CHAPTER I

INTRODUCTION
My memories date back to the time when I was a Student-Teacher in my Undergraduate Teacher Education College at Nalanchira, Thiruvananthapuram, Kerala. Our Physical Science Association thought of conducting an innovative programme to observe the National Science Day on 28th February, 1997. I was the Secretary of the Association at the time. We ended up with the idea of organizing a science exhibition, Extalsia-’97, the first one of its kind in the history of the college! This incredible idea had sprung to life, with the inspiration we had received from our mentor, who went out of his way to see our dream transform into reality. Extalsia-’97 aimed at ‘Science for All’ through fun! The scientific principles applied in daily life were illuminated through very simple experiments amalgamated with fun and action. The exhibition was inaugurated by lighting the traditional lamp using flame evolved from ‘chemical fire’ and bursting of ‘chemical crackers’. The audience that also included my colleagues was enthralled and the novelty of the experience was mirrored on their faces.

The students of the nearby schools were invited to explore the mysteries and realities of everyday science. They were very inquisitive while observing the experiments and were keen in knowing the science behind them. In
the ‘feedback diary’ I was captivated by the comment of a grade VIII student, which read; “Extalsia –’97 was an eye cum brain opener. It made me realize that learning science through fun is a joyful experience. Knowing ‘how?’ and ‘why?’ of science is more interesting than just grasping the mere ‘what’ of science. I wish the science lessons were dealt in this way at my school! Thank you for changing my mind”.

This comment prompted me to shift the focus of my academic pursuit to exploring the possibility of broadening the process approach of science in classroom. This has in turn culminated in the present investigation.

**Background of the study**

Science and technology have become an integral part of the working of the twenty first century knowledge society. It is well accepted that science and technology serve as the principal instruments which determine the standard of living of human beings in a global society. Science has almost revolutionized human life and has proved indispensable for the existence of man. Now, supremacy of science has been established in every field. In fact, so great is its importance for man and society that the present day people live in an "age of science". The emerging new society demands a human being to have developed higher rationality based on the scientific method.

New education has an important responsibility – creating a scientific spirit and the ability to create original knowledge using one’s own effort. Science as a subject is a universal discipline which knows no boundaries. The claim of science for inclusion in the school curriculum is recognized by all educational systems. The importance of science and technology in today’s world is overwhelming and therefore the education system throughout the world has to gear itself to provide the required training in scientific skills to meet this growing challenge. In this context, greater emphasis needs to be given in instilling the process aspect of science and inculcating the right attitude towards science and in maintaining the interest for learning science.
Need and significance of the study

Science is a self-accumulating, self-growing, self-pervading, self-accelerating and self-correcting enterprise, which originated in the collective curiosity of man since time immemorial. Everyone should imbibe the spirit of science, and not just a few alone. The children of today have to identify scientific principles and their applications around them in their daily life. In this world of knowledge explosion, it is difficult for education planners and teachers to keep pace with the expanding knowledge. So, in the school level itself the pupils should be taught ‘how to know’ rather than ‘what to know’. Hence, innovative, pupil-centred methods of teaching science and the acquisition of science process skills contribute largely toward the expected learning outcomes in science.

Kerala, the most literate and educationally elite state in the southern region, is way ahead of all other Indian states in popularizing general education. Kerala displays the active working model of a learning process that has its foundation in the principles of constructivism and a learner-centred, activity-based and process-oriented pedagogy. The new educational programmes at the school level lay much emphasis on the acquisition of science process skills as one of the major objectives of teaching science. Though a considerable amount of time and effort has been spent in research on the development of scientific facts and generalizations, and the ability to deal with the same, little effort has been taken to determine the degree to which the pupils should acquire the process of science. Hence, an empirical mapping of the science process skills expected to be developed in the secondary school pupils as a result of science education is quite essential.

The routine evaluation programmes in schools do not have any scope for the appraisal of the pupil’s understanding of the process of science and it simply evaluates the total achievement in science. Hence it is essential to evaluate how far the pupils are capable of acquiring the process of science. This study tries to analyse how far the students have acquired the various science process skills and also to ascertain whether it has any influence on their total achievement in science.
Introduction

The achievement in science as well as the science process skills is not merely attained through the transactions in the classroom. Several other context factors – like, factors inside the school setting as well as factors from the home and community, intrinsic and extrinsic motivation to learn science, etc., that could be termed as science instructional, familial and motivational - may have an influence. Hence the study tries to establish the relationship between the select context variables and the acquisition of science process skills and achievement on science.

The science education at the secondary school level should help the pupils understand the various processes involved in scientific method and to grasp the true spirit of inquiry. Studies have revealed that the commonly used strategy for teaching science at the school level is the lecture method which lacks efficiency in providing the essential learning outcomes. Science teachers in the modern classrooms are no longer lecturers, they are expected to be facilitators whose main task is to set goals and organize the learning process accordingly. The instructional preferences adopted by the science teachers in their classrooms determine their role as facilitators of learning, rather than educators. The teaching experience of the science teacher, the number of in-service courses attended and the laboratory facilities available at school may have an influence on the instructional preferences. Hence, the study tries to analyse the instructional preferences of the science teacher and the extent to which science teachers perform to stimulate a learner-centred science classroom to accomplish the expected science learning outcomes.

The present investigation attains significance in that its findings would help in furthering our understanding of learning behaviour in science, which in turn would have a potential value in the field of science education. The findings of the study would be helpful in formulating innovative programmes in science education for facilitating the acquisition of science process skills, inculcating proper attitude towards science learning and maintaining interest in science learning at the secondary level. The findings would assist in improving the methods that could
serve to facilitate the context variables - the instructional, motivational and familial - towards achieving the essential learning outcomes of science. The study also reveals the instructional preferences of the science teachers, which would throw light on the strengths and weaknesses of the science teachers in imparting the curriculum in the present scenario. This could help the curriculum planners and the authorities to find ways to bridge the gaps, if any.

**Research Questions**

The present study seeks to answer questions like the following:

- To what extent do the secondary school students of Kerala acquire the various science process skills?

- To what extent do the select context variables - science instructional, motivational and familial – exert an influence on the acquisition of science process skills and achievement in science of the secondary school students of Kerala?

- What is the extent of influence exerted by the acquisition of science process skills on achievement in science?

- What is the role played by certain critical demographic variables (gender, rural-urban location of the school and government-private management of school) in the acquisition of science process skills and achievement in science?

- To what extent do the instructional preferences of the science teacher contribute to stimulate a learner-centred science classroom to accomplish the expected science learning outcomes?

- To what extent do the teaching experience of the science teacher, the number of in-service courses attended and the laboratory facilities available at school influence the instructional preferences of the science teacher?
Statement of the problem

The present study has been entitled: “Relation of Achievement in Science and Certain Context Variables with Comprehensive Science Process Measures at the Secondary School Level”.

Definition of Key Terms

Achievement in science:

Achievement in science refers to the standard performance of secondary school students in science, for a test used to measure the important curricular outcomes of science. In the present study the achievement test scores are expressed in grades.

Context variables:

The identified context variables for the study are a) science instructional: select factors operating within the school b) motivational: intrinsic and extrinsic, c) familial: select factors operating within the home environment, which act as an impetus to his/her science learning. The context variable measures are scores obtained for the above three components on implementation of a Contextual Variable Scale (CVS), specially developed and validated for the present study.

Comprehensive science process measures

Comprehensive science process measures refer to the scores obtained by the science learner in the Science Process Skill Elicitation Schedule (SPROSES), developed and validated by the researcher to assess the acquisition of the various basic and integrated science process skills, expected of the secondary school students, as measured by the schedule mentioned above.
Secondary school level

Secondary school level refers to the existing third level/stage of school education in Kerala concentrating on standards VIII, IX and X. In the present investigation, the samples were limited to standards VIII and IX.

Variables of the study

The present study is an attempt to explore an important issue relating to science education in the secondary schools of Kerala - how certain context variables affect the comprehensive science process measures of the pupils and to what extent the comprehensive science process measures are related to the achievement in science of the pupils. The study also attempts to analyse the instructional preferences of the science teachers, in terms of their teaching experience, number of in-service courses attended in the last two years and their rating on the school laboratory facilities.

The study has been conceived with the following independent and dependent variables:

(a) While analysing the relation of certain context variables and comprehensive science process measures, the select context variables – science instructional, motivational and familial – constitute the independent variable, while the comprehensive science process measure constitutes the dependent variable.

(b) During the examination of the extent of relationship between the context variables and the achievement in science, the context variables form the independent variable and achievement in science constitutes the dependent variable.

(c) While probing into the relation of comprehensive science process measures and achievement in science, the comprehensive science process measures constitute the independent variable and the achievement in science of the pupils constitutes the dependent variable.
(d) While analysing the instructional preferences of the science teachers, the teaching experience of the science teachers, number of in-service courses attended in the last two years (2008 - 2010) and their rating of the school laboratory facilities constitute the independent variables, while their instructional preferences constitute the dependent variable.

Demographic variables included in the study are gender of the student, rural-urban location of the school and government-private school management. Teacher-related variables include teaching experience, number of in-service courses attended in the last two years (2008 – 2010) and rating of the laboratory facilities at school.

*Note:* The incident of shifting of the nature of variables against analysis of changing in pairs of relationships, in the course of the present study is illustrated in Chapter IV, Methodology – page 95.

### Hypotheses

Review of important studies relating to the influence of context variables and science process skills on the achievement in science, together with the researcher’s general perception of the possible level of relationship among them, formed on the basis of her experience as a science teacher and a teacher educator, helped the researcher to frame the following hypotheses.

1. There are differences among sub-samples (based on gender, location of the school and school management) in their acquisition of science process skills.
2. The context variables selected for the study will have a significant positive relationship with the acquisition of science process skills of the secondary school students.
3. The context variables selected for the study will exert a significant positive relationship on the achievement in science of the secondary school students.
4. There exists a significant positive relationship between acquisition of science process skills (basic, integrated and total) and achievement in science.

5. The instructional preferences of the science teacher is significantly dependent on the select teacher-related variables - teaching experience, the number of in-service courses attended in the last two years and the rating of school laboratory facilities.

**Objectives of the study**

1. To examine the extent to which, the secondary school students of Kerala acquire the various science process skills.

2. To examine the extent of acquisition of science process skills of secondary school students with respect to gender, location of school and the school management.

3. To examine the extent of relationship of select context variables with science process skills.

4. To examine the extent of relationship of select context variables with achievement in science.

5. To examine the extent of relationship between the acquired science process skills and achievement in science.

6. To analyze the instructional preferences of the science teachers and the extent to which science teachers perform to stimulate a learner-centred science classroom to accomplish the expected science learning outcomes.

7. To examine the extent of relationship between teaching experience, the number of in-service courses attended and the laboratory facilities available at school on the instructional preferences of the science teacher.
Methodology in brief

The study adopted normative survey method. Analysis of relevant literature was done to explore the science process skills to be acquired at the secondary school level, the context variables that may have an influence on a science learner towards the acquisition of science process skills and achievement in science and the vital components expected of a science teacher to stimulate a learner-centred science classroom. Pilot study was conducted and the developed tools were validated for the study. Survey method was adopted to gather data using the validated tools. The methodology can be summarised as under:

(a) Tools

The following tools were developed and validated by the investigator to gather data for the present study.

1. Science Process Skill Elicitation Schedule (SPROSES)
2. Contextual Variable Scale (CVS)
3. Science Teachers’ Instructional Preference Analysis Scale (STIPAS)

The grades assigned for the achievement in science were based on the data of the final examination marks, taken from the respective schools as per school records.

(b) Sample

The pilot study was conducted on 86 secondary school students and 30 secondary school science teachers, adhering to the required government/private, boys/girls, rural/urban sub samples of Thiruvananthapuram and Ernakulam districts of Kerala. The final study was conducted on a representative sample of 716 secondary school pupils from 20 schools of Kerala using stratified random sampling technique giving due weightage to the variables like gender, location of school, and school management. The sample consisted of students of grades 8 and 9. All the tools meant for collecting student data were administered on the same sample of students, towards the end of the academic year. The performance of the
students of grades 8 and 9 at the end of the academic year indicated the learning outcome of the students of the particular grades and also the entry level performance of grades 9 and 10. Hence, the selected sample could represent the holistic nature of students at the secondary school level conducive for the present study. The data on the instructional preferences of the science teachers were collected from a representative sample of 103 secondary school science teachers of Kerala, using Science Teachers’ Instructional Preference Analysis Scale (STIPAS) developed and validated by the researcher.

(c) Statistical Techniques:

The analysis of quantified data was done using the following statistical techniques:

- Tests of significance for difference between means
- Tests of significance for difference between correlations
- Karl Pearson’s coefficient of correlation
- Spearman’s rank correlation coefficient
- Chi-Square test

Scope and delimitations of the study

The topic selected for the study offers wide implications for educational practice. The results of the present study have a significant value in the field of science education, and potential value in furthering our understanding of teaching and learning behaviour in science. The present study furnishes various implications, which if properly appreciated, can go a long way in appraising the position relating to various components of science education. It could also provide the much needed basis for its vitalization and improvement.

The scope of the study is limited to examine the extent of relationship of:

(i) the select context variables, comprehensive science process measures and achievement in science, using basically the correlation technique on a sample of secondary school students of Kerala.
(ii) the instructional preferences of the secondary school science teachers of Kerala in relation to teaching experience, the number of in-service courses attended and the laboratory facilities available at school.

Other delimitations are:

(a) Among the various science processes listed in literature, those thirteen science process skills as envisaged by AAAS were selected for the study.

(b) Among the various components of instructional preferences of the science teachers, those components which are considered vital based on the principles of constructivism and a learner-centred, activity-based and process-oriented pedagogy were selected and the development of the teachers’ tool- STIPAS was delimited based on them.

Organization of the report

The study has been reported in seven chapters with contents as detailed below:

Chapter 1: Introduction

The chapter is an introduction to the report, highlighting the background, need and significance of the study, statement of the problem, definition of key terms, hypotheses, objectives of the study, methodology in brief and scope and limitations of the study.

Chapter 2: Conceptual Review

The chapter deals with a conceptual review of science education and related areas envisaged in the study.

Chapter 3: Review of Related Literature

The chapter contains a review of related studies classified under various titles.
Chapter 4: Methodology
The chapter describes the methodology of the study, tools developed and validated for the study, details of the sample used for the study, data collection procedures, administration and scoring of the tools and statistical techniques used for the analysis of data.

Chapter 5: Analysis and Interpretation
The chapter provides a detailed analysis and interpretation of the collected data.

Chapter 6: Overview of the study, findings and Suggestions
The chapter contains a brief overview of the study, summary of the findings and tenability of the hypotheses.

Chapter 7: Conclusion:
The chapter covers implications of the study, limitations and suggestions for further research.