions.

a. Education as a process of human development.

b. Education as a training for preparing teachers and

c. Education as a course of study like history, geography, psychology, etc.

Science is one among them.

I.2. Science:

“Science” is a word derived from Latin word “Sciencia”. This means “to know”. Science is a cumulative and endless series or empirical observation which results in the formation of concepts and theories, with both concepts and theories being subject to modification in the light of further empirical observations. Science is a body of knowledge and the process of acquiring it.

Science is an accumulated and systematized learning in general usage restricted to natural phenomenon. The progress of science is marked not only by an accumulation of fact, but the emergence of scientific method and of the scientific attitude.

From the above meanings, three basic principles of the nature of science can be identified such as
1. An accumulation of knowledge of the universe.

2. The scientific method of inquiry

3. The scientific attitudes

The first point indicates the product of science while second and third points indicate the process of science. In other words science is both a product and process.

Science is a process as well as the product of that process. In its process form, it suggests the ways and means of explaining the truth and in its product form it presents a systematic and organized body of useful knowledge.

I.2.a. Main characteristics of the process of science:

The major items in the process of science as advocated by the National Science Teachers Association, Washington are as follows:

1. Science proceeds on the assumption based on centuries of experience that the universe is not capricious.

2. Science knowledge is based on observation of its sample of matter that is accessible to public investigation in contrast to purely private inspection.

3. Science proceeds in a piecemeal manner even though it also aims at achieving a systematized and comprehensive understanding of various sectors or aspects of nature.

4. Science is not, and probably never will be, finished anywhere and there remain very much more to be discovered about how things in the universe behave and how they are inter related.
5. Measurement is an important feature of most branches of modern science because of the formation as well as the establishment of laws is facilitated through the development of check whether it is a qualitative or quantitative.

I.2.b. Philosophy of Science:

Science is a branch of philosophy that attempts to elucidate the nature of scientific inquiry- observational procedure, pattern of argument, methods of representation and calculation, metaphysical presuppositions and evaluate the grounds of their validity from the points of view of epistemology, formal logic scientific method and metaphysics. Historically it had two main preoccupations, ontological and epistemological. The ontological preoccupations (which frequently overlap with the sciences themselves) ask what kinds of entities can properly figure in scientific theories and what sort of existence such entities possess.

Epistemologically, philosophers of science have analyzed and evaluated the concepts and methods employed in studying natural phenomena of both the general concepts and methods common to all scientific inquiries and the specific ones that distinguish special sciences.

I.2.c. Values of science as a subject:

Galileo Galilei (1564 – 1642) once said that in questions of science “the authority of a thousand is not worth the humble reasoning of a single individual”. While learning science, the learner develops certain faculties through reasoning and experimentation. Science, as a teaching subject, possesses the various values as any other subject for which it is included in the curriculum as a teaching subject, such as intellectual values, utilitarian values, cultural values,
moral values and aesthetic values. But in addition, the study of science inculcates certain other disciplinary values peculiar to it which cannot be provided through other subjects.

I.2.c.i. Intellectual value:

The great value of science is that it has introduced as the new ways of thinking and reasoning. The chief part played by science in helping to develop consciousness of man is to be found in the new thoughts that it has made are think. Increase in consciousness appears to be of the purposes of evolution. Science has its own discipline. It sharpens intellect and makes intellectually honest, critical in observation and reasoning. It teaches to arrive at conclusions without any emotional bias or prejudice.

I.2.c.ii. Utilitarian value:

The utilization value of science need not be emphasized. Science has entered in life and daily activities so much that the existence would become impossible without it. There is a vast storehouse of natural power such as the waterfall, heat of the sun, etc.

I.2.c.iii. Vocational value:

The study of science is an open “season” for a number of professions. It forms the basis of so many studies, which are purely vocational in nature. For eg. a student of science can choose medical, engineering, agriculture or any other. The study of science at school forms the basis of many useful hobbies and other productive activities in the later life of the students.

I.2.c.iv. Cultural value:

Science has played an important role in determining the culture and civilization of a country from time to time. It has affected our way of thinking and way of living. The effect of science is multifacet. It has a direct influence in dispelling many traditional beliefs and the adoption of others suggested by the successes of scientific method.
I.2.c.v. Moral value:

Of the great values that condition the activities and make the lives worth living – goodness, beauty and truth. The man of science is mainly concerned with the disinterested passion of truth.

I.2.c.vi. Aesthetic value:

Science is important to a layman chiefly because of its practical application. On the other hand, it is the most important consideration with all scientific men for it meets one of the deepest needs of human nature which manifests itself as the desire for beauty. It is the aesthetic aspect that the whole of science lies.

I.2.c.vii. Other values:

Apart from the above values, special characteristics and salient feature of the subject of science may be enumerated as follows:

1. Science helps in bringing desirable modifications in the attitude and behavior of its learners. Gradually an attitude known as scientific attitude develops among them and consequently those who study science begin to imbibe the qualities like impartiality, objectivity and truthfulness in their behavior.

2. Science makes use of special methods known as scientific method for doing the duties and in studies. This is well known for its superiority in terms of objectivity, reliability and validity over all other methods used in the study of other subjects.

3. Science is least concerned with the part as well the ideal situation. It is mostly related with what and why of the happenings in the present. It usually focuses its attention over
the problems like what exists, why it is happening, what could happen if it continues in the same way, etc.

4. Science, through its body of knowledge and method of study, helps in diving deep into the nature of events. One can discover every truth behind every happening through the help of science.

I.2.d. Branches of Science at School Level:

Figure I.1 Branches of Science
a. Physical sciences:

1. Physics: The study of matter and energy and the interactions between them.

2. Chemistry: The science that deals with the composition, properties, reactions, the structure and matter.

3. Astronomy: The study of the universe beyond the earth’s atmosphere.

b. The earth sciences:
1. Geology: The science of the origin, history and structure of the earth and the physical, chemical and biological changes that it has experienced or is experiencing.

2. Oceanography: The exploration and study of ocean.

3. Paleontology: The science of the forms of life that existed in prehistoric or geologic periods.

4. Meteorology: The science that deals with the atmosphere and its phenomena such as weather and climate.

c. The life sciences (Biology):


2. Zoology: The science that covers animals and human life.


I.3. Nature and Characteristics of Physical Science:

Physical science is “an overall product of human activity in the form of a systematic and organized body of knowledge”. It is the product of all facts concerned with our information, concepts, generalization, laws and theories framed on the basis of vast fund of accumulated knowledge. W.C. Dampier defines physical science as, “ordered knowledge of natural phenomena and the national study of the relations between the concepts in which those phenomena are expressed”.

From the above definition, characteristic and nature, one may conclude that the “Physical Science is the discipline, which concerns with the study of properties of matter and energy and
also with the study of the compositions of various substances and of their effects upon one another”. It helps in explaining the natural phenomenon on the basis of established laws of nature. Physical sciences help children in developing scientific temper and other scientific virtues and values.

I.3.a. Values and Importance of Physical Science:

Physical sciences teach intellectual value, utilitarian value, disciplinary value, vocational value, aesthetic value, cultural value, psychological value, social value and moral value. The study of physical sciences helps in moral development and character formation. It helps in developing proper moral attitudes as there is no place for prejudiced feelings, biased outlook, doubts and half truths, discriminations, misdistribution of resources, unreasonableness and irrationality in learning of his/her subject.

The quality like honesty, truthfulness, justice, dutifulness, punctuality, self-confidence, discrimination between good and evil, observation of rules and belief in systematic organization and arrangement are indirectly included through teaching of physical sciences. These qualities go towards developing a morality and sound character. Chemistry is one among the physical sciences.

I.4. Chemistry:

Chemistry is the science that attempts to classify all kinds of matter in the universe and to understand the changes that the various forms of matter undergo. Chemistry is also concerned with the ultimate constitution of matter and the energy changes that accompany chemical reactions. The study of the exchange of energy, however, has been assumed by the physicists
because the chemists are fully occupied in formulating and applying laws of chemical change for the production of new substances and materials for the benefit of mankind.

Knowledge of chemistry is not essential to a civilization of moderate advancements. Aztecs, steel, glass, dyes and even gasoline have been prepared without the help of the chemist.

What, then, has been its role and contribution? The chemist aided by other scientists, has speeded up progress and change of civilization. He/she has made food, clothing, shelter, entertainment, education, medical aid and leisure available to the common man. Not only is the quantity of material goods greater but also the quality is infinitely better. Research in science is an excursion into the unknown. The boundaries of chemistry are constantly being parted back by the discovery of new facts and laws, which together with the old are applied to the study of matter. (The research chemist may be utterly indifferent to any practical application of his/her discovery. But the industrial chemist is quick to use the facts gleaned by the / by clean research chemist to improve the old and create the new).

Chemistry is the science that deals with the properties, composition and structure of substances (elements and compounds). The reactions and transformation they undergo and the energy related or absorbed during this process is often called the “Central Science”. Chemistry is concerned with “Atoms” as building block (rather than with the subatomic domain) with everything in the material world, and with all living things. Branches of chemistry include inorganic chemistry, organic chemistry, physical chemistry, analytical chemistry, biochemistry, electrochemistry, geo chemistry, applied chemistry, (chemical engineering) and nuclear
chemistry. Applied chemistry uses the theoretical and experimental information obtained in chemistry to build chemical plants and make useful products.

**I.4.a. Evolution of chemistry:**

Where has chemistry come from? Throughout the history of human race, people have struggled to find out? Through the branch of science called chemistry, one can gain an understanding of the matter which makes up the world and of the interactions between particles on which it depends. The ancient Greek philosophers had their own ideas of the nature of matter, proposing atoms as the smallest indivisible particles. However, although these ideas seem to fit with modern models of matter, so many other ancient Greek ideas were wrong that chemistry cannot truly be said to have started there.

Alchemy (often called the chemistry of middle ages) was a mixture of scientific investigation and mystical quest, with strands of philosophy from Greece, China, Egypt and Arabia mixed in. The main aim of alchemy that emerged with time where the quest of the elixir of life (the drinking of which would endure the alchemist with immortality) and the search for philosophers stone, which would turn base metals into gold, improbable as these ideas might seem today, the alchemists continued their quests for around 2000 year and achieved some remarkable success, even if the elixir of life and the philosophers stone never appeared.

Towards the end of eighteenth century, pioneering work by Antonie and by John Dalton on the chemistry of air and the atomic nature of matter paved the way for modern chemistry. During the nineteenth century chemists worked steadily towards an understanding of the relationships between the different chemical elements and the way they react together. A great body of work was built up from careful observation and experimentation until the relationships
which we now represent as the periodic table emerged. This brought order to the chemical world and form them on chemists.

Modern society looks to chemists to produce many things. Healing drugs, pesticides and fertilizers to ensure better crops and chemicals for the many synthetic materials are produced in the twenty first century. It also looks for an academic understanding of how matter works and how the environment might be protected from the source of pollutants. For this, chemistry holds many of the answers.

Following the progressing trend in chemistry, it enters into other branches of chemistry and answers for all these miracles that are found in all living organisms.

I.4.b. Importance of Chemistry:

Chemistry is of greater importance in industries. It plays a vital role in our daily life. Gaseous fuels are mixture of hydrocarbons. All fertilizers are chemical substances, which mainly consists of nitrogen, phosphorous and potassium (NPK). Plastics, synthetic fibers, synthetic rubber, electrical insulators, metal alloys, rocket fuels, atomic power producers, radioactive isotopes etc. are used in various fields (Eg. Medicine diagnosis and curing). All vitamins, hormones drugs (antibiotics, anti malarial, tranquilizers, anesthetics, antipyretics…..) insecticides, fungicides, synthetic protein food, etc. have revolutionized the modern living and given scope for a confident future. Explosives (Eg. Dynamite) are the wonders of chemistry.
Chemistry also plays its role in paint industry, dye industry, pharmaceutical industry, etc.
Chemistry is taught at different levels of education.

I.5. Different Levels of Education:

In 1985, the Government of India announced based on the Secondary Education Commission. According to this, New Education Policy on Education, a common educational structure 10, +2, +3 was introduced.

In school curricula, in addition to laying down a common scheme of studies for boys and girls, science and mathematics were incorporated as compulsory subjects and work experience assigned a place of importance.

National system of education gave a common educational structure 10, +2, +3 structure has been accepted in all parts of the country. Regarding the further breakup of the first 10 years, efforts were made to move towards an elementary system comprising 5 years of primary education, 3 years of upper primary followed by 2 years of high school. Efforts had been made to have the +2 stage accepted as a part of school education throughout the country. 10, +2, +3 pattern of education has been followed in the state of Tamil Nadu from 1978 onwards.
Table No. 1.1: Educational System in Tamil Nadu

EDUCATIONAL SYSTEM IN TAMILNADU

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I.5.a. Secondary and higher secondary education:

Secondary Education begins where primary education ends. Secondary education is essential for training the young pupils to be effective members of society. After secondary education students enter life knowledgeably and mentally alert. The effective terminal behavior resulting from secondary education above will help the student either for higher education or choose a job. Lawrence is regarded in Tamilnadu as the architect of Higher Secondary Education in Tamilnadu. As special officer for restructuring educational pattern in Tamilnadu and as Director of School Education. Lawrence planned and implemented the all India 10, +2, +3 pattern of education in 1978.

I.5.b. Characteristics of Higher Secondary Students:

The higher secondary school students are in the adolescent stage. The English word adolescence is a derivative of the Latin ‘adolescence’ which means ‘to grow to maturity’. This stage normally begins from twelve and continues till the age of twenty. Adolescence is the period through which a growing person makes transition from childhood to maturity.

This is the most volatile stage. Mental physical and every other kind of development take place as a rapid pace during this stage. Imagination and emotion are at their highest pitch.

In adolescence the nervous system becomes more strong with the result that the mental activities show greater tenacity and system.
Adolescence is a period of growth in all systems of the body. During adolescence physical growth reaches the Zenith. Likewise the intellectual growth reaches its final stage. The level of abstract thinking increases. Retention and recall improves. There is increased ability to generalize facts. The depth of understanding improves. Because of this intellectual developments, the adolescents can find solutions to problems in a more scientific and creative fashion. Ability to think, to differentiate and evaluate are some of the more prominent characteristics and abilities the adolescents exhibits.

The adolescent children of the age group 16 to 18 years are at the higher secondary level. After completing the terminal educational programme of secondary education (up to standard (X), the spell of two years standard (XI and XII) is intended to prepare the secondary school leavers both for general and professional higher education.

1. The Higher secondary students to grow up to big and also have some of the security that goes with being little.

2. There is something radical about being an adolescent, yet also something conservative.

3. The higher secondary students are able to draw upon his/ her resources, have a great capability for flexibility, yet they are also in many ways, a right person.

4. They line in lush season and fall between the spring time and the summer of life.

5. They try to explore their role in the world in which they live.

6. Development of self is an important phase of this stage. Self is a very complicated concept. It is composed of feelings, attitudes, impression, habits dispositions, likes and dislikes. The growing higher secondary students ability and the concept of self are influenced by the way in which they accept others.

I.5.c. Kothari Commission’s (1964 – 66) Recommendations:
The Indian Education Commission (1964 – 66) recommended the following for the improvement of school education.

1. All the secondary stage science should be taught as a discipline of the mind and a preparation of higher education.
2. At the lower secondary classes physics, chemistry, biology and earth science should be taught as compulsory subjects.
3. At the higher secondary stage there should be diversification of courses and provision for specialization.

Kothari proposed a ten year common, undiversified lower secondary and a two year higher secondary courses followed by a three year degree courses. Vocational education was also introduced in the higher secondary course. Thus the higher secondary stage comprises two spectra – a general education spectrum and a vocational education spectrum.

According to Kothari Commission (1964 -1966) “The progress, welfare and security of the nation depend critically on a rapid, planned and sustained growth in the quality and extend of education and research in science and technology”. It has recommended that up gradation of school curricula by “Research in curriculum development, revision of curriculum based on such research, the preparation of text books and teaching/ learning materials and the orientation of teachers to the revised curricula through in-service education”. They have recommended the abolition of general science and instead have emphasized the disciplinary approach at the higher secondary stage.

I.6. Chemistry at Higher Secondary Level:

National Curriculum Frame Work for School Education (2005) recommends a disciplinary approach with appropriate rigour and depth with the case that syllabus is not heavy and at the same time it is comparable to the international level. It emphasizes a coherent focus on important ideas within the discipline that are properly sequenced to optimize learning. It recommends that the critical component of higher secondary sciences should emphasize on
problem solving methods and the awareness of historical development of key concept of science be judiciously integrated into content. The present exercise of syllabus development in chemistry at higher secondary stage is based on this frame work.

- The course is self contained and broadly covers fundamental concept of chemistry.
- Practical syllabus has two components. There are core experiments to be undertaken by the students in the classroom and the part of examination while each student will carry out one investigatory project and submit the report for the examination.

1.6.a. Objectives of Teaching Chemistry at Higher Secondary Level:

- To promote “Understanding” of basic principles in chemistry while retaining the excitement in chemistry.
- To strengthen the concepts developed at the secondary stage and to provide firm foundation for further learning of chemistry at tertiary level more effectively
- To develop positive scientific attitude and appreciate contribution of chemistry towards the improvement of quality of human life
- To develop problem solving skills and nurture curiosity, aesthetic sense and creativity.
- To inculcate values of honesty, integrity, cooperation, concern for life, preservation of the environment, etc.
- To equip students to face challenges related to health, nutrition, environment, population, industries and agriculture.

1.6.b. Problems faced by the Higher Secondary Chemistry Teachers in the Teaching and Learning Process:

The implementation of higher secondary courses coupled with the explosion of knowledge has created several problems. Most of the chemistry lessons are factual or information packed. There is little scope for demonstration and investigatory approach. So the
teachers follow the traditional lecture method. But, mere chanting of factual materials is determined to the development of scientific temper as there is very little student involvement. For example, one can take the unit ‘chemical equilibrium’. It is presented in a monotonous manner by stating the definitions. Problem solving method in this case, will make the topic interesting. But as on today the students simply cram this lesson and the teachers neglect to teach this part.

Practical activities prescribed in higher secondary chemistry are simply the traditional qualitative and quantitative analysis. They were not designed to help the pupils understand the principles and concept taught in the theory classes. Element of investigation, training in the use and practice of scientific method and application of the chemical concepts to social needs are conspicuous by their laboratory facilities when equipments are more than adequate.

Further it is a known fact that chemistry curriculum of higher secondary classes is little relevance to social needs and it has no relation to local environment. This results in students losing interest in the study of chemistry. It ultimately affects the academic achievement of higher secondary students.

I.7. Academic Achievement:

‘Academic Achievement’ is often referred to as the marks secured in a subject or subjects. A critical analysis reveals that these marks are mere indications of the knowledge and capabilities attained by the student. Academic achievement, in fact, should refer to the knowledge and capabilities acquired by each of the student. It means that academic achievement is the ‘acquired potential (knowledge and capability) in a subject or subjects’. (Khader, M.A. et al. 2006, p.19).

The physiologist explain this concept using Schema theory.
Schema means knowledge structure created by the students in their memory. Knowledge structure is the internal representation of external realities. A student, for instance, forms a knowledge structure of ‘bird’ (external reality) in terms of shape wings, feather, flying and living in nests or branches of trees (national representation). Knowledge structures thus, includes different types, characteristics, biological processes and life pattern of birds. Likewise, one may form knowledge structures of ‘refraction’, in terms of propagation of light, bending of light, convergence and divergence of light and image, and later widen the structures by relating the phenomenon of refraction in nature (rainbow) and functions of optical instruments (human eye, microscope, telescope). Schema theory states that learning takes place forming appropriate knowledge structures (schema) by relating new information (e.g. Principles of microscope) to the existing knowledge structures, (e.g. Principles of refraction). This idea can be related to academic achievement. How do teachers know that the student has formed the appropriate knowledge structures?

Why do people use convex lens instead of concave lens in microscope? The student will be able to answer only if she/he possesses appropriate knowledge structures about the microscope. The answer to the question would indicate the student’s existing knowledge structures of a microscope. In fact, the marks awarded to a student represent his/her knowledge.

Knowledge is formed by relating new information to the existing knowledge. It means possessing appropriate domain-specific knowledge facilities acquisition of new knowledge. Domain – specific means existing knowledge or pre-requisite knowledge essential for learning new information in a subject. Those who possess appropriate pre-requisite knowledge (e.g. refraction principle) learn more from new information (e.g. microscope) than from those who lack such knowledge in science. This is true of all subjects. A student, thus, progresses in
attainment of knowledge in a subject by relating new information to the existing knowledge and
the progressive nature of knowledge attainment suggests the cumulative nature of learning. For
instance, students who know subtraction and multiplication (pre-requisites) will effectively learn
division and those who do not possess knowledge of that appropriate pre-requisite knowledge
would fail to learn division and continue to fail in acquiring knowledge of compound interest.

Along with knowledge the student is expected to attain related capabilities. The
knowledge discussed above includes comprehension. In other words, when a student learns the
principle of refraction, he/she should not only be able to recall, identify and recognize it (the
concept of refraction) but should also be able to demonstrate, differentiate, illustrate and explain
it. Knowledge is the basis for attaining the related capabilities involved in application (ability to
apply the principles in a new situation), analysis (ability to compare, contrast and differentiate),
synthesis (ability to derive, formulate, modify, originate) and evaluation (appraise, judge,
assess). Thus academic achievement refers to the acquired potentials (knowledge and
capabilities) in a subject or subjects.

The students differ in their academic achievement. Those who possess appropriate pre-
requisite knowledge learn more effectively than thus who lack such knowledge abilities related
to intelligence, aptitude, attitude, study habit, etc. of the students and different teachers’ variables
are essential for learning. The school and family background also lead to differences in academic
achievement.

It is usual to find a wide range of differences among students in a class or a group. These
differences are identified in terms of students’ characteristics such as physical, (appearance,
height, size, gender, colour, etc.), demographic (age, caste, socio-economic status, etc.) and
cognitive behavior (thinking, remembering, problem solving, creating idea, etc). Differences due
to physical and demographic characteristics are easy to identify. However, the differences that
exist in the way they solve problem in mathematics or in their ability to interpret and explain ideas are not easily visible but are identified through their performance. Such differences are often identified by psychologists in terms of intelligence, aptitude, creativity and academic achievement. So, the academic achievement, being dependent on many independent factors, is the concern of educationalists.

I.7.a Factors Affecting Academic Achievement?

The following factors are affecting academic achievement in general

1. Lack of inspiration
2. Lack of faculties
3. Lack of financial support
4. Lack of infrastructural facilities
5. Lack of guidance and counseling
6. Lack of material support
7. Lack of encouragement
8. Political influence

Apart from these factors, a few other factors are also affecting the academic achievement of the students. The factors differ from subject to subject, learners to learners, levels to levels, etc. The investigator being the post graduate in chemistry and teacher educator for three years is familiar with a few factors influencing the academic achievement of the students in chemistry. Besides, she had an informal talk with some post-graduate chemistry teachers, a few students and parents. The factors, influencing the academic achievement of higher secondary students in chemistry, are thus identified and grouped as follows.

I.7.a.i. Students Related Factors:
1. **Gender:** Variability among individuals is a universal phenomenon. The very ideology of gender is based on an idea of assumed differences between males and females.

   As far as general intelligence is concerned, males and females appear to be equal. The differences are either related to specific abilities or specific traits. Males on an average show superiority over females in ability to reason and to detect similarities and in certain aspect of general information.

   Girls are average show some superiority in memory, language and aesthetic comparisons. Males excel in a number of skills and in understanding spatial relations while females excel in verbal aptitude and memory. Studies have shown that female students develop facility in the use of language at an earlier age than the male counterparts. Studies on pre-school children have shown that girls had larger vocabulary than boys of the same age and had consistently higher scores in reading, sentence completion and the like.

   These differences lead to individual differences in academic achievement also. The better performance of female students in the public examinations and the male students in the competitive examinations also is to be taken for an account in this regard. The gender, therefore, is taken as one of the factors in the present study by the investigator.

2. **Medium of instructions:** Medium of instruction in this study refers to the language through which subject is taught in the classrooms. They are normally two in Tamil Nadu state such as Tamil and English.

   It has been said that the vernacular language is the better medium of instruction. The results of public examinations published by the governments at versions levels show that the academic achievement of English medium students is better than their counterpart in vernacular
medium. The reasons may be many. However, the experiences here taught the investigator that medium of instruction is one of the factors affecting academic achievement of the students.

3. Attitude towards Chemistry: Attitude is a personality trait which indicates towards individual’s likes or dislikes. Attitude influences the way an individual behaves towards an objects, institution or a person. Attitude towards a particular object is influenced by parents, teachers, school and society in which the individual lives.

   Environment around us consists of all kinds of objects, people, groups and institutions. An individual’s interaction with the environment brings the person face – to – face with varied experiences. But he/she does not always react to these experiences afresh in every encounter. The cognition, feelings and response dispositions that these objects recurrently evoke get organized into a unified and enduring system. A set of feelings and responses tendencies is available to the individual wherever he/she is confronted with an object, person, situation or idea. Attitudes predispose the individual to act in particular ways towards these objects, persons, situations or ideas and there is a degree of consistency in his/her response to these.

   Of the many definitions of attitude, the one advanced by G.W. Allport is quite comprehensive – “Attitude is a mental and neutral state of readiness, organized through experience, exerting a directive and dynamic influence upon in individual’s responses to the objects and situations with which it is related”. It is clear that the attitudes of a student are formed due to his/her experience and interaction with real situations.

   Attitudes provide the ‘frame of reference’ for a person’s life: all that he/she thinks, feels, sees and does is consistent with the reference. Attitudes involve organization of motivational, emotional, perceptive and cognitive processes. Thus attitudes are reinforced by information (the cognitive component) and often generate strong feelings (the emotional component) that may lead to a particular form of response (the action – tendency component).
Harrison (1976) identified three components in attitudes: beliefs, emotions and behavior. One’s beliefs are what are considered desirable and undesirable. They are preferences that result from value systems. Since attitudes are accompanied by emotions, and they influence each one’s the resultant behavior is always a complete interplay of both. The individual displays his likes or dislikes (attitudes) through his/her action (behavior).

Since many attitudes cannot be neutral, children acquire or learn positive or negative attitudes from their parents, peers and schools. Negative attitudes lead to avoidance, disagreements, arguments, conflicts of other confrontations. Prejudice is a premature or snap judgment that is made before examining the fact(s). It is a key factor in negative attitudes. The negative attitude generated by prejudice is usually directed toward people who are perceived to be different in some way or the other. Negative attitudes tend to restrict and individual’s interaction with objects, people places or things and thereby restricts his/her experiences which may well have been positive and a contributory factor in enlarging his/her vision. On the other hand, positive attitudes can induce an individual to assist other people, to be caring and unselfish, to be at peace with his world.

Individual differences in attitudes are observed in students. Maturity levels, planned and random experiences, physical surroundings, extent of warmth exhibited, democracy and indulgence in home environment, schooling, playmates and exposure to media are not the same for everyone. Similarly, the persons a child desires to be liked and whose attitudes he/she lends to internalize, or the persons he/she dislikes and whose attitudes he/she generally rejects would not be the same for all individuals. An object liked by one may be disliked by others and vice-versa. The result would be attitudinal differences among individuals.

An intellectually mature individual can change and modify his/her attitudes, should he/she realize that his/her attitudes are narrowing, biased or even wrong. The intellectually
immature individual, by contrast, will cling to his/her attitude even though there is enough evidence to indicate that it is not desirable.

Adolescents differ in their attitude towards authority (teachers, principals, leaders, parents and subjects) depending on the satisfaction or figures of dissatisfaction they derived during the course of their interaction with them.

The attitude towards the subject is therefore, one of the factors selected by the investigator in the present study.

4. Scientific aptitude: ‘Aptitude’ refers to the set of abilities essential for acquiring knowledge and skills specific to an area of performance. Precisely, it denotes the set of abilities required to perform a specialized activity. For instance, the set of abilities involved in learning performing in engineering is different from that of art. The same is true for medicine, mathematics, science, music, teaching or athletics.

Aptitude is different from academic achievement as follows.

1. Aptitude indicates performance that is the product of multiplicity of experience of everyday life and therefore indicates the effect of learning under unknown and relatively uncontrolled condition.

   Academic achievement indicates the performance under known and controlled conditions.

2. Aptitude is future oriented and achievement is present and past oriented. Still, these 2 tests can measure the development of the children in science.

3. The primary purpose of an aptitude is to predict what a person can learn and the primary purpose of an achievement is to evaluate what a person has learned.

4. Aptitude tests are psychometric tests and academic achievement tests are education metric tests.
5. Psychometric test is one whose major intention is to measure individual difference like general ability, aptitude or trail etc and education –metric test is one whose intension is to measure the gain or growth of individuals such as measurement of skill proficiency and achievement.

The individuals differ in their aptitude an individual may have a mechanical aptitude, another may have an aptitude for mathematics or yet another may have an aptitude for language, music or athletics. Such differences are due to the differences in the combination of abilities related to the cognitive processes, and the sensory and psychomotor components. For instance, when talk about mechanical aptitude, one may deal with ability for spatial relations, ability to acquire information on mechanical matters and ability to comprehend mechanical relations, besides sensory and psychomotor abilities. Similarly, about we discuss aptitude in music, one may identify ability for musical memory, pitch discrimination, loudness discrimination, time discrimination and judgement of rhythm. Likewise, abilities required for science or mathematics is different and each requires a separate set of abilities.

It is proved that the academic achievement mainly depends on the student’s aptitude in the concerned subject. Chemistry is the science which has its bases in all the other branches of science. Scientific aptitude is, therefore, believed to be one of the factors determine academic achievement in chemistry.

5. Study Habit: The word “habit” generally means a behavior pattern which has not grown naturally out of the body but has been put on externally. The word “study habit” refers to the individuals plan physical facilities, motivation, system of work and attitude towards study.
Study habit envisages plans, timetable, physical facilities, motivation study skills, reading ability, preparation for examination, etc. A good study habit

(a) develops positive attitude towards study.

(b) develops reading skills

(c) concentrates intensively

(d) uses efficient techniques at the examination

(e) masters the art of taking and making notes and

(f) prepares a workable study schedules

Smeltzer (1983), in tabulating the returns from his questionnaire, to 721 college students in all classes, classified the following study difficulties in order of frequency

(i) Inability to concentrate while studying

(ii) Inability to recall many of the facts once learnt.

(iii) Study time not used properly, inability to start promptly.

(iv) Inability to collect important material from a mass of information.

(v) Inability to apply learnt facts to practical problems.

According to Smeltzer (1983), the following are the causes for ineffective study habits.

(i) Incompatibility between teachers and pupils.

(ii) Failure of teachers to teach how to study.

(iii) Excessive participation in social activities.

(iv) Poor foundation.

(v) Plain laziness.

(vi) Poor health or physical defects.
(vii) Failure of curricula to meet the problems of individual differences.

(viii) Poor reading and

(ix) Emotional maladjustment.

If anybody is regular in his/her habit of study, he can be confident enough for the examination. Average students who work efficiently can shine brighter than the advanced learners. It is important to schedule study time while preparing for examination. It is better to prepare master outline of topics which help quick reviewing. Thus one of the important areas to which proper attention should be given is study habits.

Now days, the student community possess many skills, talents and abilities. One of them is certainly study habits, successful and intelligent students know how to study. Many poor achievers fail in their subjects, not because they are lacking intellectual ability, but they don’t know how to organize and assimilate the information. It has been rightly said that a major weakness of schools is their failure to develop effective and efficient study habits in children. A common factor affected the students’ academic achievement is their habit of study.

6. Age: Age is one of the crucial factors which influence academic achievement. With an increasing age, many differences appear in both boys as well as girls. The intra-group differences are also found due to different in age. It is evident that an individual’s ability to adjust to the environment grows with the age. With increasing age the individuals develop ability to deal with more and more different problem solving situations which result in better adjustment with the environment. As a child grows from infancy to maturity, his/her mental powers increase. His/her body, nervous system, brain and its functions mature and there is a corresponding maturity and development in the mental capacity. Also, the child grows experience and this tool adds to his/her mental capacity. Thus, age is important factor
contributing to academic achievement. But as compare to is influence in adulthood, you will find that is influence during childhood is greater. It means a few years in the age of the child make much more difference than a few years in the life of an adult. Age of the students, therefore, is one of the factors affecting the academic achievement.

I.7.a.ii. Institutional Related Factors:

The school, while it is related to society as a whole, represents a little society by itself. Teachers, students and other members of this little society interactively participate in their own distinctive ways. The school has its own social setting and its own culture. In a way, it represents a “total institution” in the sense that any students coming from any social culture has to abide by the rules and regulation of the school and adjust to the distinct social milieu of the school for the limited period during he/she stays at school.

1. Types of School: There are different types of school such as government, government fully aided, government partially aided and un-aided schools. Many differences are found among these schools with regard to organizational climate, interpersonal communication, infrastructure, entry and terminal behavior of students curriculum transaction, teachers competency, working strategies, etc. Academic achievements of the students also are depending on the different criteria mentioned above. Type of school, therefore, is also determining factor of the academic achievements of the students.

2. Nature of Institutions: ‘Nature of institution’ here refers to the gender of the inmates of the schools. The school was divided as the boy’s schools, girls’ school and co-education schools. Each school has different timings, norms and regulations, dressing codes, etc. The academic achievement of the students from the boy’s school and girls’ school is found to be different in various researches. It has been proved in the research that the competitive spirit is more in the co
education schools than in the school of other nature. This ultimately becomes the determining factor of the academic achievement of the students studied in these schools.

3. **Locale**: ‘Locale’ refers to the locality in which educational institution is situated. There are normally urban, rural and semi-urban. The urban students are found to be more introvert than their rural counterpart. Their soft-skills are different from the soft-skills of rural students. The locality also influence dressing style, fashion, dialects, diets, values, human relations, etc. More number of failures are found among the rural students may be because of the opportunities and exposure. However, the achievers are more among the rural people. So, the locale from where the students are coming from has also been taken as one of the factors affecting academic achievement.

4. **Lab Facilities**: Science cannot be learned or taught by mere conversation or telling something. It is matter of experimentation and verification. This is possible only by doing it. This is called “Learning by doing”.

   Science laboratory and the relevant material and equipments for the demonstration as well as experimentation, thus, become an urgent need for the teaching and learning of scientific facts and principles.

   Learning by doing is one of the cardinal principles of teaching science. Experimentation has put many theories on a sound footing. The achievements of modern science are mainly due to the application of experimental method. It is, therefore, important that practical work should form a prominent feature in any science course and the primary objective in determining a technique of introduction is to provide for a maximum of pupil activity.
Students derive the laws and principles of science themselves by actually performing experiments. They learn by their own experience, observation, testing and verification. It helps in satisfying their urges of self doing, exploration, creativity and inventiveness.

The laboratory should be adequate with equipments, chemicals, apparatus and other facilities like gas plant, distilled water, frame cupboard etc., in order to do the experiment. The practical knowledge of students develops a positive attitude and results in better academic achievement. When the laboratory is fully equipped, students can take active participation in the teaching learning process. As a bye product of these things, a well disciplined situation is developed.

In general the need and importance of laboratory for teaching science may be fulfilled on the following grounds.

1. It provides training in scientific method and includes scientific attitude among the students.
2. It fixed the learning to the minds of the pupil and as a result of this everything that the pupils learn becomes permanent.
3. It satisfies the instruct of curiosity, creativeness, self assertion, constructiveness, self expression, thereby putting the whole teaching on a sound psychological footing.
4. It develops many socially desirable habits.
5. In science laboratory, required apparatus, instruments, chemical and other material may be kept safe, secure and ready for the use of observation and experimentation as and when required to do so.
6. Laboratories are helpful in creating and promoting scientific attitude in the students.
7. While the working in groups in laboratories, the students develop a sense of co-operation and a spirit of healthy competition, the tracts very essential for getting desired success in future life.

The importance of availability and utility of laboratories in the academic achievement in chemistry, thus, cannot be overlooked.

I.7.a.iii. Family Related Factors:

It is clear that educational functions relate to an overall development of child’s personality which comprises development of worthwhile knowledge, skills, attitudes, value behaviors and above all the educability of the child depends on family. Educability means development of interest in and motivation for learning what is worthwhile and simultaneously applying efforts to achieve the same. Further, the development of the personality of the child is greatly affected by the kind of relationship he/she has with parents. There is interrelatedness of factors that contribute to emotional illness. It is believed that many of the disturbances seen in the individual members of the family are in some sense a product of disturbances in the interpersonal relations between various members and especially between father and mother. Very often the mental illness, especially of a child, has a functional significance for family equilibrium. Similarly, the value orientation of children that are deeply rooted, are mainly unconscious and markedly affect the pattern of behavior and thought – processes in all areas of activities depending upon how the parents treat their children. If the child is loved, accepted and given due freedom to take decisions on his/her own, he/she is most likely to develop a positive and caring attitude towards parents and others.

In today’s complex society, the family, therefore, plays a vital role in the development of child’s personality. His/her attitudes and values all depend upon how he/she is nurtured by
The child’s intellectual abilities, aspirations and commitments also are first acquired in the family.

1. **Fathers Qualification:** In recent years, many families are having educated father to some extent. It has been a practice of some so called best school to have interview for the father and mother of an aspirant child. It is mainly because of the fact that the educated level of parents determines their wards’ performance. The mothers of many children in Ramanathapuram district (that is accessible population for the present study) are illiterate and playing little role in the task of children’s education. Fathers’ educational qualification has, therefore, been included as one of the family factors in the present study.

2. **Socio – Economic Status:** Socio –Economic Status is considered as one of the important variables in social science research. It has been and is being included quite often as a variable in studies in psychology, sociology, education and other social science streams. ‘Socio’ comes from the word “Social” and refers to people and the ways (level) they fit into the community in which they live. It reflects how well they are educated, have jobs, etc. Economic refers to the financial position of people within society and include, how much they regularly earn, whether own a house and the assets owned, etc. Several indicators of one’s social status, viz; education health, contact with criminal justice system, employment/ unemployment, housing, access to services, water, sewerage etc. and of economic position, viz, income, ownership, assets level, holidays etc, have been outline (Australian Bureau of statistics, 1994).

Plato says “Education is the capacity to feel pleasure and pain at the right moment and it develops in the body and in the soul of the pupil, all the beauty and all the perfection which he is capable of”. Such a capability that can be attained by education can be assessed by academic achievement. Good (1945) defined Academic Achievement as the knowledge attained or skills developed in the school subjects, usually assessed by test scores or by marks assigned by
teachers. The essence of academic achievement is that one makes one’s own pan, future, expectancies and to achievement a standard of excellence in actions. Achievement of pupil is influenced by a number of factors such as examination, stress, achievement motive, intelligence and socio economic status etc.

Socio economic status can be defined as the “Individual relative position in the community”- (Chaplin J.P.) Socio economic status is usually measured in terms of occupation of father, mother, their education, their income, social caste and class, neighborhood, material possession, land form, power etc. Dave and Dave (1971) Anand (1973) Abraham (1974), Das Gupta (1975) found that students with high socio economic status were high achievers in comparison to the students with low socio economic status. Mehrotra (1986) found a positive relationship between socio economic status and academic achievement. As academic achievement plays a central role in education and it is found to be easily influenced by socio economic status.

I.7.a.iv. Teachers Related Factors:

In the words of Prof. Humayun Kabir “Teachers are literally the arbiters of a nation’s destiny”. It may sound a truism, but it still needs to be stressed that the teacher is the key to any educational reconstruction. National Policy on Education (NPE) expects a lot from teachers. It boldly opined “No people can rise above the level of its teachers”. The National Educational Policy (1985) and the programme of Action (1986) brought out by the Government of India have emphasized the need to promote the teacher training in pedagogical skills, foundations of education, development and evaluation techniques. The Secondary Education Commission rightly points out that it is convinced that the most important factor in the contemplated
educational reconstruction, is the teacher, his/her personal qualities, his/her professional training occupied in the school as well in the community. So visualizing the role of a teacher in the development of human resources in our country is essential.

1. **Educational Qualification:** It has been found the teachers who cease to read ceases to be a teacher. It has been proved in the researches also that the more the teacher is well-qualified, the better will be his/her performance in the classroom. It is because of this reason, the monetary incentives have been given for the teachers for higher qualifications.

2. **Experience:** Practice makes men perfect. The experienced teachers are proved to be a good result producer. The academic achievement of students in many places is positively correlated to the experience of their teachers.

3. **Teaching Competency:** Oxford Advanced learners Dictionary defines the word ‘competent’ as having ability, power, authority, skill, knowledge etc. to do what is needed. Teaching competency means being competent in teaching. In this study, the term ‘Teaching Competency’ denotes the measurable manifestation of the activity of the sample to teach.

   It should be noted that competence is a collective noun and has no plural. Whereas competency does occur in the plural. It is customary to regard competence as a matter of degree: “the more competencies a teacher has, the more competent the teacher is”.

   Traditionally teachers have enjoyed a position of great respect in our country. But the status of teachers has diminished during the last few decades. Deterioration in our teachers’ service conditions, the isolation in which teachers work, phenomenal expansion of the educational system, lowering of standards of teacher training, a general impression that a very large numbers of teachers do not perform their duties properly, changes in the value system of
the society etc, are found to be the reasons for the deterioration. The status of teachers has had a direct bearing on the quality of education and many of the ills of the latter can be described to the indifferent manner in which many teachers have performed their function. The National Policy on Education (NPE – 1986) therefore places complete trust in the teaching community. It calls for a substantial improvement in the conditions of work and the quality of teacher education.

Now a – days among teacher trainees there is positive attitude towards everywhere. But their competence in teaching is not up to the mark. Many persons have not tried to measure their level of teaching competency. The experiences have proved that academic result of the students depends on the teaching competency of their teachers.

Teaching competency, thus, is an important factor affecting the academic achievement of the students.

4. Gender of the Teachers: The performances of the people differ from gender to gender. It has been discussed clearly in the students’ factor. The performance of the teachers can also be included in this nature. It is because of the different body structure, health problem, mental illness as well as readiness, etc. possessed by the teachers of different genders. This affects the academic achievement of their students also.

5. Age of the Teacher: It has been proved that age is an important factor affecting work efficiency. The teaching career is not an exception. So age is also taken as one of the teacher factors determining the academic achievement of the students.

I.8. Need for Research in Academic Achievement?

Today, the need for research in science education or academic achievements in science is not realized in India. The planning for research is not as much is demanded as compared to other nation. This deficiency is felt in India especially in the academic field.

Research in academic achievement is a scale to measure how far the achievement is real and reliable. Research is done to improve the quality of one’s academic achievement. Everyone knows that science is a subject that demands experimentation, verification, hypothetiation,
assumption and arrival of theories. At present in education at higher secondary level the scope for doing research is far from satisfactory level. This necessitates the research in academic achievement.

I.9. Rational for the Present Study:

Higher secondary level is an important stage for all the students. This decided their future career. Now – a – days, students are more interested to study science so that they can opt engineering or medicine. Even for B.Sc Science group, chemistry is the basic subject.

As it has already been mentioned, the higher secondary stage is a preparatory stage for professional course. At this stage both physics and chemistry play a vital role in shaping the future of the younger generation. Then, any lacuna in understanding the concept of chemistry at this stage will not only affect the students’ choice of career but also affect their performance in higher classes continuously.

The chemistry teacher must, therefore, identify the hard nuts in higher secondary chemistry curriculum and finds a solution so as to get the students intellectually involved in the study of chemistry. As a teacher, the investigator understands the problem of students.

The teachers ought to have adopted various techniques to make these abstract concepts easy to understand.

The higher secondary students face personal problems also which affect their academic progress. Educators should find out the problems faced by the students and help them in finding a suitable solution and counsel them, where they really need. If the problems are ignored, it will lead to deteriorate the academic improvement of pupils. It is noticed that very few teachers have time to go deep into the learning problems of students, whereas others have busy schedule with their commitments. In this process, teachers have less time to interact with students and find out their personal problems. If students are helped by the teachers, things will be taken up in a different angle and can be solved out in an easy way. So the investigator, who is also a chemistry
teacher, takes up the challenges of finding out the factors affecting the higher secondary students academic achievement in chemistry and arriving at some concrete solutions to solve the problems. The investigator believes that finding out the root cause of the students’ problems would help the chemistry teacher to select a good approach to make her/his students understand and to produce successful students in chemistry.

Academic achievement of students in chemistry has been studied at various levels in various places. But many factors affecting the achievement were left untouched. It is, therefore, felt by the investigator that it is the need of the hour to find out various factors affecting the academic achievement of students in chemistry.

I.10. Delimitations of the Study:

1. Only the XII std students are selected for this investigation.
2. Only 400 students and 40 teachers from 40 schools were selected as the sample.
3. The schools situated in Ramanathapuram district only were selected for this investigation.
4. Only the limited factors were included.
5. The content included in the study was also limited.

I.11 Arrangement of the Dissertation:

The dissertation here has been submitted in five chapters. The first chapter gives the theoretical background of the study to understand the concept discussed in this work. This chapter includes need for the study. The related studies are reviewed and recorded in the second chapter. The third chapter gives the details about the methodology. The sample selected, the tools used, the statistical techniques applied etc., are given in detail. The fourth chapter gives the interpretations, for the collected data. The fifth chapter summaries the whole study. This also gives recommendation for implementations and suggestions for further studies at par with the findings of the study. The copy of the tools used for the study and the bibliography are given in the appendices.