INFLUENCE OF COGNITIVE STYLE INTELLIGENCE AND CLASSROOM CLIMATE ON PROCESS OUTCOMES IN SCIENCE OF SECONDARY SCHOOL PUPILS OF KERALA

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DOCTOR OF PHILOSOPHY

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DECLARATION

I, Aruna P.K., do hereby declare that this thesis, **INFLUENCE OF COGNITIVE STYLE INTELLIGENCE AND CLASSROOM CLIMATE ON PROCESS OUTCOMES IN SCIENCE OF SECONDARY SCHOOL PUPILS OF KERALA** has not been submitted by me for the award of a Degree, Diploma or Recognition before.

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CERTIFICATE

I, Dr. P. Usha, do hereby certify that this thesis entitled **INFLUENCE OF COGNITIVE STYLE INTELLIGENCE AND CLASSROOM CLIMATE ON PROCESS OUTCOMES IN SCIENCE OF SECONDARY SCHOOL PUPILS OF KERALA** is a record of bonafide study and research carried out by **Aruna P.K.**, under my supervision and guidance and that it has not been previously formed the basis for the award of a Degree, Diploma or Recognition.

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CHAPTER 1

INTRODUCTION

2

INTRODUCTION

Education is a product of experience. It is the process by which and through which the experience of the race, i.e., knowledge, skills and attitudes are transmitted to the members of the community. Life involves a constant and continuous modification of experiences. Education should help the child to adjust to this changing world. The aim of education has varied from race to race and generation to generation but the main point of emphasis has been on the mental and physical growth of the individual. The child is subjected to certain experiences that are intended to modify his behaviour for proper adjustment to a changing environment.

We are living in an age of Science and all our activities are controlled and governed by Science. Science has helped man to acquire supremacy over nature. It has brought about a lot of achievements and it has added to the comforts and pleasures of man kind. Science has transformed the very structure of the society and it form the very basis of development of personality.

Science which has so much of importance in life, cannot be denied an important place in the school curriculum. Teaching of science helps the students to solve the problems which encounter them in real life and so it must be given an important place in school curriculum (John, *et al.*, 1975).

The progress, welfare and security of the nation depends critically on a rapid, planned and sustained growth in quality and extent of education and research in science and technology. The Indian Education Commission (1964-66) has pointed out that "There is ofcourse one thing about which we feel no doubt or hesitations, education – science based and in coherence with Indian culture and values can alone provide the foundation as also the instrument for nations progress, security and welfare." But the contemporary system of education has become mechanical as it stuffs the young minds with dry information leaving little scope for independent thinking. It hardly sharpens creativity and fails to provide a climate of innovation and critical attitude development.

Scholastic achievement was initially considered to be the main function of cognitive constituents of personality, for example intelligence and aptitude. It is an established fact that cognitive entry behaviours, affective entry behaviours, quality of Instruction etc. will determine the nature of educational outcomes. Researchers in late 1970's pointed out that students differ in quality of what they had learned and understood (Entwistle and Robinson, 1976). Achievement in school subjects especially science is directly related to many factors such as personal, psychological, social and academic factors which includes motivation, cognitive style, personality characteristics, organized climate of school, home environment, etc. Therefore it is imperative to identify and explore various factors related to academic achievement of the learner.

NEED AND SIGNIFICANCE OF THE STUDY

Study of Science has a unique position in any school curriculum. The investigator being a Science teacher has often felt that many of the psychologically sound and talented students do not achieve high in examination. Primarily this motivated to conduct a study on the outcomes of Science and the role of certain student and school variables on it.

The importance of academic achievement has raised several important questions for educational researchers. What factors promote achievement of students? How far do different factors contribute towards academic achievement? Many of the factors have been hypothesized and researched by researchers. The factors identified are summarized as below:

i) Student characteristic like cognitive style, intelligence, attitude, aptitude, motivation, interest, carrier aspiration etc.

ii) School Environment covering classroom environment, peer interaction, type of curriculum and co-curricular activities provided in school, teacher pupil relationships, attitude of parents towards education etc.

iii) Socio familial characteristic like parents income, cultural level, home environment for study, parental aspirations.

The field of cognitive science is contributing significantly to the research and theory of learning and to the development of intelligent tutoring system. Mostafa (1985) has reported that there was significant differences in achievement in science and level of cognitive development. The cognitive style has been used to denote different ways in which children and adults perceive and categorise their environment in particular situation. Cognitive styles are typically represented as polar opposites of a single dimension such as Focusing/Scanning (Bruner, 1956), reflectivity/impulsivity (Kagan, 1960), Field Dependent/ Field Independent (Witkin, *et al.*, 1977).

Briel (1978), Sharma and Ahuja (1982), Faqua (1990), Verma and Saikh (1993) examined the relationship between cognitive style and scholastic achievement and found significant relationship. Field Independent children are more likely to be more successful in dealing with situation that relate logical analysis (Moos and Belins, 1986).

Witkin (1980) found positive relationship between Field Independent, Intelligence and school achievement. Cognitive Styles have been found to relate to intellectual and perceptual performance (Coop and Sigel, 1970). Cognitive Style influences acquisition of new materials as well as utilization of already acquired knowledge (Kagan, *et al.*, 1964). So the child's Cognitive Style is significantly involved in information processing in general. Linn (1978) found that Field dependent/Field independent is associated with logical reasoning. Significant differences in achievement as a function of cognitive style were also established (Halpin and Peterson, 1986; Kumar, 1993). Studies have also revealed that there is no relationship between cognitive style and Achievement in Science (Ritchey and Lashier, 1981; Kumar, 1993; Kumar, 1995). Suresan (1997), Sajitha (2002) reported significant relationship between process outcomes in science and cognitive style. The positive and negative relationship shown by different studies have rendered conflicting results. The review of related studies also revealed that studies relating to Process Outcomes in Science and Cognitive Style are very few. So the investigator felt the need to examine how achievement of secondary school pupil is associated with their Cognitive Style.

The wave of Intelligence research pioneered by Binet and Simon (1936) and others lead to considerable volume of researches both in India and in Western countries mainly exploring the relation of Intelligence with major psychological variables introversion, extroversion, self concept, adjustment and like. A study was conducted by Jha (1974) in which achievement in Science has been found significantly correlated with general intelligence. Research studies also revealed the relation of creativity with intelligence (Phataak, 1962; Sharma, 1971; Patel and Joshi, 1978; Sameeda, 1982; Sumangala, 1986; Qureshi, 1990; Paramesh and Narayanan, 1993). Some studies found (Wallach and Kogan, 1965; Cropley, 1967) a combination or interaction of two cognitive abilities viz., Intelligence and creativity on achievement. This warranted an interaction study of intelligence with cognitive style.

Classroom environment plays an important role in the effectiveness of classroom teaching. In the case of an environment which can provide cognitive nourishment and intellectual stimulation can aid development. Classroom climate implies a measure of quality and quantity of cognitive, creative and social support that has been available to subject during school life in terms of teacher pupil interaction. The classroom climate includes the emotional, physical and intellectual climate set up by the teacher and students to create a wholesome learning situation. Research evidences show that classroom environment and achievement were closely related. Puri (1977), Christian (1984) and Mianov (1991) studied Classroom Environment and its relationship with Achievement. Association between Classroom Climate and elementary school students Achievement was explored by Fraser and O'Brien (1985). Many research findings revealed that achievement is significantly and positively related to Classroom Climate. Achievement in Science is positively and significantly correlated with Classroom Climate (Remand *et al.*, 1993; Henderson *et al.*, 1995; Suresan, 1997; Smitha, 2002). Classroom Climate was seen negatively correlated with Process Outcomes in Science (Muraleedharan, 1997; Reema, 2002). The above review has inspired the investigator to select Classroom Climate as one of the independent variable for the present investigation.

Science as a teaching subject, possesses various values as any other subject for which it is included in the curriculum as a teaching subject. Teaching of science has become an unavoidable part of general education. The qualities imbibed by the learner through learning science are valuable for a citizen living in a society. The study of science imparts training in 'Scientific Method' and develops 'Scientific Attitude' in the learner. Research reports reveal that learner involvement had a significant effect on Achievement (Pine, 1980).

In the revised secondary school curriculum, science is having an important role in the intellectual development of child. Until recent times, science was considered a collection of knowledge, an array of facts, symbols, equation and formulae or content. The concept of that science is a process and product, though not a new idea, emerged only recently. The new concept does not overlook the older view point that science means context, but it holds that it is only a part of science. The other aspects include the methods scientists used to gain knowledge and attitudes involved in their behaviour. The two aspects what scientists know and what they do are often described as 'Subjects' and 'Method' or 'Product' and 'Process'. Achievement in Science includes Achievement in Product and Process Outcomes in Science (Klopfer and Oburn, 1971). A brief overview of related studies reveal that researches on Process Outcomes in Science has not yet come up to the expected number as in the developed countries.

Further surveys of Indian research (Buch, 1986, 1991), revealed that though there are large number of studies investigating relation between psychological variables and achievement the investigator cannot locate adequate studies dealing with Cognitive Style, Intelligence and Classroom Climate and their influence on Process Outcomes in Science independently and in combination. This made the investigator to carry out the research work on the effects of Cognitive Style, Intelligence and Classroom Climate on

Process Outcomes in Science. Apart from the above mentioned works, there are no attempts of investigation and so present attempt of the investigator is justified to be a different one.

1.2. STATEMENT OF THE PROBLEM

The problem for the study is entitled as "INFLUENCE OF COGNITIVE STYLE INTELLIGENCE AND CLASSROOM CLIMATE ON PROCESS OUTCOMES IN SCIENCE OF SECONDARY SCHOOL PUPILS OF KERALA" ~~STATE~~."

1.3. DEFINITION OF KEY TERMS

The key terms used in the statement of the problem are defined in the following part.

1.3.1. COGNITIVE STYLE

Cognitive Style is the characteristic self consistent mode of functioning which individuals show in their perceptual and intellectual activities (Witkin, *et al.*, 1977).

Cognitive Style is an individual's characteristic and consistent approach organising and processing information (Tennant, 1988).

1.3.2. INTELLIGENCE

Intelligence is the application of cognitive skills and knowledge to learn, solve problems, and obtain ends that are valued by an individual or culture (Gardner, 1985).

As used in the study Intelligence is to judge well, comprehend and to reason well.

1.3.4. CLASSROOM CLIMATE

Classroom Climate for science learning is defined as the atmosphere and general environment in classroom that may help or hinder the learning process (Hawes and Hawes, 1982).

1.3.5. PROCESS OUTCOMES IN SCIENCE

The term 'Process Outcomes' as applied to science stands for intellectual skills needed for scientific investigation attained by the students as a result or consequence of learning science.

1.3.6. SECONDARY SCHOOL PUPILS

The term refers to pupils studying in class VIII, IX and X of recognized schools of Kerala State. In the present study standard IX pupils were selected because they are the true representative pupils of secondary school classes.

1.4. VARIABLES SELECTED FOR THE STUDY

The variables selected for the study are categorized as Independent and Dependent variables and are presented below.

1.4.1. INDEPENDENT VARIABLES

The Independent Variables selected for the study are:

i) Cognitive Style
ii) Intelligence
iii) Classroom Climate

1.4.2. DEPENDENT VARIABLE

Process Outcomes in Science is treated as Dependent Variable for the present investigation.

1.4.3. BASAL VARIABLES

Basal variables selected for the study are Sex, Locale and Type of Management of Schools.

1.5. OBJECTIVES

The present study has the following objectives.

1.5.1. To compare the mean scores of Independent Variables **Cognitive Style, Intelligence, Classroom Climate** and the Dependent Variable **Process Outcomes in Science** between the sample of Boys and Girls in the Total sample.

1.5.2. To compare the mean scores of Independent Variables **Cognitive Style, Intelligence, Classroom Climate** and the Dependent Variable **Process Outcomes in Science** between the sample of Rural and Urban in the Total sample.

1.5.3. To compare the mean scores of Independent Variables **Cognitive Style, Intelligence, Classroom Climate** and the Dependent Variable **Process Outcomes in Science** between the sample of Government and Private in the Total sample.

1.5.4. To estimate the relationship between Independent Variable **Cognitive Style** and the Dependent Variable **Process Outcomes in Science** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Private and Government.

1.5.5. To estimate the relationship between Independent Variable **Intelligence** and the Dependent Variable **Process Outcomes in Science** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Private and Government.

1.5.6. To estimate the relationship between Independent Variable **Classroom Climate** and the Dependent Variable **Process Outcomes in Science** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Private and Government.

1.5.7. To estimate the relationship between Independent Variables **Cognitive Style** and **Intelligence** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

1.5.8. To estimate the relationship between Independent Variables **Cognitive Style** and **Classroom Climate** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

1.5.9. To estimate the relationship between Independent Variables **Intelligence** and **Classroom Climate** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

1.5.10. To study the main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils for Total Sample.

1.5.11. To study the main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils for Boys Sample.

1.5.12. To study the main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom**

Climate on **Process Outcomes in Science** of Secondary School Pupils for Girls Sample.

1.5.13. To study the main and interaction effects of **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils for Rural Sample.

1.5.14. To study the main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils for Urban Sample.

1.5.15. To study the main and interaction effects of **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils for Government Sample.

1.5.16. To study the main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils for Private Sample.

1.5.17. To predict High, Average and Low groups of **Process Outcomes in Science** using select set of Independent Variables (Discriminating Variables) **Cognitive Style, Intelligence** and **Classroom Climate**.

1.6. HYPOTHESES

The hypotheses formed and tested are the following.

1.6.1. There will be significant difference in the means scores of Independent Variables **Cognitive Style, Intelligence, Classroom Climate** and the Dependent Variable **Process**

Outcomes in Science between the sample of Boys and Girls in the Total sample.

1.6.2. There will be significant difference in the means scores of Independent Variables **Cognitive Style, Intelligence, Classroom Climate** and the Dependent Variable **Process Outcomes in Science** between the sample of Rural and Urban in the Total sample.

1.6.3. There will be significant difference in the means scores of Independent Variables **Cognitive Style, Intelligence, Classroom Climate** and the Dependent Variable **Process Outcomes in Science** between the sample of Government and Private in the Total sample.

1.6.4. There will be significant relationship between Independent Variables **Cognitive Style** and the Dependent Variable **Process Outcomes in Science** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

1.6.5. There will be significant relationship between Independent Variables **Intelligence** and the Dependent Variable **Process Outcomes in Science** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

1.6.6. There will be significant relationship between Independent Variables **Classroom Climate** and the Dependent Variable **Process Outcomes in Science** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

1.6.7. There will be significant relationship between Independent Variables **Cognitive Style** and **Intelligence** in the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

1.6.8. There will be significant relationship between Independent Variables **Cognitive Style** and **Classroom Climate** in the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

1.6.9. There will be significant relationship between Independent Variables **Intelligence** and **Classroom Climate** in the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

1.6.10. The main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils will be significant for the Total sample.

1.6.11. The main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils will be significant for the Boys Sample.

1.6.12. The main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils will be significant for the Girls sample.

1.6.13. The main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils will be significant for the Rural sample.

1.6.14. The main an interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils will be significant for Urban Sample.

1.6.15. The main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils will be significant for Government Sample.

1.6.16. The main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils will be significant for Private Sample.

1.6.17. High, Average and Low groups of **Process Outcomes in Science** can be predicted using Independent Variables (Discriminating Variables) **Cognitive Style, Intelligence** and **Classroom Climate**.

1.7. METHODOLOGY

The methodology of present study is outlined as below.

1.7.1. SAMPLE

The present study is conducted on a representative sample of 1000 pupils of standard IX of secondary schools of Quilon, Alapuzha, Ernakulam, Kottayam, Kozhikode and Malappuram revenue districts of Kerala representing South, Central and North Kerala. The sample was selected by proportionate stratified sampling technique, giving due representation to factors like sex, locality of students and management category of the schools.

1.7.2. TOOLS USED

All the variables were measured using standardized tools of acceptable reliability and validity. For Cognitive Style and Intelligence the investigator used available standardized tools. Scale of Classroom Climate was developed and standardized by the investigator. Test of Process Outcomes in Science was developed and standardized by investigator. The tools used are the following.

1.7.2.1. Group Embedded Figures Test (GEFT) (Oltman *et al.*, 1971).
1.7.2.2. Standard Progressive Matrices Test (SPMT) (Raven, 1958).
1.7.2.3. Scale of Classroom Climate (SCC) (Usha & Aruna, 1999).
1.7.2.4. Test of Process Outcomes in Science (TPOS) (Aruna, 1999).

1.7.3. STATISTICAL TECHNIQUES USED

The main statistical techniques employed for the present investigation are given below.

1.7.3.1. Preliminary Analysis like Mean, Median, Mode, Standard Deviation, Quartile Deviation, Skewness and Kurtosis.

1.7.3.2. Two tailed Test of Significance of Difference between Mean Scores of Large Independent Samples.

1.7.3.3. Pearson's Product Moment Coefficient of Correlation.

1.7.3.4. Three way ANOVA with 3x3x3 Factorial Design.

1.7.3.5. ANOVA followed by Scheffe' Test of Post-hoc comparison.

1.7.3.6. Discriminant Function Analysis (Direct Method).

1.8. SCOPE AND LIMITATIONS OF THE STUDY

The main purpose of present investigation is to explore how 'Cognitive Style', 'Intelligence' and 'Classroom Climate' influence

'Process Outcomes in Science' of Secondary School Pupils. For this study, appropriate tools available as well as constructed by investigator were used. With the help of appropriate tools, the required data were collected from a stratified random sample of 1000 secondary school pupils from schools of Kerala state to make the study more objective and precise. The study was conducted among the pupils of standard IX for practical reasons and assuming that it is representative of secondary school children viz., standard VIII, IX and X. Analysis of the data was done with utmost care. Since the sample for the study includes various sections from different districts, the results can be generalized. The inference of the study may provide valuable suggestions for educators and parents.

Even though possible precautions were taken to obtain reliable and generalisable results, some of the limitations likely to occur in the study are:

1.8.1. There may be many factors affecting Process Outcomes in Science, the present study was confined to one environmental variable (Classroom Climate) and only the developmental aspect of Cognitive Style (Field Dependent/Independent) and Intelligence. The effect of other variables on Process Outcomes in Science was not included.

1.8.2. The Selection of Dependent Variable has been restricted to 'Process Outcomes in Science.'

1.8.3. Due to Practical difficulties component wise analysis of the Independent Variables and Dependent Variable were not attempted.

1.8.4. Population for study was limited to standard IX students of secondary schools.

1.8.5. Selection of a few school across the state intended for data collection may not be representative of all institutions in the state.

1.8.6. Eventhough the population of the present study comprise of all the secondary school pupils of Kerala, the sample for the study was confined to six districts of Kerala viz., Kollam, Alapuzha, Kottayam, Ernakulam, Malappuram, Kozhikode, for practical reasons.

1.9. ORGANISATION OF THE REPORT

The report has been presented in five chapters as follows:

Chapter I. This chapter of the report contains a brief Introduction of problem, Need and Significance of Study, Statement of problem, Definition of the key terms, Variables, Objectives, Hypotheses, Brief methodology, Scope and Limitation of the study and organization of the report.

Chapter II. It gives the theoretical outline of the important concepts of the study and reviews of the related studies. A summary of the related literature is also presented.

Chapter III. Methodology of study was described in detail consisting of the description of the Tools employed, Variables, Objectives, Hypotheses, Sample, Data Collection Procedure, Scoring and Consolidation of data and Statistical techniques used for the analysis of data.

Chapter IV. Details of analysis of data along with conclusions and interpretations of the results are presented in this chapter.

Chapter V. Provides a summary of study along with major findings, Tenability of Hypotheses, Suggestion for improving educational practice and Suggestion for further research in the area concerned.

REVIEW OF RELATED LITERATURE

Aruna P.K. “Influence of cognitive style intelligence and classroom climate on process outcomes in science of secondary school pupils of Kerala ” Thesis. Department of Education , University of Calicut, 2004

CHAPTER 2

REVIEW OF RELATED LITERATURE

REVIEW OF RELATED LITERATURE

Review of related literature is an important part of any research. Review of related literature allow the researcher to acquaint oneself with current knowledge in the area of study. The major variables selected for the study are Cognitive Style, Intelligence and Classroom Climate besides the dependent variable Process Outcomes in Science.

The literature reviewed in the present study has been classified into the following headings.

2.1. THEORETICAL OVERVIEW OF THE VARIABLES

2.1.1. COGNITIVE STYLE
2.1.2. INTELLIGENCE
2.1.3. CLASSROOM CLIMATE
2.1.4. PROCESS OUTCOMES IN SCIENCE

2.2. RELATED STUDIES PERTAINING TO THE VARIABLES

2.2.1. STUDIES ON COGNITIVE STYLE
2.2.2. STUDIES ON INTELLIGENCE
2.2.3. STUDIES ON CLASSROOM CLIMATE
2.2.4. STUDIES ON PROCESS OUTCOMES IN SCIENCE

A detailed description of each of these subsections are the following.

2.1. THEORETICAL OVERVIEW OF THE VARIABLES

This section of the review deals with the theoretical aspects related to the Independent variables - Cognitive Style, Intelligence, Classroom Climate and the Dependent variable Process Outcomes in Science.

2.1.1. COGNITIVE STYLE: THEORETICAL OVERVIEW

Psychologists and educationists have long known and studied the individual difference among students in given classroom. They have looked at a number of personality, cognitive and intellectual factors that might explain the variation found in any group of learners. One of the important concept studied in this area has been an information processing variable called cognitive style, term used to refer to the consistency of patterning that individuals show in responding to various types of situation.

Riding, Glass and Douglas (1993) termed Cognitive Styles as "a fairly fixed characteristic of an individual and are static and relatively inbuilt features of the individual".

Different aspects of Cognitive Styles include Field Dependence Vs. Field Independence (Witkin, 1962), Global Vs. Analytical (Kirby, 1988), Objective Vs. Non objective (Leithwood and Montegomery, 1982), Organizer Vs. Non organizer (Atman, 1988), Right Vs. Left brained (Torrance and Rockenstein, 1988), Simultaneous Vs. Successive (Das, 1988), Holist-analytic Vs. Verbal-imagery (Riding and Cheema, 1991), Kolb's Learning Style model (Kolb, 1984), as well as the MBTI learning style model (Lawrence, 1984). In addition, Cognitive, Learning Styles in the literature have been viewed in three major respects – structure, process, or both structural and process (Tennant, 1988; Riding and Cheema, 1991).

Kagan *et al.* (1963) defined cognitive style as the term that refers to stable individual preferences in mode of perceptual organisation and conceptual categorisation of the external environment. The Kagan (1963) group defined these specific stylistic modes as follows. Descriptive - Analytic, Relational and Categorial - Inferential. A descriptive - analytic response reflects the tendency to clarify the item on the basis of objectives, observable that one part of the total stimulus situation. Relational contextual responses occur when items are grouped together on the basis of functional, temporal or spatial contiguity. The inferential categorical classification is illustrated by an individual who chooses to form his categories on the basis of inferences made about the objects he groups together.

A second major concept of cognitive style is presented by Witkin, *et al.* (1962). Witkin (1962) describes a cognitive style based on an analytic global continuum. It determines the extent to which individuals are able to overcome the effects of distracting background elements (Field) when they are attempting to differentiate relevant aspects of a particular situation.

A third school of thought in the area of cognitive style is the work of Gardner *et al., (*1960). Here the notion of cognitive style encompasses a number of different principles all of which function to assist the individual in adapting to a complex environment. They are levelling, sharpening, equivalence range, focal attention and constructed versus of flexible control.

A fourth perspective of cognitive style is that of Broverman (1960) who conceptualises Cognitive style as expressions of different response probabilities or response strength in certain types or classes of behaviour.

In the last few decades numerous approaches have been advanced to study the cognitive style. Among them Witkin's Field-Independent and Field-Dependent cognitive style dominated. The cognitive style for the present study is the Field Independent and Field Dependent (FI-FD) dimensions of Witkin (1954).

According to Schmeck (1988), there are two basic types of learning styles. One is global-holist/field dependent/right brained, the other is focused-detailed/field independent/left brained.

According to Riding and Cheema (1991) Learning Styles have two basic types of independent dimensions. One is holist-analytic dimension. The holist tend to view a situation as a whole, while the analytics tend to view a situation as a collection of parts and often stress one or two aspects at a time.

According to Sonnier (1991) left-hemispheric students are strong in analytical thought processing, while right hemispheric students are visual processors.

Kolb's (1984) model has been found to be effective in some language teaching activities. According to Kolb (1984) the four basic learning models are active experimentation (AE), reflective observation (RO), concrete experience CE) and abstract conceptualisation (AC). Based on four basic learning models, there are four learning styles: converger, diverger, assimilator and accommodator.

2.1.1.1. Field-Independent and Field Dependent Cognitive Style (FI/FD)

Field-Independent and Field Dependent was introduced into psychology by Witkin (1954). Witkin (1962) described a cognitive style based on analytic global continuum. He determines the extent to which individuals are able to overcome the effects of distracting background elements (field), when they are attempting to differentiate relevant aspects of a particular situation. The more independent the person is from the distracting elements, the more analytic he is said to be, conversing the more dependent or incapable the individual is of being faced from the distracting elements, the more global. People who are able to operate in an analytic manner are said to be Field Independent and people who operate in the more global manner are called Field-Dependent.

Witkin's notion of cognitive style has indicated that Field-Independent individuals tend to be analytic in intellectual approach emotionally independent, high achievers and active and controlling their environments rather than being controlled by them. Field Dependent individuals tend to be the opposite.

In Interpersonal relation Field-Dependents are more sociable, prefer to be physically close to others and have well developed sets of social skills. Field-Independent tend to be more impersonal do not appear to be very interested in others and prefer non social situation (Witkin and Good Enough, 1977). Persons who are perceptive in a Field-Dependent fashion are likely to have such global defences as repression and denial, suggestive of limited differentiation, where as Field independent perceives tend to be specialised defences as intellectualisation and isolation, suggestive of developed differentiation (Witkin *et al.,* 1967). Field independent persons enjoy individualised learning, while field dependent ones enjoy cooperative learning (Witkin *et al.*, 1977).

The test taking and looking behaviour of the children suggested that Field-Dependents were more disrupted by an unfavourable emotional climate than were Field Independents. The dependent group appear to be mere externally directed in the sense that their cognitive, affective behaviour is differentially influenced by the positive or negative social ones emitted by other (Kagan and Kogan, 1970).

Witkin *et al.* (1967) reported that field independent tends to increase with age up to seventeen with no further change from seventeen to twenty four.

2.1.1.2. Implication of Cognitive Style for Education

Cognitive styles have been related to intellectual and perceptual preferences (Coop and Sigel, 1970). Children who are Field Independent can decide how to act on their own. Field Dependent children experience difficulty in locating embedded figures. Field Independent children are more analytic and structural in their thinking likely to be more successful in dealing with situation that related logical analysis (Moos and Belins, 1986).

For Kagan *et al.* (1963) Descriptive Analytic styles are related to personality, social and intellectual characteristics. Sex differences were found, without employing more relational - contextual ones. Children who are reflexive make fewer errors in reading (Kagan, *et al.* 1964). Levelling and Sharpening is related to memory and attention (Kagan and Kogan, 1970). Given these possibilities the teacher has to consider cognitive style when evaluating behaviour and performances in academic and non academic areas. If children are having difficulty in grasping materials it could be due to child's style or discrepancy between the teacher's style and that of the child. To aid the child, the teacher has to have some idea to accomplish the alternative objective- to facilitate child learning. Cognitive styles influence acquisition of new materials as well as utilisation of already acquired knowledge (Kagan, *et al.*, 1964) have shown that children's learning of concept is related to style.

The child's cognitive style is significantly involved in information processing in general. Given this knowledge, how is, teacher to use it? The teacher can diagnose the child's style by first setting on a concept that has demonstrated maximal educational utility. Observational analysis of children's behaviour can prove very productive, especially as expressed in oral and written work. Recall that cognitive style cannot be dealt with independently of material. Thus the particular preference may be more readily apparent in some contexts than others.

Modifiability of Cognitive Style

Efforts have been expanded the influence style, especially when conceptualised according to Kagan or Sigel's definition. Baivid and Bee (1969) attempted to increase the frequency of analytic and nonanalytic responses by social reinforcement. Several studies indicate that predisposition for reflecting impulsivity can be modified (Kagan, Pearson and Welch, 1966; Yardo and Kagan, 1968).

Although little is known about the psychodynamic and organises of cognitive style, a notable exception is a study of relationship between child rearing and cognitive style (Witkin, *et al.*, 1962). Witkin suggests that cognitive style of Field Independence and Field Dependence are in part a function of child rearing practices. Mother of Field Independent children provide more differentiating experiences and create distance between themselves and children more frequently than mothers of Field-Dependent children.

Education always involves modifications, and if cognitive styles may be modified in course of education, it can be argued that such changes are usually serendipitous and not deliberate or planned. They occur in the service of other objectives. If education is in the business of contributing to the development of effective learners, then it has to be in business of modifying cognitive styles.

2.1.1.14. Application of Cognitive Style to the Classroom Diagnostic - Prescriptive Application

Since cognitive styles are evident in a variety of tasks, it becomes important to examine the preferences of the student in relations to his cognitive style. Observing the type of errors students made on formal tests is a needily available method for the teacher to do this. It may be noted that some students fail to make five discrimination between discrete parts of a factual problem. Such failures are many times written off as careless errors. But it may be that they are not carelessness at all; rather they may reflect the students basic orientation found the problem stimuli. In other words, is making a diagnosis, one must discover what the child's predominant orientation is. In this example, one source of variation in performances can be identified. The students begin to learn that various types of responses can be relevant depending on particular situations. For the teacher such an approach can reveal the range of information the various students possess and how they can use it. A variety of teaching strategies can be developed with this format, ranging from inquiry approach to asking the students to elaborate their responses, justify their responses or extend their responses (Siegel and Olmsted, 1970).

Curriculum Organisation

Curriculum should be considered in the context of cognitive style. If strategies are to be learned, there are at least two levels at which curriculum can be considered, one is emphasis on the learning of strategies to solve particular classes of problem for example, science, mathematics, social studies. There is also evidence that acquisition of concepts is related to style when Analytic concepts are learned by children with Analytic style preferences. (Kagan, *et al.* 1964). Curriculum can be organised on a descriptive level (for example, organising factual information) and on an Inferential level (for example, organizing factual data into generalizations). In effect, if curriculum information and cognitive styles are modes of processing information, the relationship is between the materials to be processed and modes or strategies for processing certain classes of material.

Learner/teaching styles are one of the several important factors to be considered by the designers and teachers for teaching learning process. Learner styles should be considered in four major instructional stages: (1) Instructional planning () Learning environment construction (3) Teaching method selection and (4) Evaluation administration.

In Instructional planning teacher should use appropriate cognitive style instruments to measure and identify the student's cognitive styles either before start of the first class or in the first class. Terminal objectives should be comprehensive to meet the cognitive style of all students. After identifying students cognitive styles, the teacher should make a full preparation for the match between cognitive styles and instructional contents, methods and styles. Learning environment construction and provide individualised learning to Field Independent and cooperative learning to Field Dependent ones.

2.1.1.5. Relationship of styles to teachers' behaviour

Teachers too have their own stylistic pattern of responding to and categorising information. Those who were Descriptive-Analytic remembered more details in sequential order. This is in contrast to those who were Relational in their approach, they tended to respond in a more global condensed way omitting the details, they tended to reorganize the sequence of the story. The cognitive style of the teacher becomes a relevant variable influencing professional behaviour.

2.1.1.6. Measurement of Field Dependent Field Independent Cognitive Style

A variety of tests have been used to measure the characteristics of cognitive style. The important and commonly used measure of Field Dependent/Field Independent are Embedded Figures Test (EFT) Rod - and - Frame test (RFT). These tests were developed by Witkin *et al.* (1954).

Different forms of Embedded Figures Test are

1) Embedded Figures Test (EFT) developed by Witkin, *et al* (1971) in which the subject is asked to locate simple figures from a complex figure.

2) Group Embedded Figures Test (GEFT) was developed by Oltman, *et al.* (1972) for group administration. The subject task is to find out the simple form in complex figures. This test has eight simple geometric forms that are embedded with in more complex stimulus pattern. The scores range from 0 to 18 correct, with higher scores suggesting more field independent functioning.

3) Children's Embedded Figures Test developed by Carp and Konstadt (1977). The children's version of EFT is used to measure the cognitive style of children in 5-9 age range. As in EFT the subject from which the simple figures correctly identified.

2.1.2. INTELLIGENCE - THEORETICAL OVERVIEW

The term intelligence is hypothetical in nature. Psychologists have been interpreting the term in different ways and are in disagreement on the meaning of the term Intelligence. In psychological literature, Intelligence has been treated as a hypothetical construct and no one knows what intelligence is. Several definitions have been advanced by psychologists but no two psychologists agree on single definition of term.

Definition

A number of definitions have been evolved by psychologists according to their own concept of term Intelligence.

(1) Intelligence is judgement, otherwise called good sense, initiative, the faculty of adapting oneself to circumstances. To judge well, to comprehend well to reason well, these are the essential activities of intelligence (Binet, 1905).

(2) Intelligence is to judge well, comprehend well and to reason well (Binet and Simon, 1936).

(3) Intelligence is the aggregate global capacity of the individual to act purposefully, to think rationally and to deal effectively with his environment (Wechsler, 1944).

(4) Intelligence is a fixed inherited cognitive ability (Burt, 1955).

(5) It is the application of cognitive skills and knowledge to learn, solve problems, and obtain ends that are valued by an individual or culture (Gardner, 1985).

The word 'Intelligence' goes back to Aristotle who, as Burt (1955) points out, distinguished ovexis the emotional and moral function from dianola - the cognitive and intellectual functions. The latter word was translated by Cicero as intelligents (inter within, legene to bring together, choose, discriminate). During past century, however there has been a great deal of controversy over its more precise definition.

All the definitions have been systematised by Vernon (1962) and Freeman. Vernon (1966) classified all definition under three main categories. (1) The biological (b) the psychological, (c) the operational. Freeman classified all definitions of intelligences into three categories as (1) Adjustment or Adaptation ability (2) Ability to learn (3) Ability to carry on abstract thinking but his approach differs from Vernon.

Vernon's classification

2.1.2.1. Biological approaches

Biological approaches give importance to the adaptable and versatile character of human beings. Thus intelligence has been defined as capacity for profiting by experiences, adaptation to environment, plasticity or ability to learn. Spencer and Binet (1936) thought of intelligence as an inherited and general capacity. But there are many strong reasons against this biological conception of the nature of intelligence. For example our intelligence tests make no attempts to measure learning capacity of individual. Another reason is that many great men whom we would regard as highly intelligent are not well adapted to physical and social environment.

2.1.2.2. Psychological Definitions

Many psychologists discarded the biological nature of the intelligence. Binet (1905) frankly regarded intelligence as a complex set of qualities, including: (1) the appreciation of a problem and direction of the mind towards its execution (2) the capacity for making the necessary adoptions to reach a definite and (iii) the power of self criticism. Burt (1955) defined intelligence as innate general cognitive ability. Most educational test correlates highly with intelligence tests, but also they depend on how much the individual has been taught and on his retention, which are related with environmental influences. The different views listed overlap considerably and constituted as partial aspect of intelligence.

2.1.2.3 Operational Approaches

Operational approaches describe abstract concept, intelligence in terms of simple observable procedures, such as scores on mental tests. Spearman (1960) believed that intelligence was operational, definable factor which emerged from analysing. The correlation between tests, regardless of particular abilities listed or the theories on which they were based. The best definition that can be given is a rather simple, non specific one, such as 'all round thinking' capacities or mental efficiency or as Burt and Bullard (1958) suggested, general mental ability.

2.1.2.4. Freeman's classification

Three Types: A variety of definition have been given by psychologists, but as a matter of fact, each can be classified into one of three groups.

1) Adjustment or adaptation ability: According to definition of this type intelligence is general mental adaptability to new problems and new situation of life; or otherwise stated, it is the capacity to reorganize one's behaviour patterns so as to act more effectively and more appropriately in novel situations. This the more intelligent person is one who can more easily and more extensively vary his behaviour as changing condition demand: he has numerous possible responses and is capable of greater creative reorganization of behaviour, whereas the less intelligent person has fewer responses and is less creative.

2) Intelligence is ability to learn: According to this definition a person's intelligence is a matter of the extent to which he is educable in the broadest sense. The more intelligent the individual is, the more readily and extensively he is able to learn.

3) Intelligence as the ability to carry on abstract thinking

This means the effective use of concepts and symbols in dealing with situation; especially those presenting a problem to be solved through the use of verbal and numerical symbols. Binet's conception of intelligence belongs largely in this category for he maintained that it is the capacity reason well, to judge well and to be self-critical.

2.1.2.5. Types of Intelligence

Thorndike (1938) has divided intelligent activity into three types: 1) Social Intelligence (2) Concrete Intelligence (3) Abstract Intelligence.

1) Social Intelligence or ability to understand and deal with persons: High social intelligence is possessed by those who are able to handle people well. Adequate adjustment in social situation is the index of social intelligence.

2) Concrete Intelligence or ability to understand and deal with things, as in skilled trades and scientific appliances. This kind of intelligence is measured by performance tests and picture test in which the individual has to manipulate concrete materials.

3) Abstract Intelligence or ability to understand and deal with verbal and mathematical symbols. All tests of intelligence which require manipulations of symbols are tests of abstract intelligence. The role of ability to deal with ideas and symbols (words and numbers) as a measure of concept formation and abstraction is of increasing importance in tests of general ability (intelligence) as age level increases.

2.1.2.6. Psychometric Theories of Intelligence or Factor Analytic Theories and Factor Analytic Models

Psychometric theories of Intelligence seek an understanding of intelligence in terms of the way it is measured through the use of statistical - mathematical techniques called factor analysis. This involves the examination of a matrix of inter-correlation for a set of cognitive tasks standardised test scores on mental ability) to uncover common patterns of individual differences in the performances of these tasks. In psychology, a number of factor analytic, theories are available. The basic assumption of factor analysis is that more similar the scores on two or more tests (high correlation) the more likely these tests measure the same ability. Psychometric theories are otherwise regarded as the Factor Analytic theories also.

Factor analytic theory is in the form of dimensional models with mathematical description of their proportion. Factor analysis used to determine the basic irreducible variables (factors) underlying a large number of inter related variables. When measurements of a large number of variable have been obtained factor analysis reduced them to a smaller number of basic types or factors.

Factor analytic theories analyse the structure of intelligence through the factor analysis technique. The method followed is this, a number of intelligence tests, diverse in character are given to an adequate sampling of the population. The results of each type of test are correlated with those of all others. The coefficient of correlation are then subjected to various techniques of statistical analysis in an effort to discover the external of common ground between them (technically known as communality) and their degree of independence (Freeman, 1971). One deduction from analysis is that tests correlate to the extent of the factors that they share in common. If two tests have no factors in common, their inter correlation is zero.

The particular theory or structure of intelligence reduced from the statistical operation will depend upon the experts interpretation of analysis, and experts differ to some extent in their interpretations.

Theories of Intelligence

Intelligence is one of the most controversial topics in psychology and many theories have been evolved and also failed as a result of the works of researchers and psychologists.

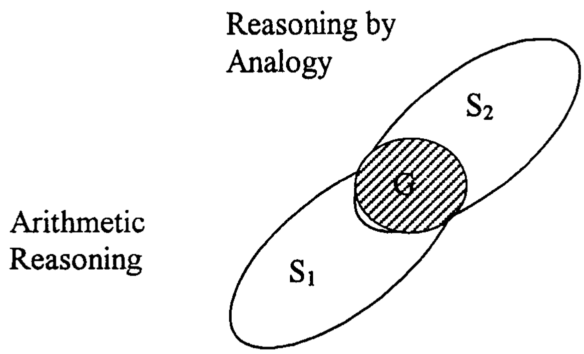
2.1.2.7. Two Factor theory, Spearman's g and s

Spearman (1904) the father of factor analysis is psychology, stated out with the simplest possible factor mode. According to Spearman, all intellectual activity is dependent upon and is expression of a general factor common to all mental activity. This factor designated by the symbol 'g' is possessed by all individuals, but in varying degrees of course since people differ in mental ability (g) and it operates in all mental activity, though in varying amounts. Since mental task differ in respect to their demands upon general intelligence, Spearman (1904) characterised this factor as mental energy, because in the realm of intelligent activity, it is maintained. It has a role similar to that of physical energy in the physical world.

Like all other concepts the general concepts can be observed through psychological tests.

Spearman (1904) postulated the existence of specific factors, called 's' factors, each of which is specific to a particular type of activity. Thus two factor theory states that all mental activities have in common some of general factor 'g', each mental activity be a member of "group" and each has its own specific factors.

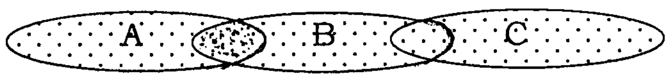
The following diagram explain relationship between 'g' and 's' abilities.



For example, if two intelligence tests, arithmetical reasoning and reasoning by analogy are correlated, each test draws from the same common ability that is the 'g'. Each test has its own specific mental abilities as S_1 and S_2 in the diagrammatic illustration. Since the two tests require a common pool of mental ability to perform specific arithmetical reasoning and reasoning by analogy, the two tests are positively correlated.

2.1.2.8. The Multifactor Theory

Multifactor Theory of intelligence was proposed by Thondike (1938) is an interpretation regarding the nature of mental organization. According to Thondike intelligence is said to be constituted of a multitude of separate factors, or elements, each one being a minute element of ability. Any other mental act involves a number of elements in combination. Hence if performances on this two mental tasks are positively correlated, the degree of correlation is due to number of common element involved in two acts. If two types of mental activities A and B are more highly correlated than A and C, the reason according to the multifactor theory, would be that the first pair has more elements in common than does the second pair. The following diagram explains relationship between A,B,C.



Multiple factor Model

2.1.2.9. The Group-Factor Theory

Prominent among the propagation of this theory was Thurstone (1938). He developed a set of measures called Tests of Primary Mental Abilities. He denied the factor theory and multiple factor theory of Intelligence. Instead the factor analysis interpretations of Thurstone led to the conclusion that certain mental operations have in common a 'primary factor' that gives them psychological and functional unity and that differentiates them from other mental operation. This mental operation constitute a group factor. A second group of mental operations has its own unifying primary factor: a third group has third, and so on. In other words there are a number of groups of mental abilities each of which has its own primary factor, giving the group a functional unity and cohesiveness. Each of the primary factors is said to be relatively independent of others.

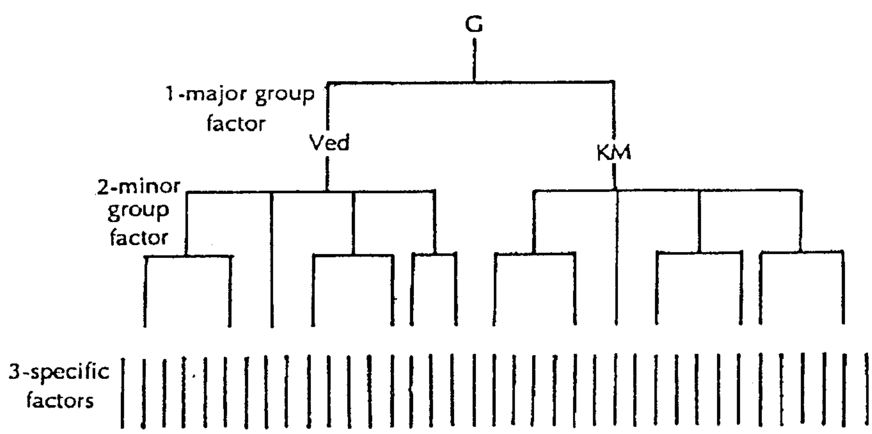
After factor analysis and correlational analysis of a large variety of mental ability test scores, Thurstone and his collaborators developed six primary factors for test design and construction. They are: The number of factor (N), The verbal factor (V), The space factor (S), The word Fluency factor (W), The Reasoning factor (R), and The Rote Memory factor (M).

The weakest aspects of group factor theory was that it discarded the concept of common factor. It did not take Thurstone long to realize his mistake and to reveal a general factor in addition to the group factors.

2.1.2.10. Sampling theory

This model was formulated by Thompson (1939) and he criticised the two factor theory of spearman. Thompson factor analaysed a variety of mental ability test and found that many tests were intercorrelated. Briefly his version that the coefficient of correlation are resulted of common samplings and combination of independent factors. The number of common independent factors utilized by two tests will determine the coefficient of correlation between these two.

2.1.2.11. Vernon's hierarchical theory



The Hierarchical Models (Vernon, 1950)

Vernon (1950) theory proposed that mind is a kind of hierarchy in which 'g' is the most prominent mental ability. Under g are two major factors, v: ed, for verbal - educational, on one hand and k.m. on the other. The latter is called "practical" as the Burt model. The former , v: ed, subdivide into verbal and numerical, while the latter k.m. subdivides three ways, into space ability, manual ability and mechanical information. Beyond these are specific factors, related with minute specific mental abilities.

2.1.2.12. The Hierarchical Model (Burt, 1955)

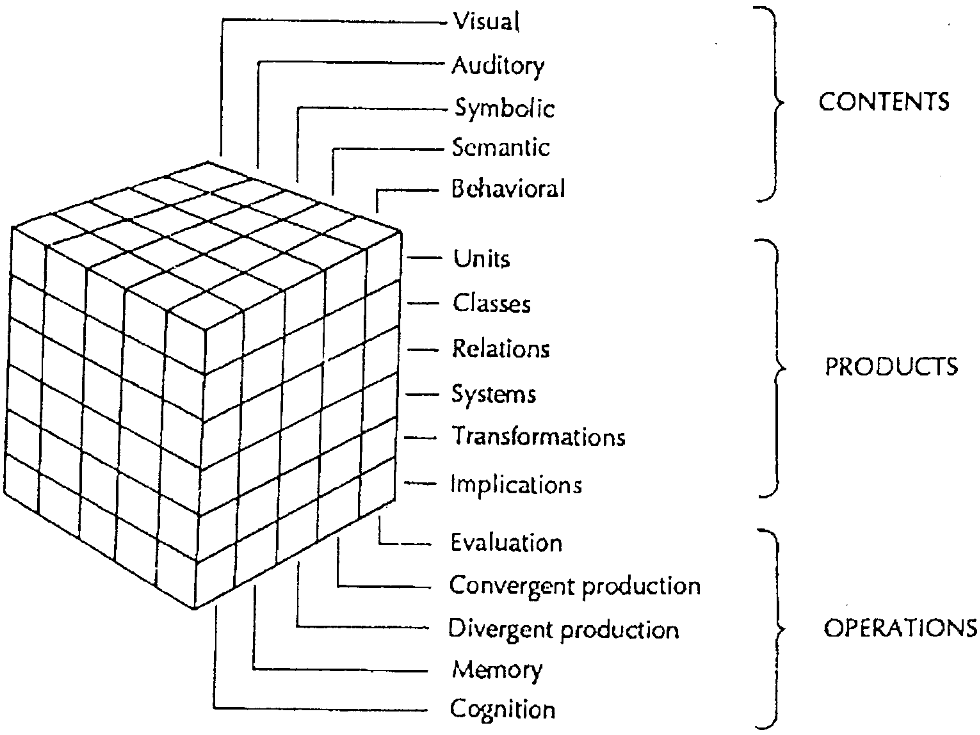
The Hierarchical Models were the elaboration of 'g' factor and group factors. Burt (1955) developed a hierarchical model which is like an inverted tree.

The model applies to whole of human mind, with first major dichotomy between intellectual characteristics, or g, and 'Practical' or behavioural Characteristics. Among the practical abilities he placed psychomotor abilities and abilities for dealing with space and mechanical affairs. The various levels of bifurcation he identified as 'relation' at the highest level, "association" at second level "perception" at third and "sensation" at fourth. At the association level, he recognized a division into memory, with a general retentiveness under which are group factors of visual, auditory, kinaesthetic and verbal - memory factors, and productive association, with a general factor of inventiveness, under which are group factors of fluency and originality. Other general - association factors include ability, language ability and, arithmetical ability, under each of which are two or three subfactors.

2.1.2.13. The structure of Intellect model

Guilford (1958) had cast doubt upon the applicability of hierarchical model, general intelligence and primary mental abilities.

He rejected group factor theory the existence of a few broader group factors and a large number of narrow group factors. Guilford (1958) proposed that the factors appear to be about equally general, being strongly represented by small numbers and many factors of intellect have parallel properties.



Guilford's model of the structure of intellect

Structure of Intellect (SOI) model is not hierarchical in nature instead it visualises human intellectual abilities into a multifactorial one. The model is a three way classification of intellectual abilities namely operations, content and products. According to Guilford, each dimension of intellect is sufficiently distinct which may be detected by factor analysis.

Importance of Intellect model (SOI)

The structure of intellect model of Guilford explained in which ways the intellectual abilities differ from another. The placement of any intellectual factor within the model is determined by its three unique properties, its operation, its content and its product.

The intellect model (SOI) is very useful in constructing psychological tests of various types for different age groups. The SOI is a theoretical model which predicts that there are intellectual abilities, if every cell of model contains a factor.

Guilford (1958) related to other theories, Spearman's fundamentals are SI units; his relation are also SI relation. Spearman's concept of "Eduction of relations" equivalent to cognition of relation. Spearman's conception of "eduction of correlates" belongs in the SI category of convergent production in which relations are concerned.

Other Structural Theories of Intelligence

2.1.2.14. Intelligence A and Intelligence B

Hebb (1949) has pointed out that there are two meanings of word 'Intelligence. 1. Intelligence A - genetic potentiality and 2. Intelligence B - present mental efficiency. Intelligence (A) an innate potential, the capacity for development of a fully minute property that amounts to possession of a good brain and a good neural metabolism. Intelligence (B) the functioning of a brain in which development has gone, on determining an average level of performance of comprehension by partly grown or mature person. Intelligence A: corresponding to genotype, intelligence B; corresponding to phenotype, the result of interaction between genotype and environment. Although there is still controversy regarding the relative influence of nature and nurture, the great majority of psychologists would agree that intelligence measure should not be interpreted as pure inborn ability.

2.1.2.15. Cattel's Fluid and Crystallised Intelligence

Cattel (1963) proposed a theory of intelligence by distinguishing between two types of intelligence, that is fluid intelligence (Gf) and crystallised intelligence (Gc). Fluid intelligence (Gf) is considered to be the mental capacity of an individual which is dependent neurological development and is relatively free from influences of education and culture. It is derived from biological and genetic factors and is less influenced by training and experience.

Crystallised intelligence (Gc) is not function of one's neurological development and therefore is not innate or unlearned like fluid intelligence (Gf). It is learned therefore dependent on education and culture. Crystallised intelligence (Gc) increases through out the life span and is primarily a reflection of one's cumulative learning experiences. It can be identified through one's fund of vocabulary, general knowledge of world affairs, manner of behaving in society, handling of machines and tools, craftsmanship art and computation.

While fluid intelligence (Gf) characterised by relatively high degree of culture, education experience and training-free performance in abstraction, thinking, reasoning and imagination, crystallized intelligence (Gc) is known for its evolution through experience, training and interaction with one's environment over a number of years. That is why it is found to continue to increase throughout one's life span.

2.1.2.16. Horn and Cattell Theory

Horn (1965) proposed that human intelligence comprises at least nine brand Gf-Gc (General fluid-General crystallised) abilities the theory was based on seminal work of Cattell (1941, 1943) who argued that general intellectual ability was of two types: fluid ability and crystallised ability. Fluid ability was concerned as being able to flow into many diverse types of mental activities. In contrast, crystallised ability was presumed to underlie the end product of an individual's exposure to education, training, or other types of experiences. Fluid ability was presumed to consists of basic reasoning and related higher-order mental processes. Crystallized ability, was presumed to reflex the ability of an individual, partly on basis of fluid ability, to learn and benefit from exposure to experiences within one's culture. The following nine broad dimension are involved in Horn-Cattel-Gf-Gc theory. They are Fluid Intelligence, Crystalised Intelligence, Quantitative Ability Long term storage and retrieval, Short term memory, Processing speed, Correct decision speed, Auditory processing, Visual processing.

2.1.2.17. Carroll's conception of Human Intelligence (Three stratum theory)

Carroll (1993) proposed a three-stratum theory that involves the classification of abilities according to the generality of factors across domain of cognitive performances of tasks as well as the level and speed by which these tasks or performances are to be differentiated. The abilities at (Stratum 1) narrow, broad (stratum 2), and general (stratum 3). Narrow, first - stratum abilities are indicative of a large number of specialised abilities presumed to reflect the effects of experience and learning. Broad second stratum abilities are indicative of moderate specialization of abilities and are particularly useful for understanding the breadth and scope of human cognition (fluid intelligence, crystallised intelligence, general memory and learning, broad visual perception, broad auditory perception, broad retrieval ability, broad cognitive speediness, and processing speed). General third stratum ability is indicative of general intelligence that reflects the domination of second-order factors by a third factor.

Intelligence as a Multidimensional Construct

Conception of intelligence as a multidimensional construct have emerged in recent years. Theorists who subscribe to his view consider the internal and external world of the individual. Three theorists who share this view of intelligence are presented.

2.1.2.18. Sternberg's Tiarchic Theory

Sternberg (1985) conceives intelligence as a triarchic construct involving three inter related sub theories, first a componential theory that focuses on cognitive processes that the individual uses in the performances of intellectual tasks. Sternberg (1985) distinguished three classes of processes (a) metacomponents a general, executive - like processes used to plan, monitor and evaluate one's performance on a task; b) performance components, specific processes used in the actual performance of the task c) knowledge - acquisition processes - specific processes used in learning of new words according to Sternberg, the contextual processes in adaptation to, selection and shaping of a red-world context important to one's life. Third the experimental sub theory posits that the individual may are there cognitive processes in situation that require the ability to deal with novel kinds of tasks and ability to automatize the processing of information.

2.1.2.19. The Multiple Intelligence (MI) Theory of Gardner

Gardner (1985) has advocated the theory of multiple intelligence. Gardner challenged the "g" factor and specific factor. He asserted that human intelligence or cognitive competence can be better described as a set of an individual's multiple abilities talents and mental skills related to multiple number of domains of knowledge in a particular cultural setting. Gardner advocated a pluralistic view of intelligence, he concluded that there are eight independent types of intelligence that grow and develop differently in different people, depending upon their hereditary characteristics or environmental experiences. The eight different types of intelligence are the following.

Linguistic Intelligence: This type of intelligence is responsible for all kinds of linguistic competence, ability to use words effectively on both orally and in writing. Linguistic intelligence can be developed by providing things to look at listen to and write about and by creating opportunities for interaction among student and between teacher and students.

Logical-Mathematical intelligence: This type of intelligence is responsible for all types of abilities, related to logic and mathematics. It can be broken down into components like deductive reasoning, inductive reasoning, scientific thinking including solving of logical puzzles, carrying out calculations and using simple machines. Logical mathematical intelligence can be developed by providing manipulation for experimentation with members and by using simple machines or computer programs.

Spatial intelligence is concerned with the ability to sense form, space, colour, line and shape. It includes the ability to graphically represent visual or spatial ideas. Professionals like land surveyors, architects, engineers, mechanics, navigators, sculptures and chess players - who found to rely upon the spatial intelligence in their own way.

Musical Intelligence covers the ability to sense the skills pertaining to the field of music. This includes such skills as ability to recognize simple songs to vary speed, tempo and rhythm in simple melodies. It visible in a quite large proportion in professionals like musicians and composers.

Bodily kinaesthetic intelligence is concerned with the ability to use body or its various parts to perform skilful and purposeful movements. Among professionals, dancers, athletes and surgeons may be seen to demonstrate a high degree of bodily-kinesthetic intelligence in their respective fields.

Intra-personal intelligence: This type of intelligence consists of an individual's abilities to enable him to know his self. The ability to understand one's own cognitive strength, styles and mental functioning as well as one's feelings, range of emotions and skills to utilize one's fund of knowledge in practical situation. This type of intelligence is demonstrated by yogis, saints and masters of Zen.

Interpersonal Intelligence is the ability to understand individuals other than one's self and one's relation to others. The ability to understand another persons moods, feelings, motivation and intentions. This type of intelligence is most visible among psychotherapists, teachers, sales people and politicians.

Naturalist Intelligence is the ability to recognize and classify plants, minerals, animals, including rocks and grass and all variety of flora and fauna.

Out of these eight types of intelligence, the linguistic, logical-mathematical and spatial abilities have been accepted widely as the types and components of intelligence, last five have been the subject of great controversy as to whether they should be categorised as separate types of intelligence or as different talents. The other striking feature and contribution of Gardner's theory of multiple intelligence is its bold declaration that the concept of a measurable 'g' is at best limited and at worst educationally misleading.

2.1.2.20. Ceci's Perspective on Intelligence

Ceci's (1990) perspective on intelligence is both developmental and contextual. In his view, a child is born with a number of biologically constrained cognitive muscles (the biological basis to remember, to classify). They are regulated by some factors within the ecology in which child grows and function as an individual. These experiences set in motion biologically constrained potentials along multiple pathways, each of which has that form the basis of adult Intelligence.

In biotechnological theory there are facets to the development of Intelligence (a) Multiple intellectual potentials a different types of intellectual abilities of individual. (b) Context the ecology that can either support or constrain the development and expression of intellectual potential. c) Domain specific knowledge, the amount and quality of knowledge that influences positively or negatively the efficiency and accuracy of intellectual process. d) Appropriate elicitors. This may be presented in the ecology to motivate the development and expression of intellectual potentials.

2.1.2.22. Intelligence As Conceived by Vygotsky

Vygotsky (1978) studied human cognitive functioning from a developmental perspective holds that socio cultural process are key influences on development. He makes a conceptual distinction between two classes of cognitive processes. Lower (natural) and higher (cultural). He considered perception, memory and attention are basic processes that create biological predisposition of cognitive development. According to Vygotsky these lower cognitive processes become transformed into higher cognitive processes, such as reasoning, planning and logical memory, through mediated activity and psychological tools. There are three basic assumption in his theorisation. (1) The individual cognitive processes have their origin in social interaction. (2) The zone of proximal development (the difference is performance with and without adult guidance in collaboration, with more capable peers, is one of the primary mechanism that accounts for the development of individual cognitive functioning (c) the development of individual cognitive processes is mediated by tools, language signs or other symbolic systems. To Vygotsky (1978) intellectual functioning is not a natural expression but a socio-cultural phenomenon that emerges through social interaction.

Socio-Cultural Perspectives on Inteligence

2.1.2.21. Lave's Concept of Intelligence

The research investigation of Lave (1988) and colleagues have provided consistent evidence for the conception of cognition as a situated socio cultural process. Example of this position include for observations of cognitive assymmetry in the performances of Liberian tailors on school based and non-school based mathematics and the context specificity of cognition in every day mathematics tasks among grocery shoppers (1988). from these works she has developed a theoretical account for the interdependence of learning and cognition as individuals became members of their communities of practice.

2.1.2.23. Boykin's concept of Intelligence

Boykin (1988) is among a growing member of researchers in racial and ethnic minority psychology to make the case for the relationship between cultural contact and cognitive performance. Boykin and Colleagues, cognitive performance is inextricably wedded to individuals views and values about what tasks should be performed. Boykin advocated that, African American culture is characterised by three non overlapping realms of experience: Mainstream, Minority and Afrocultural. Main streams experience describes the beliefs, values, and behavioural styles common to most members of the U.S. Society. Minority experience denotes certain defense mechanism or coping strategies developed by members of ethnic and linguistic minority groups within a dominant society. Afro cultural experience refers to beliefs, values and behavioural styles of African descendants throughout the diaspora and traditional West African world views. The conflicts created by these three divergent psychological experiences create what Boykin called a "triple quandary" for most Americans. For more than 15 years, Boykin and colleagues (Allen and Boykin, 1991) have engaged in research that examined the degree of success and failure of African American children on cognitive tasks in context reflective of these multiple experiences.

2.1.2.24. Sternberg and Lumbart's Investment theory

Sternberg and Lumbart (1995) proposed the investment theory of creativity. According to this theory people, like good investors, buy low and sell high. But their buying and selling is in the world of ideas. Sternberg and Lumbart argued that there are six main elements that cover to form creativity. That are intelligence, knowledge, thinking styles, personality, motivation and environment.

Intelligence is just one of the six forces that influence generate creative thought and behaviour. According to this theory three aspects of intelligence are key for creativity; synthetic, analytical and practical abilities. These three aspects are drawn from Sternberg's triarchic theory of human intelligence, proposed in 1985. They are viewed as interactive and as working together in creative functioning.

2.1.2.25. Emotional Conception on Intelligence

Goleman (1995) formulated the theory of emotional intelligence. "Emotional intelligence, he says, includes "Self awareness and impulse control, persistence, zeal and self-motivation, empathy and social deftness" basic capacities needed if individuals are to thrive and if society is to prosper. According to Goleman, Emotional Intelligence is a more reliable predictor of academic achievement than IQ. Instead of (IQ) Emotional Quotient (EQ) is now adopted as a popular measure of human intellectual functioning.

Everyone of us may be found to have varying capacities and abilities with regard to one's dealing with emotions. Depending upon the nature of this ability, he or she may be said more emotionally intelligent or lesser in comparison to others in the group.

2.1.2.26. Measurement of Intelligence

As early as 1870 Galton (1869) remarked on the individual difference more from biological interest than psychological. One of the most important of the early American psychologists in study of individual difference was Cattell (1860-1944). The term "mental tests" was first employed by Cattell in a paper publication in 1890. Cattel's tests were of memory, imagery, keenness of eyesight and of hearing, afterimages, color vision, colour preferences, perception of pitch and of weight. Ebbinghaus (1897) the father of experimental psychology of learning was called upon to make a study of fatigue in school children, in connection with which he used three tests, computation, memory span, sentence completion. Psychological tests have been devised and are used primarily for determination and analysis of individual differences in general intelligence. specific aptitudes educational achievement, vocational fitness, and non intellectual personality traits. Psychological tests, especially those of general intelligence and specific aptitudes have had very extensive use in educational classification, selection and planning from first grade through the University.

Binet and Simon in 1904 found a procedure for determining how to segregate the slow learners in Paris Schools. Terman added a few tests, such as those one interpretation of fables and ball and field test and came out with standardized Standford-Binet-Scale in 1916.

Two new forms L and M based on 1916 revision, were published in 1937 (Terman & Merril, 1937) and new combined form h-m form in recent years (Terman & Merril, 1960). This new scales included IQ or intelligence-quotient, initial scale, known as Wechsler-Bellvue Intelligence Scale (WBIS) was composed of tests in two categories. A similar scale knows as Wechsler Intelligence scale for children (WISC) was developed later and WBIS now becomes the title, "Wechsler Adults Intelligence Scale" or WAIS (Wechsler, 1958).

Classification of Intelligence Tests

(1) Individual tests in which only one individual being tested at a time. Individual tests are used primarily for diagnostic purpose. The Terman-Merrill Scale, The Standford-Binet Scale, Wechsler-Bellvue intelligence scale are the popular individual tests.

(2) Group tests in which a group of individuals are tested at the same time. Group tests are used for selection purpose and researches.

Intelligence tests may be classified on the basis of their form as verbal or language tests and non-verbal or non language tests.

Verbal or Language tests: In these the subjects make one language in which instruction are given in words, written, oral or both. eg: Vocabulary tests, Memory tests, comprehension tests, Information tests, Reasoning tests, Association tests.

Non verbal and Non-language tests: These tests involve activities in which the use of language tests. These tests involve activities in which the use of language is not necessary except for giving direction. Performance tests are a typical example of such tests.

Individual Verbal Tests: Tests involving the use of language, which are administered to one individual at a time belong to this category. Eg: The Stanford-Binet Scale, Wechsler-Bellvue Intelligence Scale.

Group Verbal Intelligence Tests: The tests which necessitate the use of language and are applied to a group of individuals at a time come under the category. eg: Army alpha test., Army general classification test.

Group Non-Verbal Intelligence Tests: These tests do not, necessitate the use of language and are applicable to a group of individuals at a time. eg. Raven's Progressive matrices test.

Standford Progressive Matrices Test (Raven, 1958)

Non-Verbal Intelligence of the subjects were measured by administering the standard form of the Raven's Progressive Matrices Test. This non-verbal Test is intended to estimate the subjects ability to discern and utilize a logical relationship presented by non-verbal materials. The test consists of five subtests of twelve items each. In each item a part of the geometrical design is missing. Six or eight alternatives are given for each design. All of these fit the missing part, but only one logically belongs to it.

2.1.2.28. Concept of Mental Age and IQ

The use of this index was first suggested by Stern and Kahlmann in 1912, but it was not actually employed as part of test findings and reports until 1916 when the first-edition of Stanford-Binet scale was made available. The intelligence quotient, the ratio of an individual's mental age to his chronological age is found by formula.

$$IQ = \frac{MA}{CA} \times 100$$

The ratio is multiplied by 100 to remove the decimal. Terman denoted this as mental ratio.

An individual's IQ indicates rate of mental development or degree of brightness. If mental development keeps pace one's life age, the quotient is 100. If mental development lags; or is accelerated, the quotient will be less than or greater than 100, depending upon the degree of retardation or acceleration. An individual whose test performance is normal for his chronological age earns an IQ rating of 100.

IQ range	**Terman's categories**
80 - 89	dullness
90 - 109	average intelligence
110 - 119	superior intelligence
120 - 140	very superior intelligence

Deviation IQ. It will be seen that standard deviation of intelligence quotients obtained by relation MA/CA are not always of same, or nearly the same size at all age levels at one age level, 50 might be 12, at another, 16: at still another, 18 difference such as these create problem and irregulation in interpretation of relation meaning of a given IQ. Thus for example in first instance an IQ of 188 - ISD) signifies a percentile rank of 16;in second instance an IQ of 84 has same percentile equivalent, while in third, an IQ of 82 signified a percentile rank of 16. In order to overcome this, difficulty deviation IQ is need with some tests. The 1960 revision of Stanford Binet Scale uses the deviation IQ. The principle is that an individual's intelligence quotient be determined by relative extent to which his score on test deviates from mean of his age group and that an intelligence quotient of a given value should have same relative significance throughout the age range.

2.1.3. CLASSROOM CLIMATE - THEORETICAL OVERVIEW

Education often speak of a Classroom's or School's Climate, Environment, Atmosphere, Tone, Ethos, or Ambience and consider it important. Although classroom or school environment is somewhat a subtle concept, nevertheless remarkable progress has been made over the last two decade in evaluating it and in researching its antecedents and consequences.

The method of using students' and teacher's perceptions has been contrasted with method of direct observation which typically involves an external observer in systematic coding of classroom communication and events according to some category scheme (Dunkin & Biddle, 1974; Everston & Green, 1986). The distinction between the objective approach of directly observing the environment and the 'subjective' approach based on milieu inhabitants apprehension of the environment is widely recognized in psychological literature (Jesser & Jesser, 1973). Another approach to studying classroom environments involve application of the techniques of naturalistic inquiry and ethnography.

Measures of classroom climate are more often like measures of motivation than measures of ability or achievement. They do not require demonstration of performance but involve judgement of psychological or social psychological states of classes or schools.

2.1.3.1. Concepts of Classroom Climate

Thelen (1974) has defined Classroom Climate as 'the way of life in classroom'. He has emphasised the life classifying that each classroom has its own distinctive culture. This 'culture' or 'climate' cannot be directly observed, but inferred from the functional interactive situations, which take place in classroom between the teacher and the pupils. This is called the 'dynamics' of the classroom group, which is the sum total of various activities that takes place in teaching-learning process, academic or non academic. The climate created through participative classroom learning activities generate classroom climate at its maximum. This classroom climate is a result and summation of dynamics, inter relationship, common and collective attitude of pupils towards their own class.

Page *et al.* (1977) defined Classroom Climate as "Authority pattern and social and emotional relationships within a teaching group". Thelen (1981) has defined Classroom Climate in terms of three constructs - components called ALP components. They are

a) Authenticity (A) - Pupils involvement. That is pupils meaningfulness, understanding, pleasant experiences, levity exciting and dramatic situation in learning activities.

b) Legitamacy (L) - Pupils satisfaction or purposefulness. That is pupils efforts in solving problems, concern for learning and preparing themselves for the purpose or aim in life.

c) Productivity (P) - Pupils goal attainment. That is pupils consciousness, effectiveness, potentials and self learning in productive learning activities. That is the climate of any classroom is essentially the direction and extent to which these constructs operate in varied combinations creating a way of life of the class.

Straom *et al.* (1991) defines classroom environment as "The total external context in which an individual operates. The concept environment is usually used to include physical surroundings and more specifically to include all different factor of physical, but to exclude the social.

2.1.3.2. Approaches to studying classroom Climate

The three common approaches to studying Classroom Climate involve systematic observation, case studies and assessing students and teacher perceptions. Much of the learning environment work has grown out of the research programs of (Moos and Walberg, 1979; Fraser, 1981; Fraser and Fisher, 1983; Moos and Spinyad, 1984).

2.1.3.3. Distinction between School Climate and Classroom Climate

There exists distinction between classroom or classroom level environment from school or school-level environment, which involves psychological aspects of climate of whole schools (Anderson, 1982;

Fraser and Rentoul, 1982; Gen, 1984). School climate research owes much in theory instrumentation and methodology to earlier work or organizational climate in business contexts (Anderson, 1982). One feature of school-level environment work which distinguishes it from classroom-level environment research is that (1) the former has tended to be associated with the field of educational administration and to rest on assumption that schools can be viewed as formal organizations. (2) Classroom level research has been concentrated on secondary and elementary schools rather than in higher education, a sizable proportion of school-level environment research involved the climate of higher education institution.

2.1.1.3.3. Concept of Classroom Climate and Classroom Environment

It may be noted that the term Classroom Environment and Classroom Climate are used interchangeably as the idea contained in both are almost identical. Good (1959) defined educational environment as "the sum of all physical, social emotional and mental factors that contribute to the total teaching learning situation.

2.1.3.4. Implications of Classroom Climate for Education

Classroom Climate can be defined as type of learning condition existing in the classroom. This includes the emotional, physical, intellectual climate set up by the teacher and students to create a wholesome learning situation. This view sees the creation of desirable classroom climate on largely depend on teacher's ability to sustain the pupil's learning to motivate them and to build up positive attitudes towards new learning (Edgar, 1984). The teacher exerts a great deal of influence on the pupil. The most powerful influence in producing such conditions is the reinforcement provided by learning environment either directly from the teacher or indirectly through his arrangement of learning task that offer good opportunities for successful outcomes in progress in learning.

Classroom Climate implies a measure of the quality and quantity of the cognitive, creative and social life in terms of teacher pupil interaction. Perkins (1951) observes that quality of teacher pupil relationship in class is major aspect of classroom climate.

Each classroom in a school can be considered a separate subsystem, the two basic complementary positions of which are teacher and students. The schools educational objectives are most effectively reached if the expectation of classroom teacher has towards the role behaviour of the students, are clearly communicated to the students, the students are motivated to accept the expectation and wish to conform to them, and the students have a good understanding of what they must be to fulfill these role expectations.

A number of authors have described the more specific activities which make up the teacher's role. Among these are putting students in content with subject matter, motivating students, planning for classroom activities, the disciplining students, evaluating students and meaning the general flow of classroom dialogue. Many other researchers have investigated teacher influence in classroom and have concluded that teacher flexibility in the use of direct and indirect methods of influence is highly related to student achievement. Every teacher wants a successful quite, democratic, busy controlled classroom, but there are difficulties in achieving this image. It is not practical in terms of the system to give students complete freedom to choose their own goals from kindergarten onwards. Giving the student a stake in his learning and entertaining classroom climate which encourages student initiative will go far toward encouraging psychological success.

Many studies reviewed provide considerable evidence to support the general proposition that the nature of classroom climate have an important influence on student's achievement of cognitive and attitudinal goals. There are important practical implications for educational wishing to improve student learning through the creation of good classroom climate conducive to learning. According to Perkin's (1956) the role of classroom climate is crucial for learning process.

Classroom climate is usually measured in terms of either student or teacher perceptions. Classroom climate scales have been used to assess.

a. Student perceptions of preferred classroom climate.
b. Student perceptions of actual classroom climate.
c. Teacher perceptions of preferred classroom climate.
d. Teacher perceptions of actual classroom climate.

The term 'preferred' classroom climate is used to mean 'expected' or 'liked to' physical, psychological and instructional environment of classroom according to students and teachers and actual is what is provided actually for the learning of different subjects.

Preferred forms are concerned with goals and value orientation and measure perceptions of classroom ideally liked or preferred.

2.1.3.5 Characteristics of Classroom Climate

Many researchers and authors have identified the following characteristics of classroom climate of Teacher-Pupil interaction - Formality, Diversity, Cohesiveness, Speed, Material environment, Friction, Favoritism, Difficulty, Apathy, Democracy, Cliqueness, Satisfaction, Teacher Support, Disorganization, Competitiveness, Involvement, Affiliation, Task orientation, Order and organization, Rule clarity, Teacher control, Innovation, Personalization, Participation, Independence, Differentiation (Fraser, 1986), Creative Stimulation, Cognitive Encouragement, Permissiveness, Acceptance, Influence of class mates, Control (Misra, 1986), Teacher talk, Accepts feelings, Praises or Encourage, Accepts or uses ideas of pupils, Asks questions, Lectures, Give directions, Criticizes or Justifies authority, Student talk response, Student talk initiation, Silence (Amidon and Flanders, 1966; Amidon and Hunters, 1966).

The classification of classroom climate by Fraser (1986) is given below:

Formality: The extend to which behaviour within the class is guided by formal rules.

Diversity: Extent to which differences in students interests exist and are provided for.

Speed: Extent to which class work is covered quickly.

Friction: Amount of tension and quarrelling among students.

Goal Directions: Degree of goal clarity in class.

Favouritism: Extent to which the teacher treats certain students more favourably than others.

Difficulty: Extent to which students find difficulty with the work of the class.

Apathy: Extent to which the class feels no affinity with the class activities.

Cliqueness: Extent to which students refuse to mix with the rest of the class.

Disorganization: Extent to which classroom activities are confusing and poorly organized.

Involvement: Extent to which students have attentive interest, participate in discussion, to additional work and enjoy the class.

Affiliation: Extent to which students help each other, get to know each other easily and enjoy working together.

Order and Organization: Emphasis on clear rules, on students knowing the consequences of breaking rules, and on the teacher dealing consistently with students who break rules.

Personalisation: Emphasis on opportunities for individual students to interact with the teacher and on concern for the personal welfare and social growth of the individual.

Physical Environment: Physical arrangement involving the placement of desk and chairs, the arrangement of books, supplies and record keeping equipment; and the location of work and activity areas are often referred to as low and high strength areas (Homme, *et.al,* 1963; Haring and Kunzelmann, 1966).

Cohesiveness: Extent to which students known, help and are friendly towards each other. It is the classroom inter personnel dynamics between pupils and includes elements like friendliness, mutual help, equanimity etc.

Teacher support: Extent to which the teacher helps, befriends, trusts and as interested in students. This includes element like teachers encouragement to student, co-operation with the students parent, giving suggestions to students etc.

Task Orientation: Organization of subject matter, content and instruction, planning the complete classroom activities involving the elements like teacher organization of the instruction learning experiences, learning activities and evaluation of subject matter.

Participation: Extent to which students are encouraged to participate rather than be passive listeners. Teachers encouragement to student to participate in class work, gaining maximum pupil participation Innovation. Extent to which the teacher plans, new unusual and varying activities and techniques and encourage students to contribute to classroom planning and to think creatively.

Democracy: Extent to which students equally participate in decision making related to the class. Harmony in the classroom rests largely on mutual respect. The free choice arrangement can be extremely revealing to the teacher in organizing and conducting class. Equally important to strong teacher-student relationship and building of mutual respect in teacher's willingness to listen to his students, to be available at times to serve as a sounding board for adolescent problems and ideas.

Teacher control: The nature of rules, how strictly rules are enforced and how severely rule infractions are punished. Each teacher must decide for himself those conditions under which be can function and his students learn most effectively.

Competition: Students competition for grades and recognition.

Independence: Extent to which students are allowed to make decisions and have control over their own learning and behaviour.

Investigation: Emphasis on the skills and processes of inquiry and their uses in problem solving and investigation.

Differentiation: Emphasis on the selective treatment of students on the basis of ability learning style, interest and rate of working.

Individualization: Extent to which students are allowed to make decisions and are treated differently according to ability, interest and rate of working.

Misra (1976) divides classroom climate into the following components.

Creative Stimulation: This refers to such activities of the teacher as it promote the child's ability to find new solutions to a problem, new modes of artistic expression and bring in to existence a product new to the individual.

Cognitive Encouragement: It implies teacher's behaviour which promotes the child's awareness of its surroundings, understanding things and solution to think and reason clearly and an overall efficiency in intelligent behaviour.

Permissiveness: It indicates a school climate in which students are provided opportunities to express their views freely.

Acceptance: If refers to teacher's recognition that students have the right to express feelings, to uniqueness and to be autonomous individuals. Teachers accept the feelings of students in a non-threatening manner.

Control: It indicates autocratic atmosphere of the school in which general restrictions are imposed on students to discipline them.

Influence of Classmates: It implies behaviour of other students in the class towards the child.

Flanders and Amidon (1966) includes the following components for classroom climate.

Teacher Talk: Teacher talk is the verbal behaviour of the teachers in classroom and divided into teachers indirect influence and teachers direct influence. Control of the teacher often aims at conformity and compliance. Direct influence tends to increase the teachers activity and restraints student's behaviour. Indirect influences encourages student participation and freedom of actions. Indirect influence is divided into four. 1) Accept feeling 2) Praises or encourages 3) Accepts or uses ideas of pupils 4) Asks questions. Direct influence includes Lectures, Giving direction and Criticizing or justifying authority.

2.1.3.6. Measurement of Classroom Climate

The most extensively used environment inventories for the secondary schools in developed countries are the following:

1) Learning Environment Inventory (LEI) (Anderson & Walberg, 1974; Fraser, Anderson & Walberg, 1982)

2) Classroom Environment Scale (CES) (Fisher & Fraser, 1983; Moos & Trickett, 1987; Trickett & Moos, 1973)

3) Individualised classroom Environment Questionnaire (ICEQ) (Rentou & Fraser, 1979; Fraser, 1990).

4) My Class Inventory (MCI) (Fisher & Fraser, 1981; Fraser, Anderson & Walberg, 1982; Fraser & O'Brien, 1985)

5) College and University Classroom Environment Inventory (CUCEI) (Fraser & Treagust, 1986; Fraser, Treagust & Dennis, 1986)

6) Science Laboratory Environment Inventory (SLEI) (Fraser, Giddings & McRobbic, 1991).

2.1.3.7. Preferred Forms of Scales

In addition to a form that measures perceptions of actual classroom environment, there is another form to measure perceptions of preferred classroom environment. The preferred (or ideal) forms are concerned with goals and value orientation and measure perceptions of the classroom environment ideally liked or preferred. Although item wording is identical or similar for actual and preferred forms different instructions for answering each are used. Although the LEI and MCI originally were designed only to measure actual environment, Fraser and Deer (1983) and Fraser and O'Brien (1985) have used a preferred form of the MCI successfully with elementary school classes.

2.1.4. PROCESS OUTCOMES IN SCIENCE - THEORETICAL FRAMEWORK

2.1.4.1. Concept of Process Outcomes in Science

Science is a cumulative and endless series of empirical observation which results in formation of concepts and theories being subject to modification in the light of further empirical observations. Later it was envisaged that science has to do with direct expectance with natural phenomena and collection of information.

The terms Process outcomes in Science stands for the intellectual skills needed for scientific investigation attained by the students as a result of learning science.

Educational outcomes in science treated as mastery over the process of science is relatively new development in the history of science education. It is in the late decades of the 20th century, that the process element began to acquire prominence in science teaching. The major shift in emphasis is to be attributed to two major factors:

(1) As a reaction against fact-laden, content-oriented science teaching and information based encyclopaedia, science text books, that provided science teaching at different stages.

(2) The works of prominent educational thinkers like John Dewey and pragmatic school of educational philosophy which helped to direct the education activity towards experience as the on scientific method.

Science has both process and product approaches. This has been enunciated through the definition of science according to Oxford English Dictionary, as the branch of study which is concerned with a connected body of demonstrated truths or with observed facts systematically classified and more or less collegiated by being brought under general laws and which includes trustworthy methods of discovery of news truth within its own domain. Science a process approach was a project of American Association for the Advancement of science (AAAS) during 1962-68, stressed this new development of science teaching in curriculum. For today there is a shift of emphasis on the mastery of the subject through the acquisition of skills in the process of how knowledge is gained has been generally accepted.

The proponents of 'process' approach point out that teaching based on 'content' approach usually results in a passive acquisition of second hand knowledge which the learner will never be able to use.

The advocators of the process approach in science teaching have attempted to identify the weakness of the traditional content based teaching of science. The defects pointed out by such writers are the following:

(a) Over emphasis on information resulting in a lack of understanding or appreciation of the implications of the content itself.

(b) It makes the learner a passive recipient of second hand information with the result that the whole be either unable to create new knowledge or whole fail to appreciate the methods through which new knowledge is created.

(c) Content based teaching and learning is unpsychological and as such implies that this is a wastage of time and effort.

(d) The learner fails to develop real concepts and interrelationships of concepts which are the hallmarks of real scientific understanding.

The teaching of science should be done with the approach of science as a 'process'. Teaching science today obviously demands more diversified skills than ever before. The present science education system demands the teacher to compare a variety of knowledge, skills and strategies to meet, the individual differences. The effectiveness of science education will depend not only on the efficiency of teacher and nature of learning materials, but also on the classroom environment and learner. The classroom environment and teaching-learning activities directly promote the acquisition of problem solving skills.

Process Organisation

A singularly influential and classic model for process organisation (AAAS, science: A Process Approach, 1965) is designed around eight basic and five integrated process. Instructional sequences are designed to bring children to increasingly greater proficiency in each of the processes. Science content is viewed as medium or inquiry, while the inquiry processes are regarded as essential ingredients of all scheme, regardless of content. Expected terminal behaviours are explicitly stated for each category. Activities within the categories are selected to provide children with the necessary experience for teaching these behaviours. The following are the illustrative.

Classification

The desired terminal behaviour is competence in making multistage classification which may then be used to identify and describe independent objects. Experiences one suggested for classifying subjects according to such properties as texture, colour, hardness, shape, size and other special characteristics. Single-stage classifications followed by two-stage and multistage classification is shown in the following illustrative sequence. Name objects in a collection of shells or leaves; name several properties, that is, colour, texture, shape; make and explain a single-stage classification; make a two stage classification use a color code to classify the objects; make a multistage classification.

~~Influence~~ Inference

The designed terminal behaviours include competence in drawing more than one inference from a set of data, demonstrating that inferences can be tested by further observation, and demonstrating that an inference can be tested by applying known tests of properties of subjects under study. Special attention is given to distinguish between observation and inferences and between the observer and what is observed. The following sequence is illustrative. Induce inference that plants need water; demonstrate a way to measure the water used by a plant, induce inference that water drawn through plants is transferred to the atmosphere: infer and use concept of evaporation; test inference regarding the water in usage of plants through additional observations.

Communication

The desired terminal behaviour is competence in describing an experiment so that an individual who has not seen it and carried out out. Experiences clearly describing objects and events are followed by recording tools such as charting and graphing as shown in following example. Identify and name events that can be quantified, such as five bounces of a ball: make a chart for recording the frequencies of several observed events, make a bar graph to show the relative frequencies record and graph measured variables, describe measured changes in speed, temperature, and other properties; make a prediction on the basis of recorded measures; make a graph to shown the prediction; record and graph experimental data so that replication is possible.

Measurement

Designed terminal behaviours include competence in qualifying physical variables through direct and indirect measurement, in measuring the magnitude and direction of variation in an illusion, and in explaining that differences exist in perceptions of dimension (length, weight, area, volume, rate of evaporation, rate of change) of physical world. The following sequence is illustrative. 1) Distinguish and relate properties of objects by using such terms as "heavier" and "lighter". 2) identify relative weight by lifting; use a balance to distinguish heavier from lighter objects 3) order objects according to relative weight using a spring scale 4) Select and assign arbitrary and standard units to weight measurement 5) explain effects of gravitation and inertia 6) use weight measurement to describe, order and classify various objects.

Numbers

The desired terminal behaviour is competence in naming rational numbers greater than one as a product of ten and a rational number between one and ten. The intention is to develop those number concepts needed for the descriptive, quantitative aspects of science. The following sequence is illustrative: identify cardinal numbers; identify ordinal numbers, arrange the integers, (positive and negative) on a geometric continuum; performs basic operation in the field of rational numbers; express numbers exponentially; are scientific notation for numbers derived from science inquiry.

Observation

The desired terminal behaviour is competence in observing natural phenomena and in translating observations into records useful to others. Attention is given to both oral and written descriptions of objects and events in terms of measurable variable such as length, area, volume weight, time, and temperature. The hierarchy begins with observing and describing single objects or events and moves to describing of relationship between variables as shown in following examples. Describe objects according to colour, texture, relative size, and other properties; distinguish and describe differences in temperature; identify and name factors in water variability such as temperature, moisture, air, pressure, air movement, land forms, describe weather; distinguish between adequate and inadequate descriptions of observations describe selected items so that others can identify these including plants and animals, describe relationship between objects and behaviours.

Space/Time

The desired terminal behaviours include competence in ordering objects according to position or rate of change and in finding the rate of change or the position of an object. Measurement of location in time intervals and distance are given attention as shown in following example. Distinguish various angles according to size, identify and name angular and compass directions use angular measures to designate changes in position; describe relationships to observe position using angles and distance relate speed and time of arrival of moving objects; describe and quantity speed of objects; a rule to find speed of objects: order of objects in terms of their speeds.

Prediction

The desired terminal behaviour is competence in making and testing predictions involving two measurable quantities. Various tasks are included such as organising data, graphing data, interpreting line graphs and understanding functional relationships between measured variables. The following example is illustrative of a sequence that involves graphs: use a Cartesian section to graph some measurements: analyze a graph to determine the pattern of relationship (increasing, decreasing, stable) use a graph to predict a continuation of a trend (extrapolation): predict independent events using a graph (interpolation) recognize the value of making prediction from several observation conduct an experiment to test predictions.

Formulating Hypotheses

Children draw inferences and makes prediction and learn to frame testable hypotheses regarding predicted behaviours or relationships. They learn to seek generalizable information over limited information. For example, they are encouraged to state an hypothesis about the behaviour of plants rather than about the behaviour of likes, when to do so is appropriate. They learn to develop hypotheses that lend themselves to testing and to state them in very specific, clear language. They also learn to modify statements of hypotheses that can not readily be tested or are unclear and ambiguous. They are encouraged to use graphs, pictures and models or arts in presenting hypotheses. Activities indulging this process help children refine their skill in defining. They learn to distinguish operational from non operational definitions. They are expected to apply two criteria in framing operational definitions 1) the definition must include an action. What is to be done and 2) the definition must include observation what is to be observed.

Controlling Variables

Earlier experiences in observation and measurement are drawn together as well as skills in influence and prediction in the sequence of activities on controlling variables. Children are taught to observe events and interactions carefully and infer certain cause and effect relationships then suggest tests for these inferences under controlled situations. For example the question of liquid movements in various materials is considered. The children may infer that the nature of material effects the movement of liquid. In analyzing what properties of the materials affect the behaviour of liquids the separate properties one isolated for independent testing.

Interpreting Data

Children learn to reason from data. They extend their abilities to perform numerical analysis that bring out otherwise obscure findings. Predominantly data are obtained through the children's direct observation. In other cases, data are supplied for special analysis by children. For example, the children may be given a series of measurements representing experimental trials. They are asked to prepare a table for recording and organizing the data and then asked to construct a histogram for purposes of clarification. They make prediction about new trails and suggest hypotheses which may explain patterns observed in the data

Experimenting

This process includes all other processes in some form. Absolute proficiency and complete independence with experimental methodology are not expected in elementary grades but increasing sophistication is sought in each of the underlying process: observing constructing questions for investigation predicting; constructing hypotheses, identifying variables, stating operational definitions, controlling variables, drawing inferences and organizing data, interpreting data, modifying hypotheses, summarizing and reporting findings.

The revised Kerala state curriculum includes the following processes skills in science curriculum in the secondary stage.

1) Classification 2) Inference 3) Communication
4) measurement 5) Numbers 6) Observation
7) Space/Time 8) Prediction 9) Formulating hypotheses
10) Defining operationally 11) Controlling Variables
12) Interpreting Data 13) Experimenting.

Klopfer (1971) and Obourn (1960) classified the different skills involved in the scientific process as follows.

i. Recognising and defining a problems

The learner of science should be made to observe his surroundings and should encourage to identity the problems by themselves.

ii. Formulating the Hypothesis

The test item in this section contains the tentative solution to the problem. By analyzing the data the student select the best inference that can be drawn from the given evidences.

iii. Collecting data

This category focused on the behaviour of the science student involving in enquiry. The designing of procedure for performing experimental tasks, the students observation and measurement of things using appropriate instruments are all include in this section.

iv. Interpreting data

The student process the data obtained from experimentation or presented to him in the form of recorded observations and measurements to yield quantitative and qualitative judgments.

v. Evaluating hypothesis

The students needs to check whether or not the finding verifies the hypothesis. Therefore in this sub-test the student is expected to find out whether the evidence is consistent with the formulated hypotheses.

vi. Formulating generalisation

The formulating generalisation is a complex behaviour involving higher mental process. The student considers the result of his experiments with other similar inquiries. If this original findings are corroborated with others, he is justified in formulating and empirical generalisation.

The investigator used the classification of objectives by Klopfer (1971) and Obourn (1960) as the basis for the different steps in the Test of Process Outcomes in Science.

Klopfers (1971) Classification of process of scientific enquiry is one of the most popular. According to him the major processes of scientific inquiry are: 1) Observing and measuring; 2) Seeing a problems and seeking ways to solve it; 3) Interpreting data and formulating generalisations; 4) Building, testing and revising a theoretical model.

Another classification given by Nay and others (1971) conceives of scientific inquiry as consisting of: 1) initiation; 2) collection of data; 3) Processing of data; 4) Conceptualization of data; 5) Open endedness.

Tanneubucum (1971) considered science process as: 1) Observing; 2) Classifying; 3) Quantifying; 4) Measuring; 5) Experimenting; 6) Inferring; 7) Predicting.

Bhandula *et al.* (1979) suggest fine processes of science: 1) Observing; 2) Classifying; 3) Measuring; 4) Communicating; 5) Reorganising number relation.

2.1.4.3. Objectives of Science Education

In the past emphasis was placed on "facts" of science and on technological applications. Currently emphasis is given to the study of science qua science, and content and process are entertained. The focus is on the nature of investigative scheme and embedded inquiry processes so that students will be more progressively toward the attainment of science objectives which are consistent with the nature of science. Such objectives as the following characterize the modern program.

Process Objectives

To develop a functional competency with the procedure of scientific inquiry so that the child is able to do the following.

Observe and classify the natural phenomena with ease and objectivity.

Form and test hypotheses relating to counter-intuitive observations and discrepant events.

Place predictions and generalisations about objects and events of natural world.

Develop creative designs for solving problems, answering questions, and testing hypotheses through experimentation, field study, use of references and other means of investigation.

Skill objectives

To develop a functional competency with the tools of science so that child is able to do the following.

Use common laboratory apparatus in scientific investigation. Measure and record scientific phenomena with precision ii) and under standing.

Employ appropriate quantitative methods to record and interpret data derived scientific investigation.

Accurately report the results of scientific investigators orally and in writing.

2.1.4.3. Process Outcomes Tests

Andrew (1980) developed a test to evaluate skill in scientific processes of secondary school pupils using Klopfer's classifications. The item cover Physics, Chemistry and Biology.

Bursis, Wise and Okey (1983) developed a test of item assessing identification of variables, statement of hypotheses, operational definitions, design of investigation and the display and interpretation of data.

2.2. REVIEW OF RELATED STUDIES

This section deals with research studies related to Independent Variables with Pupil Achievement.

2.2.1. STUDIES ON COGNITIVE STYLE

Studies related to Cognitive Style are grouped into studies showing Positive Relationship with Cognitive Styles and Academic Achievement, Cognitive Styles and Academic Achievement - Negative or No Relationship, Cognitive Styles and Age Difference, Cognitive Styles and Sex Difference – Negative/No relation, Cognitive Styles and Locale Difference, Cognitive Styles and Affective Variables.

2.2.1.1. Cognitive Styles and Academic Achievement - Positive Relationship

Watkin and Astilla (1980) conducted a study on Cognitive Style and its relation with Academic Achievement of Fillipine girls. It was found that there is positive relationship between Field-Independent students and their Academic Achievement in school subjects.

Lanka (1983) studied whether Cognitive Style is a predictor of student performance in secondary classes. The results indicated that Field Independent students were superior to Field Dependent students in most of the factors under study and concluded that Cognitive Style is considered as a predictor of student performance.

The relationship between self perception Cognitive Style and learning was studied by Das (1985) on 360 school students and found that Cognitive Styles were significantly and positively correlated to school Achievement.

Davey and Kapinus (1985) investigated the effects of prior knowledge and information orderings on the immediate and delayed recall of unfamiliar information under various levels of control for the effects of Cognitive Style and Reading Achievement and significant interaction effects were discovered.

Ballard (1985) conducted a study on the interaction of Cognitive Style and Achievement of select students of English as second language. It is found that significant correlation exist between Field Independent Cognitive Style and Achievement scores in Language.

Frank and Noble (1985) investigated the hypothesis that Field-Independent individuals are more efficient in their use of Cognitive restructuring skills than are Field-Dependent individuals. Thirty two Field Independent and Thirty two Field-Dependent female under graduates were required to solve a series of anagrams under either an easy or difficult anagram condition. Each individual received five anagrams constructed from 'social' words and five anagrams from 'non-social' words. Field Independent solved the anagrams significantly quicker than did Field-Dependent students.

Harritte (1987) conducted a study to determine the strength of relationship between Field Independence/Dependence, visualization and Problem Solving in adolescent males and females. Hundred, 8^{th} graders were administered the Group Embedded Figures Test (GEFT). Pursue Perceptual Screening Test (PPST) and Cognitive Abilities Test and Verbal Problems Test to measure Field Independence/Dependence Visualization and Problem Solving ability respectively. Statistical analysis revealed that Problem Solving was positively related to Cognitive Style and Visualisation. Field Independent scored higher than Field-Dependent in Problem Solving measures. Males were found to be more Field Independent than females. Males scored higher than females on GEFT.

An attempt was made by Helen, *et al.* (1987) to find out the Cognitive Learning style and Achievement in Mathematics. Two categories of subjects into Field Dependent/Independent groups 44 high and low achieving students were given Group Embedded Figure Test. They concluded that the greater number of low achieving students were classified as Field Dependent.

Saracho (1988) in his study Cognitive Style and young children's learning discussed the relationship between Cognitive Style and Academic Achievement and found significant interaction between them.

Hacker (1989) examined the relationship of Cognitive Style to instructional conditions and Academic Achievement of second language students. The results showed significant relation between Cognitive Style and Achievement. FI students learn better grades than FD students regardless of instructional condition.

Moore and Dwyer (1991) conducted a study on 119 university students by classifying them as Field-Dependent, Intermediate and Field Independents and were administered two verbal criterion tests measuring different educational objectives. The results showed that FI's achieved significantly higher scores on two criterion tests than did the FD's.

In a study Paramo and Tinayero (1991) examined whether there is a relation between Field-Dependent /Field-Independent and school performance of Boys and Girls and reported that Field-Independent students performed better in all subjects, especially Boys. These finding does not support the neutrality of Field-Dependent and Field-Independent.

Varma (1991) reported that Academic Achievement of both male and female children was positively and significantly related with Field-Independent Cognitive Style. Field-Independent children were found to have significantly higher mean Academic Achievement than their counter parts.

Beigal (1992) in a study examined Cognitive Style and Academic Achievement on a sample of 81 students broken into four general content areas, science, English, Mathematics and Social studies and found that Cognitive Style (Field-Dependent/Field-Independents) of the subjects influence their Achievement in school subjects.

Russel (1992) studied the differential effects on Learning of subjects with FD and FI Cognitive Style and found positive correlation between GEFT scores and Achievement.

Riding and Douglas (1993) reported from their study that Cognitive Styles are found to be interacting with the learning performance depending on how the task is presented.

Ganihar (1993) conducted a study on relationship between Cognitive Style and School Achievement. The study comprises a sample of 200 school students of standard IX in Dharward City. GEFT was administered on the sample and categorized Field-Dependent and Field-Independent students. The results showed significant difference between Field-Dependent and Field-Independent groups on their Achievement in all school subjects. The Field Independent groups performed significantly better than the Field-Dependent groups. The Field – Independent groups are not only High-achievers in Maths and Science area, but also Achieved high in other school subjects.

Martinsen (1994) conducted a study on relationship between Cognitive Style and Achievement Motives, and Problem Solving Performance and found significant relationship among high school students Problem Solving Performance.

Kumar (1995) in his study on the Effect of Cognitive Style and Classroom Environment on Achievement in Social Science of standard IX students, found that significant relation exists between Cognitive Style and Achievement in Social sciences. But there is no significant relation between Cognitive Style and Classroom Environment at secondary school level.

Rialing and Agrell (1997) investigated the relationship between Cognitive Skills and Cognitive Styles in Anglo phone Canadian students. The result showed that there is a statistically significant relationship between sex and.performance in some subjects between Skill, Style and Subject in their effect on performance.

Sujita (2002) in a study examined the relationship between Cognitive Style and Process Skills in Biology among 500 standard IX pupils. The study revealed that the relationship between Cognitive Style and Process Skills in Biology is positive and significant.

David (2003) studied the relationship between Achievement in Business studies and Cognitive Style of the 500 Higher Secondary school pupils. The findings revealed that Achievement in Business studies were significantly correlated with Cognitive style. The study also revealed that there was no significant gender difference in Field Independent/ Dependent group.

2.2.1.2. Cognitive Styles and Academic Achievement - Negative or No Relationship

Ritchey and Lashier (1981) studied the relationship between Cognitive Style and instructional mode to Achievement of college science students and obtained no significant difference between Field – Independent and Field Dependent students in their ability to locate and identify anatomical structures.

Ritchey, *et al.* (1981) determined whether a test of Cognitive Style can predict student Performance on a test of scientific knowledge and examined possible interactions between Cognitive Style and Teaching Method in terms of student Achievement and found no significant relationships between Cognitive Style and student Performance or between Cognitive Style and Teaching Method.

Harmon (1983) from his study on Academic success in college freshmen calculus obtained a weak correlation between Cognitive Style and Achievement in calculus. Although students have different Cognitive Styles, it does not prevent or predict Achievement in calculus.

Yore (1986) studied effects of lesson structure and Cognitive Style on the Science Achievement of elementary school children. Findings indicated that increased lesson structure did not significantly improved Science Achievement for the participating grade IV and V students.

Williams (1989) examined the effects of Cognitive Style and Classroom Climate on the Achievement and Attitude of ninth grade English students. The classification by both Cognitive Style and Classroom Climate resulted in a final sample of 104 students. The data were analysed by a two way multivariate analysis of co-variance. There was no significant difference found for either Cognitive Style or Classroom Climate as related to either Achievement or Attitude.

Rice, *et al.* (1991) investigated the differences and similarities in the performance of integrated Science Process Skills with differing cognitive style preferences. Learning Style 'inventory (LSI) was used to measure individual cognitive styles. Integrated process skills was measured using test of integrated process skills. The sample used was 107 college students. Cognitive Style preferences were not significantly related to performance of integrated Science Process Skills.

Feuton (1992) studied how individual difference in Cognitive Style interact with student Performance and found little relationship between Cognitive Style and Academic Performance.

2.2.1.3. Cognitive Styles and Age Difference

Drouin, Talbot and Goulet (1986) investigated the Field Dependence/Independence of 77 female and 115 male French Canadian University athletes by means of the Embedded figures Test. There was no significant difference by age, level of competition or sports.

Bill (1987) conducted a study on examination of developmental trends in Field Dependence among age groups of 13 or 21 years of age. They were tested on a rod and frame apparatus. Result showed that 16-18 year olds were more Field Independent. Developmental trends indicated decreased Field Dependence into late adolescence and increased Field Dependence in early childhood.

2.2.1.4. Cognitive Style and Sex Difference - Positive relation

Huss and Kayson (1985) investigated the effects of age and sex on speed of finding Embedded Figures Test. The sample consisted of 20 male and 20 female students. Ten of each sex was in grade 3 or 4 and 10 of each sex was in grade 11 or 12. Each subject was given 3 or 4 and 10 of each sex was in grade 11 or 12. Each subject was given 3 pairs of figures and told to find the sample figure that was embedded in more complex figure. Results showed that sex and age were significant. Boys found the hidden figures faster than girls, and older subjects were faster than younger one.

Shade (1986) examined the possibility of a unique culturally induced Afro-American Cognitive Style. One hundred and seventy eight 9th grade students stratified by race, sex and achievement level were administered 3 Cognitive Style tasks (GEFT). Results revealed a significant difference between Afro and Euro American subjects in their perceptual orientation to the environment. Results also showed that sex and age were significant.

Paul, *et al.* (1992) from a study found that there was significant interaction effect of Cognitive Style and Sex on the use of Defence Mechanism Clusters.

Santacane, *et al.*, (1993) analysed Field Dependence/ Independence Cognitive Styles as function of Socio-economic Status, and Sex. Subjects of upper middle socio-economic status achieved significantly higher scores than did subjects of low socio-economic status. Boys scored higher than girls in FI variable.

O'Brien and Terrance (1994) studied Cognitive Style and Academic Achievement in secondary education. The research analysed difference in Academic Achievement related to Cognitive Style, Gender, Grade and Age found that concrete sequential students had the highest grade point averages and females out performed males and Achievement varied by grade level.

2.2.1.5. Cognitive Styles and Sex Difference - Negative/No relation

A comparative study of Cognitive Style in 3 ethnic group was studied by Ghuman (1980). He assessed the test performance of 3 groups, 50 English, 50 West Indians and 50 Asians, whose cultures differ in socialization practices. Subjects were secondary school students. The GEFT and spatial Mathematics Test were given to assess performance. Results revealed that performance of Asiatic and West Indian subjects were significantly superior to that of English on GEFT. Asiatics were significantly superior to West Indian and English groups on Mathematics Test. No significant differences appeared between group on spatial tests, and no sex differences were found.

Dani (1984) conducted a study on Scientific attitude and Cognitive Styles of Higher Secondary students. The sample consisted of 1265 pupils selected at random. The major findings were (1) About 71 percent of the students were clearly Field Dependents (2) Boys and girls did not differ in their Cognitive styles. (3) Science students possessed high Field Independence ability than arts and commerce students (4) City students possessed higher Field Independence ability than the town and village students (5) The early adolescents were found to be more Field Independent than the middle and late adolescents.

Brennan (1984) conducted a study to investigate the effect of hemispheric preference, cognitive style, method of instruction and gender and found no significant difference between Cognitive Styles and Sex.

In a study on children of occupational programme areas Walsh (1988) found to significant interaction between Age, Sex and Cognitive Style.

2.2.1.6. Cognitive Styles and Locale Difference

Varghesa (1987) revealed that the correlation between each of the cognitive abilities and Biology achievement obtained for both urban and rural groups were found to be significant. Also she observed that the urban and rural subjects significantly differ in the relation of the six cognitive abilities with biology achievement out of ten variables.

Tharakan (1989) reported the effects of rural and urban backgrounds on Cognitive Style over a sample of 80 adolescents aged 16-20 years belonging to Brooms in the Plateau state of Nigeria. GEFT was administered to study the Cognitive Style. The results indicated urban males are highly Field-Independent than urban females. When both the urban and rural boys and girls are compared a significant difference was found.

2.2.1.7. Cognitive Styles and Affective Variables

Batnagar and Rastogi (1985) conducted a study on Cognitive style and basic-ideal disparity. The self concept scale developed by Rastogi (1987) and the Embedded Figure Test were administered to 192 Science Post-graduates of Lucknow University, India. Results indicate that the self concept is most significantly linked with Cognitive Style.

Hadfield and Maddux (1988) investigated the association of Field Dependent/Independent Cognitive Style with Mathematics Anxiety and indicated that Field Dependent learners experienced more Mathematics Anxiety than Field Independent learners.

2.2.1.8. Cognitive Styles and Problem Solving Style on Internet

Ford, *et al.* (1994) found significant correlations between Cognitive Style and online searching.

Leader and Klein (1996) revealed that significant interaction between search tool and Cognitive Style in the hypermedia database search.

Nahl and Tenopir's (1996) studied the influence of affective domains and Cognitive Style on online researching behaviour and found that Cognitive Style influenced the online researching behaviour.

A Summary of Studies on Cognitive Style and Academic Achievement follows.

I. Cognitive Style and Academic Achievement

	Author	Variables	Result
1.	Watkin and Astilla (1980)	Cognitive style and Academic achievement	Positive relationship
2.	Lanka (1983)	Cognitive style and Academic achievement	Cognitive Style is considered as a predictor of student performance
3.	Ballard (1985)	Cognitive style and Academic achievement	Significant correlation exists
4.	Das (1985)	Cognitive style and Academic achievement	Significantly and positively related to achievement
5.	Davey and Kapinus (1985)	Cognitive style and Academic achievement	Exists significant interaction effects
6.	Frank and Noble (1985)	Cognitive style and Academic achievement	Field Independent are more efficient in cognitive style than Field Dependent
7.	Harritte (1987)	Cognitive style and Academic achievement	Positive relationship exists
8.	Helen *et al.* (1987)	Cognitive style and Academic achievement	Significant difference in Academic Achievement between Field Independent/ Dependent

9.	Saracho (1988)	Cognitive style and Academic achievement	Significant interaction exists
10.	Hacker (1989)	Cognitive style and Academic achievement	Significant relation
11.	Moore and Dwyer (1991)	Cognitive style and Academic achievement	F1 scored higher in criterion tests than FD's
12.	Paramo and Tinayero (1991)	Cognitive style and Academic achievement	F1 performed higher in tests than FD
13.	Varma (1991)	Cognitive style and Academic achievement	Positive and Significant relationship exists
14.	Beigel (1992)	Cognitive style and Academic achievement	Cognitive style influences the academic achievement
15.	Russel (1992)	Cognitive style and Academic achievement	Positive correlation
16.	Riding and Douglas (1993)	Cognitive style and Academic achievement	Cognitive styles interact with learning performance.
17.	Ganihar (1993)	Cognitive style and Academic achievement	F1 groups performed significantly better than FD groups.
18.	Martinsen (1994)	Cognitive style and Academic achievement	Significant relationship exists
19.	Kumar (1995)	Cognitive style and Academic achievement	No Significant relationship
20.	Rialing and Agrell (1997)	Cognitive style and Academic achievement	Significant relationship exists
21.	Sujitha (2002)	Cognitive style and Academic achievement	Positive and significant relationship

22.	David (2003)	Cognitive style and Academic achievement	Significant correlation
23.	Ritchey and Lashier (1981)	Cognitive style and Academic achievement	No relationship
24.	Ritchey *et al.* (1981)	Cognitive style and Academic achievement	No significant relationship
25.	Harmon (1983)	Cognitive style and Academic achievement	Weak correlation exists
26.	Yore (1986)	Cognitive style and Academic achievement	No Significant relationship
27.	Williams (1989)	Cognitive style and Academic achievement	No relationship exists
28.	Rice *et al.* (1991)	Cognitive style and Academic achievement	Cognitive Style preferences were not significantly related to performance
29.	Feuton (1992)	Cognitive style and Academic achievement	Little relationship exists
	II. Cognitive Style and Age level		
30.	Drouin, Talbot and Goulet (1986)	Cognitive Style and Age level	No Significant difference age level
31.	Bill (1987)	Cognitive Style and Age level	There was significant different by age level
	III. Cognitive Style and Sex difference		
32.	Huss and Kayson (1985)	Cognitive style and sex difference	Significant sex difference
33.	Shade (1986)	Cognitive style and sex difference	Significant sex difference
34.	Paul, *et al.* (1992)	Cognitive style and sex difference	Significant interaction effect of cognitive style
35.	Sentacane, *et al.* (1993)	Cognitive style and sex difference	Boys and Move F1 then girls.

36.	O'Brien and Terrance (1994)	Cognitive style and sex difference	Female out performed males in achievement
37.	Ghuman (1980)	Cognitive style and sex difference	No significant sex difference
38.	Dani (1984)	Cognitive style and sex difference	No significant sex difference
39.	Brennan (1984)	Cognitive style and sex difference	No significant sex difference
40.	Walsh (1988)	Cognitive style and sex difference	No significant interaction between sex and cognitive style
III. Cognitive style and Locale difference			
41.	Varghesa (1987)	Cognitive Style and Locale difference	Significant Locale difference
42.	Tharakan (1989)	Cognitive Style and Locale difference	Significant Locale difference
IV. Cognitive Style and Affective Variables			
43.	Batnagar and Rastogi (1985)	Cognitive style and self concept	Significant relationship
44.	Hadfield and Maddux (1988)	Cognitive style and self concept	Significant relationship

2.2.2. STUDIES ON INTELLIGENCE

Studies on Intelligence are included in this section as studies related with Intelligence and Academic Achievement - Positive relationship, Intelligence and Sex Difference, Intelligence and Locale Difference.

2.2.2.1. Intelligence and Academic Achievement - Positive Relationship

Raj and Krishnan (1980) in a study of Intelligence and socio economic status and family size as correlates of Achievement observed that achievement has positive and substantial correlation with both intelligence and socio economic status. Correlation between Academic Achievement and Intelligence was found to be 0.681.

Sharma and Aggarwal (1980) observed the following conclusions (1) The performance of students on different taxonomic categories of cognitive tasks varies directly with Intelligence. (ii) Total school achievement does not have significant relationship with the performance on cognitive task in algebraic concepts (iii) The interaction between Intelligence and school Achievement has significant impact on the performance in cognitive tasks only at knowledge level and not at the comprehensive level or application level.

Mathew (1981) got a significant correlation between Non-verbal Intelligence and Biology Achievement in a study to find out Cognitive and affective correlates of Biology Achievement of secondary school pupils.

Sha and Krishan (1982) found that (1) Intelligence contributes 18.74 percent, adjustment contributes 1.20 percent, dependency contributes 0.73 percent and classroom trust contributes 1.36 percent to Academic Achievement (ii) Intelligence, adjustment, dependency and classroom trust contributes 22.04 percent to Academic Achievement of students.

Basu (1983) in his study on Intelligence as related to creativity, insecurity, academic achievement and security-insecurity revealed that there was high degree of relationship between Intelligence and Academic Achievement.

Bhargava (1983) in his study of some cognitive process in science learning with reference to physics for students of Higher Secondary classes, found that the scores on Science Process were found to be correlated with Intelligence and also with components of Socio-economic status.

Swean (1984) studied Academic Achievement of High School students in relation to Instructional design, Intelligence, Self concept and Achievement Motivation. It was found that high intelligent students score significantly better than low intelligent students and students with high self concept achieve higher than those with low self concept. Also students with high achievement motivation gained significantly higher than low achievement motivated students. Significant interaction effect was noticed between Intelligence and Self Concept to produce a sufficient difference in the mean Achievement scores of the students.

Kumar (1984) in a study of influence of Intelligence and Attitude Towards Problem Solving on Mathematics Achievement of secondary school pupils, reported that Mathematics Achievement depends upon Intelligence and Attitude Towards Problem Solving of secondary school pupils.

Gakhar (1985) revealed that (1) there is significant correlation between measures of Intelligence and Creativity taken singularly on one side and Achievement in Mathematics on other side. (ii) Intelligence and Achievement in Mathematics free from creativity and also creativity and Achievement in Mathematics free from intelligence remain significantly correlated. (iii) Intelligence is good predictor of Achievement in Mathematics.

Harnek and Parminder (1985) designed a study to explore the extent of relationship of Intelligence with Achievement in Science across different levels of socio economic status. The result indicated that Intelligence and Achievement in science are significantly positively correlated and also the relationship of Intelligence and

Achievement in Science does not vary significantly across different levels of Socio-economic Status.

John (1985) in his study reveals that there is significant relationship between the experimental variables such as Intelligence, Socio-economic Status and Achievement in English when taken in Pairs.

Kumar (1985) in a study on Achievement in Biology of secondary school pupils of High, Average and low Intelligence found that Biology Achievement was highest for the high Intelligence group, followed by average and low Intelligent groups.

Mathews (1986) tested the effects on Intelligence and creative performance were tested. Subjects were 80 male university students. The study revealed that Intelligence was highly correlated with creativity performance.

Mehna (1986) in an investigation of some factors affecting Academic Achievement in Science of standard IX students of Grater Bombay found that Verbal Intelligence, is a significant predictor of Achievement in Science.

Pillai (1986) while studying the relative efficiency of science aptitude and Intelligence to predict Biology achievement come to the conclusion that Biology achievement of secondary school students can be predicted from given Intelligence and science aptitude of the subjects, the contribution of Intelligence is found to be more and contribution of science aptitude is comparatively low.

Sontakey (1986) in a study found that high Achievers are more Intelligent, self-reliant and realistic than low Achievers in Biological sciences.

Kelu (1987) studied the relationship between Intelligence and listening comprehension in Malayalam of secondary school pupils He concluded that there was significant relationship between intelligence and listening comprehension and correlation co-efficient between these variables was found to be 0.61.

Kulwinder Singh (1987) in an attempt to explore the relationship of creative thinking and Intelligence with Academic Achievement of high school students found both creatives and high Intelligent students to be High Achievers.

Singh (1987) revealed that high Intelligence high school students are High Achievers, in comparison to low intelligent counterparts though more markedly among girls. Further high creatives differ more markedly in their academic performance from low creatives specially at high intelligence level for girls and low intelligence level among boys.

Berrington (1988) has reported that intellectually gifted and average subjects clearly differ in their science knowledge of terms and concepts.

Teasdale, *et al.* (1988) found that differences between the regions were found for both variables viz., Intelligence and educational level. Also analysis revealed that 92 percent of the regional variation in Intelligence test scores should be produced from the corresponding differences in Educational Level.

Naseema (1989) in a study to find out effect of Intelligence and science learning approach on Achievement in Physics found that there is significant and positive relationship between Intelligence and Achievement in Physics.

Kumar (1990) in a study on the interaction effect of intelligence, Cognitive Style and approaches to studying on Achievement in Biology of secondary school pupils found that significant main effect on Achievement exists only for Intelligence. But the interaction effect of Intelligence with other two variables viz., Cognitive Style and Approaches to studying is not significant.

Sreemathi (1991) in her study the effect of Intelligence on the Affective Achievement in Biology of secondary school pupils, revealed that high, average and low intelligent group of pupils differ significantly in their mean scores of Affective Achievement in Biology. High Intelligence groups have advantage over average and low Intelligence group.

Gupta, *et al.* (1993) in a comparative study of the factors affecting Academic Achievement found that Intelligence is the most important factor affecting Academic Achievement.

Srivastava (1993) in a study to find predictability of verbal test of Intelligence to Science and Mathematics Achievement found that verbal Intelligence measure is a high predictor of success in Mathematics and Science.

Singh (1994) in an investigation to find correlates of Academic Achievement found that there is a positive relationship between Academic Achievement and Intelligence.

Schaefer, *et al.* (1999) in their study Learning Behaviour and Intelligence as explanation for children's scholastic Achievement, assess the complementary ability of childhood Intelligence and learning related behaviour to explain variation in Achievement outcomes. Results reveal substantial proportion of assigned grade variance explained primarily by learning behaviour and Achievement test score explained by Intelligence.

Maree, *et al.* (2002) in their study Emotional Intelligence and Achievement, examined the meanings of the construct, 'emotional intelligence.' Two case studies of adolescent males are presented and indicate the emotional Intelligence has a significant impact not only on the qualitative level of Intelligence actualization but also on the quantitative level of Intelligence measurement and Scholastic Achievement.

2.2.2.2. Intelligence and Sex Difference

Chadda and Sen (1981) conducted a study on 166 students of twelfth grade from Delhi Higher Secondary School. Out of these, 61 were girls and remaining were boys. The tools employed were Raven's Progressive Matrices and Kulshrestha SES scale. Results showed a significant difference between high creative and low creative boys as well as girls on Intelligence.

2.2.2.3. Intelligence and Locale Difference

Singh (1982) conducted a study to find out the relationship between Creativity, Intelligence and SES. The sample consists of 400 rural and 400 urban high school students drawn from sixteen intermediate colleges in Varanasi and Faizabad division. The study depicted that men Intelligence score of Urban students was significantly higher than that of Rural students.

A summary of studies on Intelligence and academic achievement follows.

Intelligence and Achievement

	Author	Variables	Result
1.	Raj and Krishna (1980)	Intelligence and achievement	Positive relationship
2.	Sharma and Aggarwal (1980)	Intelligence and achievement	No Significant Relationship Achievement and cognitive task
3.	Mathew (1981)	Intelligence and achievement	Significant correlation between Non-verbal Intelligence and Biology Achievement
4.	Sha and Krishan (1987)	Intelligence and achievement	Positive relationship
5.	Basu (1983)	Intelligence and achievement	High degree of relationship
6.	Bhargava (1983)	Intelligence and achievement	Positive correlation
7.	Swean (1984)	Intelligence and achievement	Positive relationship
8.	Kumar (1984)	Intelligence and achievement	Positive relationship
9.	Gakhar (1985)	Intelligence and achievement	Significant correlation exists
10.	Harnek and Parminder (1980)	Intelligence and achievement	Significant Positive correlation exists
11.	John (1985)	Intelligence and achievement	Significant relationship
12.	Kumar (1985)	Intelligence and achievement	Positive relationship
13.	Mathew (1986)	Intelligence and achievement	High correlation exists
14.	Mehna (1986)	Intelligence and achievement	Verbal intelligence is a predictor of Achievement in Science
15.	Pillai (1986)	Intelligence and achievement	Significant relationship
16.	Sontakey (1986)	Intelligence and achievement	Significant relationship

17.	Kelu(1987)	Intelligence and achievement	Significant relationship
18.	Kulwinder Singh (1987)	Intelligence and Academic Achievement	Positive relationship exists
19.	Singh (1987)	Intelligence and Academic Achievement	Significant relationship exists
20.	Berrington (1988)	Intelligence and Academic Achievement	Positive relationship
21.	Teasdale, *et al* (1988)	Intelligence and Academic Achievement	Significant relationship
22.	Naseema (1989)	Intelligence and Academic Achievement	Significant ant Positive relationship exists
23.	Kumar (1990)	Intelligence and Academic Achievement	Significant main effect on achievement by Intelligence
24.	Sreemathi (1991)	Intelligence and Academic Achievement	Positive relationship
25.	Gupta *et al.* (1993)	Intelligence and Academic Achievement	Intelligence is the most important facto affecting achievement
26.	Srivastava (1993)	Intelligence and Academic Achievement	Intelligence is a high predictor of success in Mathematics and science.
27.	Singh (1994)	Intelligence and Academic Achievement	Positive correlation exists.
28.	Schaefer *et al.* (1999)	Intelligence and Academic Achievement	Positive relationship
29.	Maree, *et al.* (2002)	Intelligence and Academic Achievement	Positive relationship

Intelligence and Sex difference			
30.	Chadda and Sen (1981)	Intelligence and sex difference	Significant sex difference
Intelligence and Locale Difference			
31.	Singh (1982)	Intelligence and Locale Difference	Significant Locale difference

2.2.3. STUDIES ON CLASSROOM CLIMATE

Studies exploring the relation between Classroom Climate and Achievement are abstracted below with relevant findings. Studies conducted on abroad, India and Kerala are grouped under sections as Classroom Climate and Academic Achievement, studies related with Student Perception and Teacher Perception of Classroom Climate, Classroom Climate and Sex difference, Classroom Climate and other related variables, Climate and Locale Difference, Classroom Climate and Curriculum Evaluation Studies.

2.2.3.1. Classroom Climate and Academic Achievement

Fraser and Fisher (1980) studied the Effect of Classroom Psychological Environment on Student Learning. The investigation revealed that there occurs statistically significant association between Students Learning Outcomes and their Classroom Environment Perception.

Mintzes (1982) examined the relationship between student's perception of classroom environment and learning outcomes in college Biology. The findings of the study revealed that Achievement was related to student's perception of Classroom Environment.

Fraser (1983) studied the association between student Learning Outcomes and their perception of Classroom Environment.

Results indicated that student Learning Outcomes were enhanced in classes with greater application, task orientation and order and organization. There is significant correlation between Affective Outcomes and Classroom Environment variables like Involvement, Affiliation and Teacher support.

A study of Classroom Influences on Attitude towards Science and Achievement in Science among, tenth grade Biology students was conducted by Tatton (1983). The results revealed that the Classroom Environment was strongly related to Attitude but relatively weakly associated with Achievement and Attitude plays an important role in mediating the influence of Classroom Environment on Achievement of students.

Christian (1984) conducted a study on group dynamics, Academic motivation and Academic performance on a sample of 293 Higher secondary pupils. The study revealed that the pupils in urban classroom had shown higher mean scores on Academic motivation as well as Classroom Climate. But average scores on Academic performance.

Byrne, *et al.* (1986) conducted a study on the student perceptions of preferred Classroom Learning Environment on a sample of 1675 students from 8 schools. It was found that there is significant relation between students Achievement and Classroom Climate.

Fraser (1986) in his study found that teaching behaviour, teaching styles and students perceptions of Learning Environment are related to Student Learning.

Jene and Barry (1986) studied the relationship between students Achievement and Classroom Environment Perception. The sample consisted of 1675 students in grades 7, 9 and 11 from 18 schools on the cost of New South Wales, Australia, Estimates of Achievement for English and Mathematics were found to be more highly correlated to actual Environment.

Beine (1989) attempted to find out the relationship of Science Learning Environment and Science Learning Approach on Biology Achievement. It was found that correlation obtained between Science Learning Environment and Science Learning Approach with Biology Achievement are positive and significant.

Ramsden, *et al.* (1989) conducted a study on School Environment and sixth forum pupils Approaches to Learning. This presents result from a study of Australian Pupils in their final year of secondary schooling. A key finding is that, perceived School Environment and pupils learning are related in systematic way. School Environment offering supportive teaching coherent structure, emphasis on autonomy and moderate state on Achievement are associated with learning.

Hardney (1992) investigated the relationship between instructor goals and Classroom Climate perception for adult learners. It was reported that teacher support demonstrated the strongest relationship with student outcomes or final grade Achievement.

Padhi (1992) in his study on the relation between the Psycho-Social characteristics of Classroom Environment, Creative ability, Academic self concept an academic Achievement of Secondary School Pupils. The study revealed that creative ability and Psycho-Social characteristics of Classroom Environment of students are significantly related to their Academic self concept and Achievement in school subjects.

Raymond, *et al.* (1993) conducted a study on character analysis of high school science Classroom Environment and Attitude towards science. The sample for study were selected high school students the results suggested that perception of their Classroom Environment effect the Attitude and Achievement of students.

Gregories (1994) investigated the effects of leadership social skill training in mixed gender, co-operative groups on science achievement, attitude towards science and classroom climate. Results indicated that students in the leadership condition and students in the non-leadership condition were not significantly different in their view of the Classroom Climate and in the Test of Science Knowledge.

Prabha (1994) in her study found that there was a significant different in the Achievement in basic concepts in Biological Science between pupils of good Classroom Climate and moderately good Classroom Climate schools.

Henderson, *et al.* (1995) conducted a study on Association between Learning Environment and Student Outcomes in Biology of Australian Biology students. The study indicated that certain aspects of Learning Environment are associated with Students Outcomes. These include the integration of practical and theory work, the degree of open-endedness, teachers leadership behaviour and the level of student responsibility and freedom.

Hunng (1995) studied the relationship between Home and School Environment on the Academic Achievement of eighth grade Asian American students. Their learning environments, in terms of parent guidance, teacher support, class order satisfaction and teaching quality were studied with attention to gender and language spoken at home. Subjects were 1527 eighth grade Asian Americans of differing ethnic backgrounds. In general Asian American students had favourable learning environments at home and in school. Student reported good parent support, positive teacher support, good teaching quality and satisfaction. Girls had a more favourable perception of parental guidance and class orders than boys. It is also found that significant difference in achievement between favourable learning environment group and less favourable environment group.

2.2.3.2. Student Perceptions and Teacher Perceptions of Classroom Climate

The findings from prior research are high lighted in the results of a meta-analysis involving 734 correlations from a collection of 12 studies of 10 data set from 823 classes in eight subjects areas containing 17,805 students in four nations (Haertel, Walberg & Haertel, 1981). Learning post test scores and regression adjusted gains were found consistently and strongly to be associated with cognitive and affective learning outcomes, although correlation generally were higher in samples of older students and in studies employing collectivities such as classes and schools as the units of statistical analysis. In particular, better achievement on a variety of outcome measures were found consistently in classes perceived as having greater cohesiveness, satisfaction, and Goal Direction, and less Disorganisation and Friction.

Lawrens and Much (1984) used the MCJ to invstigate whether the grouping of stuents in the laboratory according to their formal reasoning ability affected the perceived laboratory learning environment, among a sample of 91 undergraduate science students. The finding was that the method of laboratory grouping did not affect students perception of their Classroom Learning Environment.

Talmage, Pascarella and Ford's (1989) evaluative investigation of teacher's involvement in a cooperative good structuring project included as one of the its efficacy criteria a measure of student perceptions of Classroom cooperation based on a modification of a scale contained in the My Class Inventory (MCI). It was found that the length of teacher experience with cooperative grouping was significantly associated with student perceptions of classroom cooperation, even with student prior achievement, grade level and initial cooperative environment perception held constant.

Mary and Roger (1994) in their study on "College Classroom Environments; Disciplinary and Institutional Type Differences and effects on Academic Achievement in Introductory course," using the college Classroom Environment Scales and controlling for differences in class size, a study found significant differences in college students perception of their classroom social climates depending on institution type and academic discipline and that Perceptions of Environment differentially affected students grades in each discipline area.

2.2.3.3. Classroom Climate and Sex Difference

Owens and Straton (1980) in a study involving students preferences for different types of classroom environments, girls were found to prefer co-operations more than boys, but boys preferred both competition and individualization more than girls.

Patel (1987) studied the dimensions of Classroom Environment. The sample consisted of 2594 students of Std. VIII, IX and X of 22 secondary schools of Gujarath state. The major findings were 1) Classrooms were classified as open, intermediate and closed in terms of the environment of classroom. (2) There was a significant difference between boys and girls on Classroom Environment scores.

(3) Data did not support the association among different categories of Classroom Environment with respect to area that is rural and urban.
(4) There was a significant difference in mean Classroom Environment scores of pupils belonging to three categories of Achievement.

2.2.3.4. Classroom Climate and other related variables

Kuhlemiuer (1983) used instruments based on the ICEQ in evaluating PLON, a new physics curriculum, emphasizing inquiry based teaching methods. His data were obtained by administering a Dutch instrument based on all five scales in I.C.E.Q. It was found that PLON students perceived their Classroom as having greater emphasis on participation, independence, investigation and differentiation.

Kumar (1984) conducted a study on perception of Classroom Social Climate with reference to production of dimensions of Academic Motivation of high school students. The findings of the study were (1) There was positive and significant correlation between nine dimensions of academic motivation. There was significant correlation between total Classroom Social Climate and total Academic Motivation scores.

Short, *et al.* (1991) perceived studies on Classroom Environment and students behaviour in Secondary classrooms. The study investigated the relationships between Classroom Social Climate and on task behaviour of students. Multiple regression analysis indicated that social climate variables were significantly related to classroom on task behaviour. Most of relationships between Social Climate and task behaviour was accompanied by teacher support, rule clarity, teacher control and innovation as measured by the Classroom Environment Scale.

Fouts (1992) reported that in classrooms with significant student environment, teacher support, group affection, organisation and teacher innovation, student attitude towards science were highest.

Kalyanidevi (1997) conducted a study on home and school environment, their influence on perceptual style. The sample of the study constitute 240 high school student of Thirupathy town. One of the key findings of the study revealed that the Field dependence/Independence is significantly influenced by school environment. The study reveals that the Home and School Environment are responsible for Perceptual Abilities in children.

Muraleedharan's (1999) study on the relationship between Process Outcomes in Science and Classroom Environment of secondary school pupils revealed that there exist significant relationship between these variables for total sample and some of the set for sub samples Boys, Girls, Government, Private, Rural and Urban.

Reema (2002) conducted a study on Relationship between Process Outcomes in Science and Classroom Climate of secondary school pupils of Kerala. The present study was carried out on a representative sample of 400 pupils of standard IX. She found that the relationship between Classroom Climate and Process Outcomes in Science in positive and significant for total sample and all other samples.

2.2.3.5. Classroom Climate and Locale Difference

In a study by Pandya (1991) on Classroom Climate in school under different types of management using a ratified random sample consisting of secondary schools of Bombay, it was found that (ii) dimension of Classroom Climate of students coming from aided, unaided and central schools do not differ significantly from each other and (ii) Students coming from Municipal schools differed on the Classroom Climate score and its dimensions significantly from those coming from other types of schools.

Kumari (1996) studied the influence of Classroom Climate and Approaches to studying on Achievement in Physics on a sample of 1000 secondary school pupils. Results showed that Classroom Climate has significant effect on Achievement in Physics in total sample and subsamples based on sex and locale.

2.2.3.6. Classroom Climate and Curriculum Evaluation

Levin (1980) reported the use of student perception of Classroom Environment as dependents variables in evaluating an individualized curriculum in 57 first to third grade classroom in three cities in Israel. Results indicated that students in individualized Classrooms perceived greater autonomy than students in traditional classrooms.

Wang, *et al.* (1984) included five Classroom Environment dimensions assessed by My Class Inventory to study the effects of a programme designed to provide special education services for mainstreamed handicapped students in regular classroom settings on a full time basis. This analysis suggested that compared with their general education peers, mainstreamed special education students seemed to perceive their classes as less difficult, more competitive and less cohesive.

Wiestra (1984) used instruments based on the ICEQ in evaluating PLON, a new physics curriculum emphasizing inquiry-based teaching methods. Wietra administered a scale based on a translation and modification of the ICEQ's participation and investigation scales to 254 PLON students and 144 control students. It was found that PLON students perceived greater levels of inquiry in their classrooms than did control students.

A summary of studies on Classroom Climate and Student Outcomes follows.

Classroom Climate and Student Outcomes

	Author	Variables	Result
1.	Fraser and fisher (1980)	Classroom climate and Student Outcomes	Significant association exists
2.	Mintzes (1982)	Classroom climate and Student Outcomes	Positive relationship
3.	Fraser (1983)	Classroom climate and Student Outcomes	Positive relationship
4.	Tatton (1983)	Classroom climate and Student Outcomes	Classroom climate is strongly related to attitude but weakly associated with achievement
5.	Christian (1984)	Classroom climate and Student Outcomes	High relation with academic motivation and average with academic performance
6.	Byrne, *et al* (1986)	Classroom climate and Student Outcomes	Significant relation exists
7.	Fraser (1986)	Classroom climate and Student Outcomes	Positive relationship
8.	Jene and Barry (1986)	Classroom climate and Student Outcomes	High correlation exists
9.	Beine (1989)	Classroom climate and Student Outcomes	Positive and significant correlation

10.	Ramsden *et al.* (1989)	Classroom climate and Student Outcomes	Positive relationship
11.	Hardney (1992)	Classroom climate and Student Outcomes	Positive relationship
12.	Padhi (1992)	Classroom climate and Student Outcomes	Positive relationship
13.	Raymond *et al* (1993)	Classroom climate and Student Outcomes	Positive relationship
14.	Gregories (1994)	Classroom climate and Student Outcomes	No significant difference in Classroom climate
15.	Prabha (1994)	Classroom climate and Student Outcomes	Positive relationship
16.	Henderson, *et al.* (1995)	Classroom climate and Student Outcomes	Positive relationship
Students Perceptions and Teacher Perceptions of Classroom Climate			
16.	Hartel, Walberg and Haertel (1981)	Student Perception of Classroom Climate and Learning Outcomes	Positive relationship
17.	Lawrence and Much (1984)	Student Perception of Classroom Climate and learning outcomes	Negative relationship
18.	Talmage, Pascarella and Ford (1989)	Student Perception of Classroom Climate and learning outcomes	Significant association
19.	Mary and Roger (1994)	Student Perception of Classroom Climate and learning outcomes	Significant relationship
Classroom Climate and Sex Difference			
20.	Owens and Straton (1980)	Classroom Climate and Sex difference	Significant difference between boys and girls in Classroom environment

21.	Patel (1987)	Classroom Climate and Sex difference	Positive relationship
Classroom Climate and Other Related Variables			
22.	Kuhleminer (1983)	Classroom climate and Participation, independence, investigation and differentiation	Positive relationship
23.	Kumar (1984)	Classroom climate and academic motivation	Significant correlation
24.	Short, *et al.*, (1991)	Classroom climate and academic motivation	Significant relation exists
26.	Fouts (1992)	Attitude towards science and classroom Climate	Positive relationship
27.	Kalyanidevi (1997)	Attitude towards science and classroom Climate	Positive relationship
28.	Muraleedharan (1999)	Attitude towards science and classroom Climate	Significant relationship exists
29.	Reema (2002)	Attitude towards science and classroom Climate	Positive and significant relationship
Classroom climate and Locale Difference			
30.	Pandhya (1991)	Classroom Climate Locale and Management	Significant Locale difference
Classroom Climate and Curriculum Evaluation			
31.	Levin (1980)	Classroom Climate and Curriculum	Individualised classroom perceived greater autonomy than traditional classroom
32.	Wang, *et al.* (1984)	Classroom Climate and Curriculum	Significant difference in Classroom Climate between handicapped special education students and general education students.

33.	Weistra (1984)	Classroom Climate and Curriculum	Students from Inquiry based teaching methods perceived greater levels of inquiry conventional students.

2.2.4. STUDIES ON PROCESS OUTCOMES IN SCIENCE

Reviewed studies on Process Outcomes in Science are grouped under different as Studies Related with Process Outcomes in Science and Sex Difference, Process Outcomes in Science and Affective Variables, Process Outcomes in Science and Other Related Variables, Process Outcomes in Science and Curriculum.

2.2.4.1. Process Outcomes in Science and Sex Difference

Mini (1989) reported significant and high mean difference for Process Outcomes in Biology between equated groups of boys and girls of equating age, intelligence, socio economic status and locale.

Prasad (1995) conducted a study on Interaction of Approaches to Studying and Achievement motivation on Process Outcomes in Physics of secondary school pupils. His study revealed that there is no significant difference between mean scores of boys and girls in Process Outcomes in Physics.

Soumya (2003) investigated the effect of creativity and Intelligence on Process Outcomes in Science of 500 standard IX pupils. Results showed that Intelligence yield significant main effect on Process Outcomes in Science. The study revealed that boys and girls difference significantly in their Intelligence and Process Outcomes in Science. However the interaction effect of intelligence an Creativity and Process Outcomes in Science is not found to be significant.

2.2.4.2. Process Outcomes in Science and Affective Variables

Gabel and Rubba (1980) made an attempt to modify an existing physics course which would improve the pre-service teacher's attitudes towards science and science teaching and their ability to use Science Process Skills. The result showed that Physics students enrolled in science method class was slightly more proficient in Science Process Skills.

Zeitler (1981) conducted a study to determine the influence of two types of practice used during Process Skills Instruction on pre-service elementary teachers acquisition and classroom utilization of those skills using Process Skill tests on 29 female undergraduates, the result showed significant gains in Skill acquisition.

Cox (1982) investigated the development of related Science Process Skills in required and elective. Science classes in the high schools of sub urban Origon school. The results showed that formal reasoning was the strongest predictor of Process Skills Outcomes.

Noushad (1989) in a study to find the effect of sex, locale and attitude towards problem solving on Process Outcomes in Biology got significant relation between Attitude towards Problem Solving and Process Outcomes in Biology.

Varghese (1989) in a study of Affective Correlates of Process Outcomes in Biology, found that Process Outcomes in Biology can be predicted by using the score of attitude towards problem solving, attitude towards science and achievement motivation.

Ampili (1991) studied the relationship between Process Outcomes and Scientific Attitude and found that Process Outcomes have a determining influence on Scientific Attitude and a very close and considerable relationship.

Sujatha's (1994) study on the relationship between adjustment and Process Outcome in Biology is significant at 0.01 levels for personal Adjustment, Social Adjustment and Total adjustment separately with Process Outcomes in Biology.

Paulose's (1995) study on the influence of scientific attitude of university entrants on their Process Outcomes in Physics found that three independent variables viz., Scientific Attitude, Sex and Residence exerted a significant influence on the dependant variable viz., Process Outcomes in Physical Science.

Geetha (1991) conducted a study on Attitude Towards Science and Process Outcomes in Biology of secondary school pupils and found that there exist a significant relation between Process Outcomes in Biology and Attitude Towards Science.

Vineetha's (2000) study on relationship between Science Studying Approach and Attitude Towards Science with Process Outcomes in Physical Science of secondary school pupils revealed the existence of significant relationship between the Process Outcomes in Physical Science and each of the independent variables.

Sabitha (2003) studied the relationship between Process Skills in Science an Attitude Towards Science of 500 standard VIII pupils. The findings revealed that Process Skills in Science was significantly correlated with Attitude Towards Science. One way analysis of the variance of revealed that Attitude towards Science has significant effect on Process Skills in Science.

2.2.4.3. Process Outcomes in Science and Other Related Variables

Alderton, *et al.* (1985) in their study individual differences in Process Outcomes for Verbal Analogy and classification solution, found that Process Outcome measures accounted for overall performance and were related to ability. Problem form differed in terms of which measures predicted individual differences. Common Process Outcome measures showed highest correlation across problem forms.

Adey and Harlen (1986) conducted a survey to determine the level of Science Process Skills in representative sample of 11 years of old children in Britain. It was found that the level of cognitive demand was a reliable predictor of limiting difficulty of an item.

Padilla and Padilla's (1986) study on the Science Process Skills, suggest that thinking in science can be taught and learned by elementary, middle and secondary students. Suggestion for teachers are offered and implication for instruction offered skills like (1) making the teaching tasks and expectations to the level of learner (2) Teaching efficient problem solving strategies.

Suresh (1991) in his study on identification of certain Sociological, Environmental variables related to Process Outcomes in Secondary School Biology, found significant relationship between Process Outcomes in biology and certain sociological environmental variables.

Valsala (1997) studied the effects of certain Cognitive and Affective correlates on Process Outcomes in Physics on a sample of 575 First year degree students. The study revealed that among cognitive variables, 'Creativity', 'Spatial ability' and 'Intelligence' are the best correlates of 'Process Outcomes in 'Physics'.

Joshy (2002) conducted a study on Environmental awareness in relation to Process Outcomes in Science of Secondary School Pupils of Trissur district. The study was conducted on 450 secondary school pupils of standard IX. He found that there exist significant substantial positive correlation between Environmental Awareness and Process Outcomes in Science.

Shabana (2003) investigated the relationship between Intelligence and Process Outcomes in Science of 500 standard IX pupils. The results showed that the relationship between Intelligence and Process Outcomes in Science is positive and significant.

2.2.4.4. Process Outcomes in Science and Curriculum

Shymansky (1983) analysed experimental studies involving different innovative Science Curricula. Students exposed to new curricula performed better than students in traditional courses in general achievement, analytic skills, Process Skills and related skills as well as developing more positive attitude towards science.

Blosser (1985) support the idea that the Science Curriculum improvement project materials developed after 1955 were successful in promoting Student Achievement in the use of Process Skills in creativity and in higher cognitive skills at both elementary and secondary school levels. Research focussed more or programmes than on test books.

Khalwania (1986) conducted a study which showed that the concept based Curriculum was more effective than conventional curriculum in terms of Process Skills as well as in developing better cognitive structure.

Yager (1989) used the inter disciplinary approach of Science/ Technology/Society (STS) for illustrating how curriculum should be structured to improve creativity and Process Skills.

Wilson and Neubauer, in 1990 compared the teachers roles in three exemplary hands – Science A Process Approach (SAPA), Elementary Science Study (ESS) and Science Curriculum Improvement Study (SCIS) on elementary science programmes. The study revealed that with SAPA studies scores highest gain 36%.

Romance and Vitale (1992) report a study of replacing a basal reading programme with a curriculum emphasizing science activities, Science Process Skills and science content based reading in three fourth grade classrooms. The results showed the students displayed significantly greater scores on test of reading and science and more positive attitude towards science and reading compared to a demographically similar control groups.

Strawitz (1993) conducted study on the effects of review on Science Process Skill acquisition. This study examined how programmed materials could be implemented to promote a higher level of process skill proficiency. Conclusions from the study were that review strategies did not affect Science Process Skill proficiency and programmed instruction was more effective than teacher directed instruction.

Sunnal (1998) conducted study on relationship of science skill performance to pre-science teaching behaviour. Results indicate the level of ability to perform Science Process Skill tests is not related to teacher classroom behaviour consisted with teacher roles in new elementary science curricula.

A summary of studies on Process Outcomes in Science and Academic Achievement follows.

Process Outcomes in Science and Affective Variables			
1.	Gable and Rubba (1980)	Attitude towards Science and Process Outcomes in Science	Positive relationship
2.	Zeitler (1981)	Attitude towards Science and Process Outcomes in Science	Positive relationship
3.	Cox 1982)	Attitude towards Science and Process Outcomes in Science	Formal reasoning was the strongest predictor of Process skills outcomes
4.	Noushad (1989)	Process Outcomes in Science and Affective Variables	There is significant relation between Attitude Problem solving and Process Outcomes in Biology
5.	Varghese (1989)	Process Outcomes in Science and Affective Variables	Process outcomes in Biology can be predicted by using the score of attitude towards problem solving attitude towards science and achievement motivation.
6.	Ambili (1991)	Process Outcomes in Science and scientific attitude	Positive relationship
7.	Geetha (1991)	Process Outcomes in Science and Attitudes	Significant Relationship
8.	Sujatha (1994)	Process Outcomes in Science and Adjustment	Significant relationship
9.	Paulose (1995)	Process Outcomes in Science and Attitude	Significant relationship
10.	Vineetha (2000)	Process Outcomes in Science with Science Studying Approach and Attitude Towards Science	Significant relationships

11.	Sabitha (2003)	Process Outcomes in Science and Attitude	Significant relationship
Process Outcomes in Science and Other Related Variables			
12.	Alderton, *et al.* (1985)	Verbal analogy and Process Outcomes in Science	Positive correlations
13.	Adey and Harlen (1986)	Verbal analogy and Process Outcomes in Science	The level of cognitive demand was a reliable predictor of limiting difficulty of an item.
14.	Padilla and Padilla (1986)	Thinking in Science and Science Process skills	Thinking in Science can be taught
15.	Yagar (1989)	Science Process Skills Creativity and Curriculum	Science Education can be effective
16.	Valsala (1997)	Process Outcomes in Science and Cognitive and Affective variables	Creativity, Spatial availability and intelligence are best correlates of process Outcomes.
17.	Joshy (2002)	Process Outcomes in Science and Environmental Awareness	Positive correlation
18.	Shabana (2003)	Process Outcomes in Science and Intelligence	Positive and significant relationship
Process Outcomes in Science and Curriculum			
19.	Shymansky (1983)	Process Outcomes in Science and Science Curriculum	Positive correlations
20.	Blosser (1985)	Process skills in Science Curriculum improvement project materials	Promoting Achievement

21.	Khalwania (1986)	Concept based Curriculum and Process skills	Concept based curriculum has significant effect on process skills
22.	Wilson and Neubauer (1990)	Teachers role and Science A Process Approach (ASAPA) Elementary Science Study (ESS) Science Curriculum Improvement study (SCIS)	Teachers role is high in SPA
23.	Romance and Vitale (1992)	Science Process skills Science content based reading	Significant high reading scores in Science Process skills curriculum

VARIABLES, HYPOTHESES AND METHODOLOGY

Aruna P.K. “Influence of cognitive style intelligence and classroom climate on process outcomes in science of secondary school pupils of Kerala ” Thesis. Department of Education , University of Calicut, 2004

CHAPTER 3

VARIABLES, HYPOTHESES AND METHODOLOGY

VARIABLES, HYPOTHESES AND METHODOLOGY

Methodology is an operational framework of the study with which the design of the study is described. As such it is very crucial that the success of any research depends on method adopted and the tools and techniques employed for data collection and analysis.

The method followed for the study is described under the major headings viz.,

3.1 VARIABLES
3.2 OBJECTIVES
3.3 HYPOTHESES
3.4 METHODOLOGY

3.1. VARIABLES

The present investigation is an attempt to study the influence of select independent variables namely, **Cognitive Style**, **Intelligence** and **Classroom Climate** on **Process Outcomes in Science**. The variables of the study have been selected on the basis of following rationale.

3.1.1. RATIONALE FOR SELECTION OF VARIABLES

The independent variables of the study were decided after an initial review of literature in the area of academic achievement. The literature suggested that academic achievement of a student is associated or linked with a number of variables of the dimensions like **Cognitive, Affective, Environmental, Socio-familial** etc. In the present study, the investigator gave prominence to the Cognitive and Environmental dimensions, in which a good number of studies were done and are to be studied in depth. From these variables, that are closely related with **Process Outcomes in Science** were identified.

Students personal characteristics basically initiate performance either as short term or long term academic achievement. Student characteristics have a good deal in determining who would do what in the academic field and later in life. It was experimentally established that **Academic Achievement** and **Intelligence** are highly related. (Srivastava, 1993; Singh, 1994; Schaefer, 1999). Thus **Intelligence** was taken as one of the Independent variable for the study. Many studies revealed that **Cognitive Styles** are related to Intellectual and Academic Achievement (Coop and Sigel, 1970; Briel, 1978; Bhargava, 1983). But studies conducted in this area is comparatively less. So **Cognitive Style** was taken as another independent variable for the study. In case of an environment which can provide cognitive nourishment and intellectual stimulation, will aid development. **Classroom Climate** is another variable having relation with Achievement as studied by many researchers (Mintzes, 1983; Fracer, 1986; Byren, *et al.* 1986; Huang, 1995). This warranted an interaction study of **Intelligence, Cognitive Style** and **Classroom Climate.**

On a preliminary review of both theory and research studies in the area of Achievement in Science, the investigator felt that will be of extreme importance to know why some intelligent students achieve very low in spite of their problem solving ability. This also motivated the investigator to design the study with independent variables as, **Cognitive Style** and **Intelligence**. Environmental variable viz., **Classroom Climate** was also selected as another independent variable for the study.

3.1.2. Criteria used for Selection of Variables

After identifying the important factors affecting **Process Outcomes in Science**, the investigator made a cautious selection of variables for the present study considering the following aspects.

3.1.2. 1. Variables should be strongly related to Process Outcomes in Science.

3.1.2.2. Process Outcomes in Science is a field of attraction for educational investigation recently, as science learning and teaching are process oriented.

3.1.2.3. Among the variables which affect achievement, the role played by Intelligence and Cognitive Styles are established one.

3.1.2.4. Favourable Classroom Climate largely contributed to the development of child's Cognitive Styles.

3.1.2.5. Cognitive Styles and Intelligence are related to environmental variables, social class, rural and urban background.

3.1.2.6. Standardised test should be available for selected variables or could be developed within a reasonable time.

3.1.2.7. The factors selected can be objectively measured.

Considering the above criteria the following variables were selected as Independent variables for the present study.

3.1.3. Independent Variables

The major objective of the study is to find out the main effect and interaction effect of three select independent variable on **Process Outcomes in Science**. The Independent Variables are

1) Cognitive Style
2) Intelligence
3) Classroom Climate

3.1.4. Dependent Variables

Process Outcomes in Science is the dependent variables or criterion variable of the study.

For the present study the term 'Process Outcomes' as applied to science stands for intellectual skills needed for scientific investigation attained by the students as a result or consequence of learning science.

3.1.5. Basal Variables

The variables like Gender of Student (Boys or Girls), School Locale (Rural or Urban), Type of Management of School (Government or Private) are treated as basal variables for the study.

3.2. OBJECTIVES

The present study has the following objectives.

3.2.1. To compare the mean scores of Independent Variables **Cognitive Style, Intelligence, Classroom Climate** and the Dependent Variable **Process Outcomes in Science** between the sample of Boys and Girls in the Total sample.

3.2.2. To compare the mean scores of Independent Variables **Cognitive Style, Intelligence, Classroom Climate** and the Dependent Variable **Process Outcomes in Science** between the sample of Rural and Urban in the Total sample.

3.2.3. To compare the mean scores of Independent Variables **Cognitive Style, Intelligence, Classroom Climate** and the

Dependent Variable **Process Outcomes in Science** between the sample of Government and Private in the Total sample.

3.2.4. To estimate the relationship between Independent Variable **Cognitive Style** and the Dependent Variable **Process Outcomes in Science** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Private and Government.

3.2.5. To estimate the relationship between Independent Variable **Intelligence** and the Dependent Variable **Process Outcomes in Science** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Private and Government.

3.2.6. **To estimate the relationship between Independent Variable** Classroom Climate **and the Dependent Variable** Process Outcomes in Science **for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Private and Government.**

3.2.7. To estimate the relationship between Independent Variables **Cognitive Style** and **Intelligence** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

3.2.8. To estimate the relationship between Independent Variables **Cognitive Style** and **Classroom Climate** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

3.2.9. To estimate the relationship between Independent Variables **Intelligence** and **Classroom Climate** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

3.2.10. To study the main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils for Total Sample.

3.2.11. To study the main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils for Boys Sample.

3.2.12. To study the main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils for Girls Sample.

3.2.13. To study the main and interaction effects of **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils for Rural Sample.

3.2.14. To study the main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils for Urban Sample.

3.2.15. To study the main and interaction effects of **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils for Government Sample.

3.2.16. To study the main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom**

Climate on **Process Outcomes in Science** of Secondary School Pupils for Private Sample.

3.2.17. To predict High, Average and Low groups of **Process Outcomes in Science** using select set of Independent Variables (Discriminating Variables) **Cognitive Style, Intelligence** and **Classroom Climate.**

3.3. HYPOTHESES

The hypotheses formed and tested are the following.

3.3.1. There will be significant difference in the means scores of Independent Variables **Cognitive Style, Intelligence, Classroom Climate** and the Dependent Variable **Process Outcomes in Science** between the sample of Boys and Girls in the Total sample.

3.3.2. There will be significant difference in the means scores of Independent Variables **Cognitive Style, Intelligence, Classroom Climate** and the Dependent Variable **Process Outcomes in Science** between the sample of Rural and Urban in the Total sample.

3.3.3. There will be significant difference in the means scores of Independent Variables **Cognitive Style, Intelligence, Classroom Climate** and the Dependent Variable **Process Outcomes in Science** between the sample of Government and Private in the Total sample.

3.3.4. There will be significant relationship between Independent Variables **Cognitive Style** and the Dependent Variable **Process Outcomes in Science** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

3.3.5. There will be significant relationship between Independent Variables **Intelligence** and the Dependent Variable **Process Outcomes in Science** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

3.3.6. There will be significant relationship between Independent Variables **Classroom Climate** and the Dependent Variable **Process Outcomes in Science** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

3.3.7. There will be significant relationship between Independent Variables **Cognitive Style** and **Intelligence** in the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

3.3.8. There will be significant relationship between Independent Variables **Cognitive Style** and **Classroom Climate** in the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

3.3.9. There will be significant relationship between Independent Variables **Intelligence** and **Classroom Climate** in the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

3.3.10. The main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils will be significant for the Total sample.

3.3.11. The main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on

Process Outcomes in Science of Secondary School Pupils will be significant for the Boys Sample.

3.3.12. The main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils will be significant for the Girls sample.

3.3.13. The main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils will be significant for the Rural sample.

3.3.14. The main an interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils will be significant for Urban Sample.

3.3.15. The main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils will be significant for Government Sample.

3.3.16. The main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils will be significant for Private Sample.

3.3.17. High, Average and Low groups of **Process Outcomes in Science** can be predicted using Independent Variables (Discriminating Variables) **Cognitive Style, Intelligence** and **Classroom Climate.**

3.4. METHODOLOGY

The methodology of the study has been described under the following heads.

3.4.1. TOOLS USED
3.4.2. SAMPLE SELECTION
3.4.3. DATA COLLECTION
3.4.4. SCORING AND CONSOLIDATION
3.4.5. STATISTICAL TECHNIQUES USED FOR ANALYSIS
3.4.6. CLASSIFICATION TECHNIQUES

3.4.1. TOOLS USED

The independent and dependent variables of the present study are measured using tools with adequate psychometric properties.

For the present study, the data needed were collected using the tools listed in Table 3.1.

TABLE 3.1

Details of the Tools Used

Sl. No.	Tools used	Reliability	Validity
1.	Group Embedded Figures Test - GEFT (Oltman, *et al.*, 1971)	0.82 (Split half)	Ranged between -0.63 - -0.82
2.	Standard Progressive Matrices Test – SPMT (Raven, 1958)	Ranged between 0.80 - 0.90	Ranged between 0.50 - 0.86
3.	Scale of Classroom Climate - SCC (Usha & Aruna, 1999)	0.85 (Test Retest)	0.54 (Criterion related validity)
4.	Test of Process Outcomes in Science - TPOS (Aruna, 1999)	0.86 (Test Retest)	0.81 (Criterion related validity)

Each of the above tool is described below with essential details like authority of tool, variables measured by each, definition of the variable and description of tool development, different dimensions of tool with examples, scoring scheme, item analysis and psychometric characteristics like reliability and validity.

3.4.1.1. Group Embedded Figures Test - GEFT (Oltman, *et al.*, 1971)

Data regarding Cognitive Style of students were collected using Group Embedded Figures Test (GEFT) developed by Oltman, *et al.*, (1971). Cognitive Styles refers to different ways in which people process information and utilize information while learning concepts. Two major types of Cognitive Style, viz., Field-Independent (FI) and Field-Dependent (FD) were identified. This was associated with the programme of research triggered by Witkin (1950). It was found that the perceptual judgements of some people are consistently influenced by the context, while for others the context has little influence.

Field-Independent refers to articulated dimension of Cognitive Style. It is the ability to overcome embedding context in perceptual functioning and it is considered to be an analytical aspect of an articulated mode of field approach as expressed in perception.

Field-Dependent refers to global dimension of Cognitive Style. It is a tendency to perceive globally. The perception is guided by organization of field as a whole. The GEFT by employing a hidden figure format require a subject to identify certain basic shapes in 25 different items, divided into three parts. The first part contains only seven items. The second and third part contains nine items each. The subject test scores were obtained by finding the sum of correct items on second and third part of test.

The time limit of 3 minutes for practice section and 5 minutes for second and third section was given as per test manual. The scores ranged from 0-8 indicating Field-Dependent (FD) Orientation, scores 9-13 intermediate (INT) Orientation and 14-18 scores Field-Independent (FI) Orientation.

3.4.1.2. Validity and Reliability

Split half reliability of 0.81 was reported in the test manual, when Embedded Figure Test (EFT) was used as criteria. The validity ranged between -0.63 and -0.82. (The coefficient of correlation is negative because GEFT is scored in negative fashion). In a study conducted by Kusuma (1997) in Andhra Pradesh the reliability coefficient was found 0.428 for males and 0.527 for females by Test-retest method.

3.4.1.3. Standard Progressive Matrices Test - SPMT (Raven, 1958)

It is designed to assess as accurately as possible a person's present clarity of observation and level of intellectual development. This was established by Raven (1958). This is a non verbal test. The test consists of five sub-tests of twelve items each. In each item a part of the geometrical design is missing. Six or eight alternatives are given for each design. All of these fit the missing part, but only one logically belongs to it. This test is reliable and valid one. The reliability coefficients as reported by Raven vary from 0.80 to 0.90. Validity of the test has been estimated in a variety of usual ways. When Stanford-Binet test was used as criterion, correlation varied from 0.50 to 0.86. In a study conducted by Nair (1967) in Kerala, the reliability coefficient was found varying from 0.70 to 0.86 by split-half method and from 0.84 to 0.91 by test retest method. The test was administered and scored according to instruction given in Standard Progressive Matrices Manual (Raven, 1958). The scoring key consists of 5 categories, A, B, C, D, E: under each category there are 12 items. Each correct response is given a credit of 1. Total score in each category is 15. Maximum score possible on whole test is 60. With an Indian study Sinha (1977) reported a split-half reliability of 0.89 and 0.95. Dey (1984) with Indian students obtained a Kuder-Richardson correlation of 0.91. The response sheet and scoring key are presented in Appendices Ia and Ib respectively.

3.4.1.3. Scale of Classroom Climate – SCC (Usha & Aruna, 1999)

The Scale of Classroom Climate was developed and standardised by investigator in consultation with experts. The scale is intended to assess the perception of Classroom Climate by Secondary school students. Classroom Climate is the type of learning condition existing in the classroom. This includes the emotional, physical, social intellectual climate set up by the teacher and students to create a wholesome learning situation. Classroom Climate Scale and Learning Environment Inventory developed by Fraser (1982) formed the major source for the preparation of items. In developing SCC, reviewed conceptual and empirical literature in educational and organizational psychology, sought description of Classroom Climate and Classroom Environment Inventories from prior educational research and popular literature and observed classroom in several contrasting high schools. The personal interviews with teachers and students, opinions from a group of educationists, opinion of researchers and review of literature and Inventories relating to Classroom Climate and Classroom Environment available are the sources for the development of the items.

3.4.1.3.1. Identification of Salient Dimensions

The first step in the development of Scale of Classroom Climate is identification of tentative list of the individual dimensions which characterise Classroom Climate. Three major factors which affect the Classroom Climate of schools are physical, social and educational. According to Moos (1979) three basic types of dimensions are relationship dimensions, which identify the nature and intensity of personal relationship within the environment and assess the extent of which people are involved in the environment and support and help each other, personal development dimensions which assess the basic direction along which personal growth and self enhancement tend to occur; and system maintenance and system change dimensions which involve the extent to which the environment is orderly clear in expectation, maintain control and is responsive to change.

The investigator with help of experts selected ten components for the development of the Scale of Classroom Climate. They are: Material Environment, Cohesiveness, Teacher Support, Task Orientation, Innovation, Involvement, Teacher Control, Democracy, Satisfaction and Competition.

3.4.1.3.2. Details of Components Included in the Scale of Classroom Climate

a) **Material Environment:** Material environment involved the placement of task and chains, adequate book, the arrangements of book supplies and record keeping equipment, space, lighting and windows, usage of chalkboard and bulletin boards and classroom cleanliness.

b) Cohesiveness: Extend to which students know, help and are friendly towards each other. It is the classroom interpersonal dynamics between pupils and includes elements friendliness, mutual help, equanimity, mutual quarrel, rejection, co-operation, solidarity etc.

c) Teacher support: Extent to which the teacher helps, be friend, trusts and is interested in students. This includes element like teachers encouragement to student, co-operation with the student's parents, giving suggestion to students, etc.

d) Task Orientation: It refers to teacher's organisation of subject matter and content, planning the complete classroom activities involving the elements like teacher organisation of the instruction learning experiences, learning activities and evaluation of subject matter.

e) Innovation: It involves the extend to which the teacher plans new, unusual and varying activities and techniques and encourage students to contribute to classroom planning and to think, creatively.

f) Involvement: It refers the extent to which students have attentive interests, participate in discussion, do additional work and enjoy the class.

g) Teacher control: It refers to teacher's autocracy and restrictions. Each teacher must decide for himself those conditions under which he can function and his students learn most effectively. The nature of rules, how strictly rules are enforced and how severely rule infractions are punished.

h) Democracy: It indicates the extent to which students share equally in decision-making related to class. The free choice arrangement can be extremely revealing to the teacher in organising and conducting the class.

i) **Satisfaction:** It refers to students satisfaction in class work, enjoyment in class work and in group work, curricular activities and enjoying self learning.

j) **Competition:** This refers to students competition for grades and recognition. According to this view the chief purpose should be to understand the student as a whole unique person with his own goals, his own ways of viewing people and world. He should be concerned less with how much information he can absorb in competition with others and more with how he is organizing subject matter in his subjective world and his behaviour in all situation (Bloom, 1971).

3.4.1.3.3. Writing of Test Items

In writing items, particular attention was paid to ensure that each item is measuring only the dimension covered by its prior assigned scale. The Scale of Classroom Climate measures the student perception of Classroom Climate. Under each dimension 10 items were written initially. Items were prepared by abiding to the rules of Attitude Scale Construction (Edwards, 1969). Each of these items were read and evaluated carefully by experts.

The final draft inventory consisted of 80 items of which 65 were positive and 15 were negative items. For the first 8 items the respondents have to respond by choosing any one of the two alternatives 'Yes' or 'No'. One score is given for the item responses 'Yes' and zero score given for the responses 'No'. For the rest of the items from 9 to 80 there are three alternatives viz:- Always (A), Sometimes (S) and Never (N). The scoring was 2-1-0 for the alternatives (A), (S) and (N) respectively and 0-1-2 for the negative items. All the items are in Malayalam with a maximum score of 224 and a minimum score of zero.

3.4.1.3.4. Pilot Testing

A Pilot test was administered for examining the time limit and identifying the ambiguity of the items. The Pilot test was administered to 50 students of standard IX. The time taken to complete the items were noted. It ranged from 45 to 60 minutes. Thus the time fixed for answering the Try-out scale was fixed as 60 minutes. Each item was carefully analysed and defects were rectified. The draft test is given as Appendix Ia.

3.4.1.3.5. Field Testing and Item Analysis

The third phase of instrument development involves the try out of the test item to a sample of students in target population followed by application of item analysis procedure to test the data. The draft inventory was tried out on a stratified representative sample of 400 pupils of standard IX. From 400 response sheets discarded incomplete ones and selected 370 response sheets and scored for item analysis. The procedure suggested by Edward (1969) was used to find out the discrimination power of items. The response sheets of 370 subjects were arranged in rank order of scores obtained by them. The scores obtained by top 100 students (27%) and bottom 100 students (27%) were taken as the Upper group and Lower group respectively. Then two tailed test of significance of mean difference ('t' value) was calculated to find out the discriminating power.

The following formula was used to calculate 't' value.

$$t = \frac{\overline{X}_H - \overline{X}_L}{\sqrt{\frac{\Sigma(X_H - \overline{X}_H)^2 + \Sigma(X_L - \overline{X}_L)^2}{n(n-1)}}}$$

Where,

$$\Sigma(X_H - \overline{X}_H)^2 = \Sigma X_H{}^2 - \frac{(\Sigma X_H)^2}{n}$$

and $\Sigma(X_L - \overline{X}_L)^2 = \Sigma X_L{}^2 - \frac{(\Sigma X_L)^2}{n}$

$\overline{X}_H$ = The mean score on a given item for high group

$\overline{X}_L$ = The mean score on same item for low group

X_H = Score of High group

X_L = Score of Low group

n = number of cases

Those items exceeding a 't' value of 2.58 were selected for the final inventory. The details of the item analysis are presented in Table 3.2.

TABLE 3.2

Results of Item Analysis of the Scale of Classroom Climate

Item No.	t-value	Items selected/ rejected	Item No.	t-value	Items selected/ rejected	Item No.	t-value	Items selected/ rejected
1	4.130	Selected	28	8.522	Selected	55	10600	Selected
2	8.727	Selected	29	10.410	Selected	56	15.56	Selected
3	6.071	Selected	30	8.325	Selected	57	9.965	Selected
4	9.615	Selected	31	9.037	Selected	58	9.61	Selected
5	6.450	Selected	32	10.620	Selected	59	1.504	Rejected
6	5.246	Selected	33	8.390	Selected	60	2.500	Rejected
7	8.273	Selected	34	12.980	Selected	61	12.780	Selected
8	7.823	Selected	35	7.340	Selected	62	8.860	Selected
9	5.780	Selected	36	9.961	Selected	63	11.18	Selected
10	5.937	Selected	37	9.861	Selected	64	6.048	Selected
11	0.736	Rejected	38	9.620	Selected	65	8.570	Selected
12	5.398	Selected	39	10.54	Selected	66	11.410	Selected
13	-0.23	Rejected	40	7.472	Selected	67	9.790	Selected
14	1.913	Rejected	41	12.040	Selected	68	12.580	Selected
15	4.28	Selected	42	10.386	Selected	69	13.290	Selected
16	7.110	Selected	43	0.980	Rejected	70	10.240	Selected
17	8.67	Selected	44	7.525	Selected	71	9.410	Selected
18	9.297	Selected	45	11.31	Selected	72	3.930	Selected
19	8.397	Selected	46	6.22	Selected	73	7.580	Selected
20	8.483	Selected	47	4.009	Selected	74	11.770	Selected
21	9.989	Selected	48	11.204	Selected	75	13.38	Selected
22	9.225	Selected	49	7.333	Selected	76	8.571	Selected
23	7.854	Selected	50	1.810	Rejected	77	11.800	Selected
24	3.100	Selected	51	6.861	Selected	78	11.29	Selected
25	3.691	Selected	52	9.768	Selected	79	8.82	Selected
26	1.678	Rejected	53	9.900	Selected	80	0.618	Rejected
27	8.181	Selected	54	2.400	Rejected			

The final form of scale contains 70 items of which 60 are positive and 10 are negative.

Some illustrative items are presented below.

a) Component - Material Environment

Example :- There is enough air and light in the class.

Yes	No

b) Component - Cohesiveness

Example:- All students know each other very well.

Always	Sometimes	Never

c) Component - Teacher support.

Example: - The teacher talks with each students

Always	Sometimes	Never

d) Component - Task Orientation

Example:- Activities of the class are clearly and carefully planned.

Always	Sometimes	Never

e) Component - Innovation

Example:- New ideas are always being tried out

Always	Sometimes	Never

f) Component - Involvement

Example:- Teacher use to ask questions during lectures

Always	Sometimes	Never

g) Component - Teacher control

Example:- Teacher begins and end the class in time.

Always	Sometimes	Never

h) Component - Democracy

Example:- Students express their opinions during discussions

Always	Sometimes	Never

i) Component - Satisfaction

Example:- Learning activities in the classroom gives encouragement to students for further study

Always	Sometimes	Never

j) Component - Competition

Example:- Some people always try to do their work better than others.

Always	Sometimes	Never

3.4.1.3.6. Validity of the tool

The validity of the scale was estimated by criterion related technique. In order to find out the coefficient of correlation, the scores obtained from 50 students were correlated with that of an external criterion, the scores of another similar standardised test, i.e., 'Scale of Classroom Climate – SCC' (Santhakumari, 1991). The coefficient of validity was found to be 0.536.

3.4.1.3.7. Reliability of the tool

The Test-retest reliability of the tool was worked out on a representative sample of 50 students after an interval of three weeks time. The reliability coefficient was found to be 0.849.

The indices of validity and reliability coefficients show that the scale is a valid and reliable tool for assessing the Classroom Climate of Secondary School Students.

The draft scale of Classroom Climate, the final scale, response sheet and English version of final scale are given in appendices IIa, IIb, IIc and IId respectively.

3.4.1.4. Test of Process Outcomes in Science

The test of Process Outcomes in Science was developed by the investigator (Aruna, 1999) for quantifying pupils process outcomes in science. The steps followed and techniques employed in the construction of the test of process outcomes in science are described below.

The intention of the Test of Process Outcomes in Science is to quantify the awareness of different process in reaching a product. This type of learning is intellectually stimulating and scientifically authentic.

The classification of objectives by Klopfer (1971) and Obourn (1960) was used as the basis for the development of different steps in this tool. The different sources used for item development were text books, reference books and question banks.

The classification of process skills and subskills are presented.

i) Recognising and defining a problem

a) Pupils recognise scientific problems in a new situation.

b) Pupils isolate the major idea of a problem

c) Pupils state problems as definite and concise questions.

ii) Formulating hypothesis

a) Pupils suggest tentative solution to the problem.

iii) Collecting data

a) Pupils select a suitable test of hypothesis
b) Pupils design experiment.
c) Pupils select equipments for experiment.

d) Pupils observe objects and phenomena

e) Pupils measure objects and changes.

iv) Interpreting data

a) Pupils organize data collection

b) Pupils identify relationships

c) Pupils interpret relationships

v) Evaluating hypothesis

a) Pupils formulate conclusion on the basis of relationship found.

b) Pupils evaluate hypothesis in relation to the data interpreted.

vi) Formulating Generalization

a) Pupils apply conclusion to new situations.

b) Pupils formulate generalizations on the basis of relationships identified and conclusions formed and applied.

3.4.1.4.1, Planning of the Test

In order to quantify the Process Outcomes in Science of Secondary School pupils, a list of items to measure Process Outcomes in Science was constructed by the investigator. It was decided to develop a test comprising of 60 multiple choice items for sixty minutes duration. Test of Process Outcomes in Science includes certain fundamental and inter related areas of Physics, Chemistry and Biology for Secondary School Pupils. The areas chosen from Physics syllabus are Forces of Nature, Circular Motion, Work Power and Energy Heat, Sound, Current Electricity and Universe. The topics from Chemistry syllabus are Atomic Structure, The Mole Concept, Periodic Table Oxidation and Reduction, Elements of Group VII, Elements of Group VI, Elements of Group V, Elements of Group IV and Chemistry and Environment. The topics from the

Biology syllabus are Excretion in Animals, Reproduction and Growth, Heredity and Variation, Food and Nutrition, Cell Adaptations, Respiration and Life process.

3.4.1.4.2. Items writing

A careful analysis of the objectives was made and as per the objectives of Klopfer (1971) and Obourn (1960), the investigator initially pooled 100 questions. The different sources used for item development were text books, reference books, question banks and the following special literature.

1) Science Teaching and Testing (Nedelsky, 1965)
2) Science Education in Nineteen countries - An Empirical studies (Comber and Keeves, 1973).
3) Teaching Physical Sciences in Secondary Schools (Gupta, 1981).
4) Science Teaching in Schools (Das, 1985).

The items are subjected to scrutiny by subject experts in science. The items are re-edited in light of expert criticism. Thus the number of items are brought down to sixty. Equal considerations were given to Physics, Chemistry and Biology while items were framed. Items were grouped under six tests with one text intended for each skills of the scientific process thus covering the sixteen subsections of the scientific process listed earlier. Details of the test with illustrative items are given below.

a) Recognising and defining a problem

Problematic situations are included in this test. The students recognition of a problem may pass through several states that is from the awareness of the problem area to identification of a specific problem. In this test item the students would choose the correct response from the alternative responses given thereby indicating their behaviour. This subtest includes ten items each from Physics, Chemistry and Biology. An example of the test item is given below.

Example:- Take a bucket full of water and a cork. Immerse the cork in water and suddenly rlease it. The cork jumb up to the surface of water. Here the problem is.

a) Whether the water exerts an upward thrust on cork.
b) Whether the earth exert a downward pull on immersed cork.
c) Whether it is due to the reaction to downward pressure executed on the cork.

A✓	B	C

b) Formulating hypotheses

The test item in this section contain the tentative solution to the posed problems. Here the students seek whether the specific problem is susceptible to experimental investigation and it might lead the student to formulation of working hypothesis that would give direction to investigation. In the test item three hypotheses are given as the probable solution to the problem. The student required to select appropriate one. The subtest includes ten items. An illustration of the test item is given below.

Example : Some chemicals are seen kept in brown bottles.

The reason is

a) May be because chemicals would decompose in the presence of light.
b) May be because chemicals would lose colour.
c) May be because chemicals would decompose emitting light.

A✓	B	C

c) Collecting data

This section contains experiments that constitute a valid test of hypotheses. This category focuses on the behaviour of the science students involving an enquiry. The designing of procedure for performing experimental tasks, the students observation and measurement of things, using appropriate measuring instruments are all included in this section. This subtest includes ten items. An example of item is given below.

Example:- Heat conductivity of metals are different. Which one is the suitable experiment to prove this.

a) Heat similar iron rod and copper rod at same temperature. Observe the results.

b) Heat an iron and another copper rod at the same temperature. Observe the results.

c) Heat similar iron rod and copper rod at different temperature. Observe the result.

A✓	B	C

d) Interpreting the data

In this section the student process the data obtained from experimentation or presented to him in the form of recorded observation and measurements to yield quantitative and qualitative judgements. First the student analyse the results of experiment. This includes the behaviour of manipulating, adjusting and organising his observation and measurements. Again present these data in the form of functional relationships. Besides this the pupil interprets the relationships. This substest includes ten items. An example of the items is given below.

Example: The exoskeleton of prawn appear luminescent during night time. What is the suitable explanation for it.

a) Self luminescent bacteria is present on the exoskeleton of prawns.
b) The exoskeletons of prawns is capable of emitting light.
c) The exoskeletons of prawn contains lot of phosphorous.

A✓	B	C

e) Evaluation of hypotheses

A report by student about his performance and thinking is most common for evaluation. The student selects a valid test of hypotheses. The experiments are designed and carried out, data having been collected, organised and interpreted, the student needs to check whether or not the findings verifies the hypotheses. Therefore by the sub-test the student is expected to find out whether the evidence is consistent with the hypotheses. This subtest includes ten items. An illustrative test item is given below.

Example:- Plant fossils are rare than animal fossils. What can be inferred from this?

a) Animals originated on the earth first.
b) Number of animals are greater than plants.
c) Animals have strong bones, teeth and nails

A	B	C✓

f) Formulating generalisation

A report by the students about his performance and thinking is most common for evaluation. The student selects a valid test of hypotheses. Formulating generalization is a complex behaviour involving higher mental process. The student considers the results of his experiments with other similar inquiries. If this original findings is corroborated with others, he is justified in formulating an empirical generalisation. The sub-test includes ten items. An illustrative test item is given below.

Example:- Consider two trains be moving on parallel tracks in the same direction with same speed. To an observer in one train, the other train appear to be not moving. From this it can be understood that:

a) The relative velocity of both trains are different

b) Relative velocity of the train and observer are different.

c) The relative velocity of the train and the observer are different.

A	B	C✓

Design showing the weightage to skills are given in the Table 3.2.

TABLE 3.3

Design showing the Weightage to Skills

Sl. No.	Skills	No. of question	Marks	Percentage
1.	Recognising and defining a problem	10	10	16.7
2.	Formulating hypothesis	10	10	16.7
3.	Collecting data	10	10	16.7
4.	Interpreting data	10	10	16.7
5.	Evaluation of hypothesis	10	10	16.7
6.	Formulating generalization	10	10	16.7
Total		60	60	100

3.4.1.4.3. Try out of the test

Stratified random sampling using class as a unit was employed to get the sample for the try out test. Try out of the test was administered on 400 pupils. One score was given for a correct response and no score was given for wrong answers. Among the 400 response sheets after rejection of incomplete answer sheets as well as random rejection of a few answer sheets, 370 answer sheets were used for item analysis.

3.4.1.4.4. Item analysis

The quality of a test depends upon the individual items of which it is composed. So it is necessary to analyze whether each item is useful for the purpose to which it is being constructed. For item analysis the procedure suggested by Ebel (1972) was used. Accordingly the scored answer sheets where arranged in order of scores from high to low. Then separated upper 100 and lower 100 response sheet. The middle 170 was discarded. Each item in the response sheet were tallied for the hundred high scores (U) and 100 low scores (L). Through the process of difficulty index and discrimination power the reliability of easiness and hardness of item can be assessed.

Difficulty index of an item is represented by percentage of students who responded correctly each item. Difficulty index is calculated using the formula, $Di = (U+L)/2N$ where, U = Number of correct response in the upper group, L = Number of correct responses in lower group, N = Number of pupils in any group. Discrimination power of an item is the quality of an item at which it discriminates between pupil with high and low marks the discrimination power of each item is found out by using the formula, $Dp = (U-L)/N$ Where N = Number of correct responses in the upper group, L = Number of correct responses in the lower group. N = Number of pupils in any group. For the selection of items, difficulty index above 0.40 where readily selected. Items, which have difficulty index above 0.375 were selected as reasonably good. Other items having difficulty index below 0.375 and Discriminating power below 0.30 were rejected and thus 40 items were selected for final test. The Draft Test in Process Outcomes, Malayalam version of the Final Test, its English version, Response Sheet and Scoring key are given as Appendices IIIa, IIIb, IIIc, IIId and IIIe respectively. The details of item analysis is given in Table 3.3.

TABLE 3.4

Details of Item Analysis of Test of Process Outcomes in Science

Item number	Difficulty Index	Discriminating power	Item number	Difficulty Index	Discriminating power
1*	0.85	0.300	31*	0.440	0.360
2*	0.540	0.560	32	0.160	0.140
3	0.225	0.030	33*	0.550	0.520
4*	0.590	0.660	34*	0.375	0.390
5*	0.400	0.460	35	0.355	0.110
6*	0.650	0.320	36*	0.735	0.410
7*	0.650	0.600	37	0.440	0.200
8*	0.585	0.550	38	0.580	0.220
9*	0.485	0.610	39	0.330	0.000
10	0.175	0.010	40*	0.570	0.360
11	0.355	0.070	41*	0.415	0.490
12*	0.490	0.580	42*	0.380	0.400
13*	0.715	0.450	43	0.430	0.060
14*	0.370	0.340	44*	0.560	0.400
15	0.155	0.050	45	0.300	-0.120
16*	0.710	0.420	46	0.230	0.000
17*	0.585	0.530	47*	0.575	0.310
18*	0.550	0.300	48	0.325	0.190
19*	0.720	0.510	49	0.190	0.020
20*	0.510	0.580	50*	0.615	0.310
21*	0.410	0.480	51*	0.430	0.540
22*	0.425	0.470	52*	0.550	0.360
23*	0.595	0.410	53	0.390	0.200
24*	0.575	0.310	54	0.265	0.070
25*	0.560	0.500	55*	0.465	0.490
26*	0.380	0.340	56*	0.545	0.410
27	0.265	0.290	57*	0.520	0.320
28*	0.530	0.400	58*	0.415	0.390
29	0.280	0.140	59	0.365	-0.030
30	0.210	0.020	60*	0.800	0.360

*Items selected for the final test.

3.4.1.4.5. Validity and Reliability of the test

The criterion related validity of test was ensured by means of statistical technique in which scores of test were compared with the scores of second terminal science examination as external criteria. The value of coefficient of correlation obtained is 0.808. It shows that the test is a valid one.

The investigator used test-retest method to find out the reliability of the test. The test-retest reliability of the tool was worked out on a representative sample of 50 students after an interval of three weeks time. The Reliability of the present test computed by test-retest method is 0.86.

3.4.2. SAMPLE SELECTION

The population meant for the study is secondary school pupils of Kerala state. To meet the representativeness in sample selection the investigator had to take decision on three major aspects viz., i) Size of the sample. ii) Techniques of sampling. iii) Factors represented.

3.4.2.1. Size of the sample

The size of the sample is the crucial factor for the validity of the results. Krech and Crutchfield (1968) had observed that sample size of 500 would yield reasonably good results, which would keep the error less than 5 percent. Further inferential statistics says that as the size of the sample increases, the amount of sampling error will be reduced.

The investigator aimed to select representative sample of 1000 secondary school pupils from 26 schools of Malappuram, Kozhikode, Ernakulam, Kottayam, Alappuzha and Kollam districts in Kerala. Students of standard IX were given preferences on the assumption that these pupils form a true representative sample of secondary school population comprising of standard VIII, IX and X.

3.4.2.2. Technique of sampling

The population consists of large number of pupils belonging to different strata like sex, school locale, type of school management etc. Because of this stratification in the population the investigator has to adopt proportionate stratified sampling method to select a sample, which will be a good representative of the population. According to Garret (1966) when the population is composed of sub groups or strata of different sizes, stratified sampling method is applicable.

3.4.2.3. Factors Represented

The following factor or strata of the population were taken into consideration while selecting the sample.

i) Sex of the subjects
ii) Locale of schools
iii) Instructional efficiency of schools
iv) Type of management of schools.

i) Sex of the subjects

Sex has great influence upon the findings of research on Achievement. Provisions of Cognitive Style, Intelligence and Classroom Climate differ in accordance with Sex differences. Almost equal number of boys and girls get educated in the secondary schools of Kerala. So the investigator decided to include equal proportion of boys and girls in the sample. There are three categories of schools in the sample of study. It includes the sample from Boy's school, Girl's school and Co-educational schools.

ii) Locale of Schools

It is found that Locality of the school affects the performance of the students. In schools of urban area more children are in higher socio-economic status when compared to schools of rural area. The educational facilities for former children are better than latter. Often different performance in examination is noticed between rural and urban area schools. Investigator expected significant differences in perception of Cognitive Style, Intelligence and Classroom Climate between Urban and Rural students. Since greater number of schools are in Rural area compared to Urban area the investigator selected sample on the basis of Locale in the ratio rural : urban = 3:2.

iii) Instructional Efficiency of Schools

Based on the results of the S.S.L.C. Examination for three consecutive years preceding the study (1999-2001), the school were classified as Above Average, Average and Below Average schools. Schools having pass percentage with 60 percent and above were considered as Above Average, those with pass percentage in the range 40-60 percent were considered as Average and those schools getting pass percentage below 40 were taken as Below Average schools. The schools were selected in the ratio 1:2:1.

iv) Management of Schools

Based on agencies which run the schools there are two categories of schools in Kerala, Government and Private schools. There are more number of schools run by Private agencies when compared with schools managed by the state Department of Education. Therefore due weightage was given in selection of samples from both Government and Private Schools in the proportion 2:3.

Considering the above factors it was decided to collect data from students of standard IX. Assuring that each class division has a strength of approximately 40-50 students, one class division of standard IX was selected from each school. This covered up a basal sample and is given in Table 3.4.

TABLE 3.5

Break up of the Basal sample

Sex of the sample	Private		Government		Total
	Urban	Rural	Urban	Rural	
Boys	110	200	100	115	525
Girls	120	185	120	100	525
	230	385	220	215	
	615		435		1050

Adequate representation was given to schools located in different regions of Kerala. Thus schools from Kollam, Ernakulam, Kottayam, Alappuzha, Malappuram, and Kozhikode districts were taken to ensure representation of Southern, Central and Northern Kerala.

3.4.3. DATA COLLECTION

After careful planning of the test and sample selection necessary arrangements were made for conducting final test. The investigator personally contacted the heads of institution chosen for collecting data.

The investigator individually administered all the tests and class teachers of respective classes assisted in conduct of tests. Before administering the tools the purpose of study was made clear to the students. After giving general instruction, the method of answering each test was explained and demonstrated on the black board to familiarise them with the test. The Investigator supplied sufficient copies of test booklets and response sheets to the subjects before starting each test. Sufficient interval was given between two consecutive administration. Time limit and procedure for test administration were strictly followed, while conducting the tests. Uniform procedure was adopted for data collection in all schools. Accordingly data from 1050 students were collected.

3.4.4. SCORING AND CONSOLIDATION OF DATA

All the response sheets collected from students were scored according to the directions in the respective tools. Thus the scores of Dependent and Independent variables and other relevant data regarding each pupils were obtained. Often mechanised scoring keys were used to facilitate scoring.

Rejection of incomplete cases resulted in reduction of sample size to 1000 and this comprised the final sample of the study

The breakup of the final sample is given in table 3.5.

TABLE 3.6

Break up of the final Sample

Sex of the sample	Private		Government		Total
	Urban	Rural	Urban	Rural	
Boys	109	191	95	105	500
Girls	114	186	115	85	500
Total	223	377	210	190	1000
	600		400		1000

A detailed list of schools selected for the sample is given in Table 3.6.

TABLE 3.7

Details of the Final Sample

Sl. No.	Name of the school	Rural/ Urban	Govt./ Pvt.	Co-education/ Boys/Girls	School efficiency	District	No. of Students		
							Boys	Girls	Total
1.	St. Joseph Boys High School, Kozhikode	Urban	P	B	Above Average	Kozhikode	42		42
2.	St. Joseph Girls High School, Kozhikode	Urban	P	G	Above Average	Kozhikode		30	30
3.	St. Michael's Girls High School, Kozhikode	Urban	P	G	Above Average	Kozhikode		35	35
4.	S.P.B.S. Ramanattukara	Rural	P	G	Average	Kozhikode	28	7	35
5.	S.R.K.M. High School, Kozhikode	Urban	P	G	Average	Kozhikode	27	13	40
6.	G.M.H.S.C.U. Campus, Thenjipalam	R	G	G	Average	Malappuram	27	23	50
7.	G..S.S., Chelari	R	G	G	Below Average	Malappuram	25	15	40
8.	G.G.G.H.S. Kozhikode	U	G	B	Average	Kozhikode		33	33
9.	G.G.B.H.S. Kozhikode	R	G	G	Average	Kozhikode	40		40
10.	G.R.H.S. Kottakkal	R	G	G	Average	Malappuram	20	19	39
11.	S.N.M.H. Papappanangadi	R	P	G	Average	Malappuram	42	33	75
12.	G.G.H.S. Ernakulam	G	G	G	Average	Ernakulam		21	21
13.	Palace Girls High School, Tripunithara	R	G	G	Below Average	Ernakulam		38	38
14.	K.P.M.S. Poothotta	R	P	G	Below Average	Ernakulam	37	16	53

15.	C.C.L.M.A.J.H.S. Thevara	G	P	G	Above Average	Ernakulam	40	5	45
16.	St. Little flower High School Vaikom	Urban	P.	G	Below Average	Kottayam		39	39
17.	St. Mary's Vallakom, Vaikom	Rural	P	G	Below Average	Kottayam	24	7	31
18.	St. Ann's E.M.H.S. Ernakulam	Rural	Pvt.	G	Above Average	Ernakulam	24	12	36
19.	G.V.H.S.S. Edappally	Rural	G	G	Average	Ernakulam	18	20	38
20.	G.G.H.S. Vaikom	Urban	G.	G	Average	Kottayam		22	22
21.	G.H.S.S. Vaikom	Urban	G.	B	Below Average	Kottayam	27		27
22.	St. Mary's G.H.S., Cherthala	Rural	P	G	Below Average	Cherthala		73	73
23.	S.D.V.B.H.S. Alappuzha	Rural	P.	B	Below Average	Alepuzha	36		36
24.	St. Joseph A.J.S.H.S., Quilon	Urban	Pvt.	G	Above Average	Quilon		30	30
25.	G.H.S. Mayyanad	Rural	Got.	G	Below Average	Quilon	17	9	26
26.	Govt. Boys High School, Quilon	Urban	Govt.	B	Below Average	Quilon	26		26

3.4.5. STATISTICAL TECHNIQUES USED FOR ANALYSIS

The main statistical techniques employed for the present investigation are given below. The data was analysed using computer facility, using Statistical Package for Social Science (SPSS Software) (Einspruch, 1998).

3.4.5.1. Preliminary Analysis

Preliminary analysis like mean, median, mode, standard deviation, quartile deviation, skewness and kurtosis of select variables were computed for total sample and subsamples based on sex, locale and type of management of schools.

3.4.5.2. Two-tailed Test of significance of Difference between mean scores of large Independent samples (Garret, 1979)

To compare the group differences for the independent and dependent variables two-tailed test of significance of different between means was calculated using the formula.

$$CR = \frac{M_1 - M_2}{\sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}}}$$

M_1 and M_2 are group mean, σ_1 and σ_2 standard deviation and N_1 and N_2 respective group size.

The mean difference is said to be significant depending on whether the critical ratio exceeds $\pm$ 2.58 or $\pm$ 1.96 at 0.01 level and 0.05 level of significance respectively.

3.4.5.3. Pearsons Product Moment Coefficient of Correlation 'r' (Garret, 1979)

The coefficient of correlation is the index of indicating extent of the relation between two variables, of which one may be dependent and other dependent.

The formula for computation for 'r' is

$$r_{xy} = \frac{N\sum xy - \sum x \sum y}{\sqrt{(N\sum x^2 - (\sum x)^2 (N\sum y^2 - (\sum y)^2}}$$

Where x and y are two variables, r_{xy} = coefficient of correlation between variable x and y

Σx	=	The sum of all x scores in data
Σy	=	The sum of all y scores in data
Σx^2	=	The sum of square of all x scores in data
Σy^2	=	The sum of square of all y scores in data
Σxy	=	The sum of products of all paired x and y values of data
N	=	size of sample.

Verbal Interpretations of 'r' (Garret, 1970)

r from .00 to $\pm$.20 Indifferent or negligible relationship
r from $\pm$ .20 to $\pm$ .40 Low or slight relationship
r from $\pm$ .40 to $\pm$ .70 Substantial or marked relationship
r from $\pm$ .70 $\pm$ 1.00 High-to very high relationship

Test of significance of correlation coefficient

Test of significance of correlation coefficient was computed by using the formula,

$$t = r\sqrt{\frac{N-2}{1-r^2}} \qquad \text{(Ferguson, 1971)}$$

where 't' is the critical ratio, 'r' is correlation coefficient and 'N' is the size of the sample. This was done by calculating the 5% and 1% level of significance by using two tailed test of significance.

The 0.99 Confidence Interval of 'r'

0.99 confidence interval or 'r' was estimated by using the formula r $\pm$ 2.58 SEr is which SEr is the Standard error 'r .

$$SE_r = \frac{1-r^2}{\sqrt{N-1}}$$

where, r being the obtained coefficient correlation.

Percentage of variance (Fox, 1969)

This was estimated by finding out r^2x100, where 'r' being the obtained correlation coefficient.

3.4.5.4. Three way ANOVA with 3x3x3 Factorial Design

Analysis of variance employing three independent variables involving three way classification was done to determine the single effect and interaction effect of select independent variables on the dependent variable.

Analysis of variance employing three independent variables involving three-way classification is three way ANOVA, which involves R levels of one factor, C levels of second factor and L, levels of a third factor, the number of treatment combinations RCL.

Three levels of Cognitive Style (Field independent, Intermediate orientation, Field dependent) three levels of Intelligence (High, Average and Low) and three levels of Classroom Climate (Favourable Classroom Climate, Moderately Favourable

Classroom Climate, Less Favourable Classroom Climate) have been adopted for 3x3x3 factorial Design.

ANOVA was employed for total sample and subsamples based on Sex, Locale and Type of Management of schools. Thus altogether 7 ANOVA was undertaken for present investigation. Each of the subject in the sample was identified as belonging to any one of the 27 combinations of select independent variables as follows.

1) Field Dependent with High Intelligence and Favourable Classroom Climate.
2) Field Dependent High Intelligence and Moderately Favourable Classroom Climate.
3) Field Dependent with High Intelligence Less Favourable Classroom Climate.
4) Intermediate Orientation with High Intelligence and Favourable Classroom Climate.
5) Intermediate Orientation with High Intelligence and Moderately favourable Classroom Climate.
6) Intermediate Orientation with High Intelligence and Less favourable Classroom Climate.
7) Field Independent with High Intelligence and Favourable Classroom Climate.
8) Field Dependent with High Intelligence and Moderate Favourable Classroom Climate.
9) Field Dependent with High Intelligence and Less Favourable Classroom Climate.
10) Field Dependent with Average Intelligence and Favourable Classroom Climate.
11) Field Dependent with Average Intelligence and Moderately Favourable Classroom Climate.

12) Field Dependent with Average Intelligence and Less Favourable Classroom Climate.
13) Intermediate Orientation with Average Intelligence and Favourable Classroom Climate.
14) Intermediate Orientation with Average Intelligence and Moderate Favourable Classroom Climate.
15) Intermediate Orientation with Average Intelligence and Less Favourable Classroom Climate.
16) Field Dependent with Average Intelligence and Favourable Classroom Climate.
17) Field Dependent with Average Intelligence and Moderately Favourable Classroom Climate.
18) Field Dependent with Average Intelligence and Less Favourable Classroom Climate.
19) Field Dependent with Low Intelligence and Favourable Classroom Climate.
20) Field Dependent with Low Intelligence and Moderately Favourable Classroom Climate.
21) Field Dependent with Low Intelligence and Less Favourable Classroom Climate.
22) Intermediate Orientation with Low Intelligence and Favourable Classroom Climate.
23) Intermediate Orientation with Low Intelligence and Moderately Favourable Classroom Climate.
24) Intermediate Orientation with Low Intelligence and Less Favourable Classroom Climate.
25) Field Independent with Low Intelligence and Favourable Classroom Climate.
26) Field Independent with Low Intelligence and Moderately Favourable Classroom Climate.

27) Field Independent with Low Intelligence and Less Favourable Classroom Climate.

Each sum of square has an associated degrees of freedom to obtain variance estimate or Mean squares which are used to test the significance of Main or Interaction effects.

F-ratios are formed from the variance estimate and used to test significance of rows, columns and Interaction effects. A model of Three-way ANOVA follows in Table 3.7.

A Model of Three-way ANOVA follows in Table 3.7.

TABLE 3.8

Three-way Model ANOVA

A	a – 1	$SS_A = nbc\ \Sigma_i a_i^2$
B	b – 1	$SS_b = nct\Sigma_i B_i^2$
C	a – 1	$SS_a = nbt\Sigma xk^2$
A * B	(a-1) (b-1)	$SS_{A+B} = nc\Sigma_{ij}(\alpha\beta)_{ij}^2$
A * C	(a-1) (c-1)	$SS_{A+C} = nb\Sigma_{ik}(ax^2)_{ik}$
B * C	(b-1) (c-1)	$SS_{B+C} = nb\Sigma_{jk}(\beta x)_{jk}^2$
A * B * C	(a-1) (b-1) (c-1)	$SS_{A+B+C} = n\Sigma_{ijk}(\alpha\beta x)_{ij}^2$
error	abc(n-1)	$SS_{ERROR} = \Sigma_{ijkl}(x_{ijkl} - L_{ijk})^2$

3.4.5.5. Scheffe' Test of Post-Hoc Comparison

Scheffe' Test of Multiple Comparison (Scheffe', 1959) was applied to compare the mean scores of Process Outcomes in science of pairs of different levels of select independent variables. This was attempted only for independent variables giving significant F-ratios in three way ANOVA. Multiple comparison using Scheffe' procedure, (Ferguson, 1976) was done separately for the total sample and subsamples based on sex, locale and management.

To apply Scheffe' procedure, F-value is calculated at first using within group variance estimate Sw^2 and using the following formula

$$F = \frac{(\overline{X}_i - \overline{X}_j)^2}{\frac{Sw^2}{ni} + \frac{Sw^2}{nj}} \quad \text{(Ferguson, 1976)}$$

Where

$\overline{X}I$ = M_1 = Mean of the first group

$\overline{X}j$ = M_2 = Mean of the second group

Sw^2 = Within group variance estimate

ni = Number of subjects of group i

nj = Number of subject of group j

Then consult a table of F and obtain the value of F required for significance at 0.05 or 0.01 level, of significance for df_1 = k-1 and df_2 = N-K. As a third step, calculate the quantity F', which is K-1 times the F required for significance at the desired significance level, that is, F' = (K-1)F. Fourth, compare the values of F and F'. For any difference to be significant at the required level, F must be greater than or equal to F' (Ferguson, 1979).

3.4.5.6. DISCRIMINANT FUNCTION ANALYSIS (Tabachnick and Fidell, 1989)

Discriminant function Analysis (Direct method) was performed to predict High, Average and Low groups of Process Outcomes in Science on the basis of a select set of discriminating variables (Independent Variables). Because there are three groups and three predictors in the case, there are two discriminant function contributing over all relationship.

A discriminant function score is predicted from the sum of scores of prediction, each weighted by a coefficient. There is one set of discriminant function coefficients for the first discriminant function, a second set coefficient for second discriminant function.

1) To solve for the (Standard) discriminant function score the following formula is used.

$$Di = di_1z_1 + di_2z_2 + \ldots\ldots + di_pz_p$$

A child's standardised score on i^{th} discriminant function (D_i) is found by multiplying the standardised score on each predictor (z) by its standardised discriminant function coefficient (di) and then adding the products for all predictors.

2) A discriminant function score can also be produced by multiplyng the raw score on each predictor by its associated standardised discriminant function coefficient, adding the products over all predictors, and adding a constant to adjust for means. Then the formula is

$$Di = Cj_0 + di_1x_1 + di_2x_2 + di_px_p$$

3) Classification: Discriminant scores can be used to classify cases into groups. With numerous groups (more than two groups) as classification is possible from discriminant function. To assign cases into groups classification equation is developed for each group. Here three classification equations were developed for three groups. Data for each case are insisted into each classification equation to develop a classification score for each group for the case. The case is assigned to the group for which it has highest classification score.

In its simplest form the classification equation for j^{th} group ($j = 1,2,\ldots k$) is

$$C_j = Cj_0 + Cj_1x_1 + Cj_2x_2 + \ldots\ldots + Cj_px_p$$

A score on classification function for group j(Cj) is found out by multiplying the raw score on each predictor (x) by its associated classification function coefficient (Cj), Summing over all products and adding a constant Cj0.

The score of 1000 students for different tests and other data relating to them were tabulated on a consolidated data sheet. The data were entered in such a way that they could be used for computer data processing.

3.4.6. CLASSIFICATION TECHNIQUES

Classification of independent variable Cognitive Style is based on the range of the scores suggested by Witkin. Classification of the other two independent variables Intelligence and Classroom Climate into three different levels are based on the formula Mean $\pm$ 1 SD.

i. Classification of Cognitive Style

Cognitive style was classified into three on the basis of total test score acquired by the subject. The scores ranged from 0-8, indicating Field Dependent (FD); scores 9-13 Intermediate Orientation (INT) and 14-18 scores Field Independent (FI) orientation. The actual number of subjects falling under each group categorised on the basis of Cognitive Style is given in Table 3.8.

TABLE 3.9

Distribution of sample classified on the basis of Cognitive Style for Total Sample and relevant Subsamples

Sample	FD	INT	FI	Total
Total sample	502	326	172	1000
Boys	127	249	124	500
Girls	374	77	49	500
Rural	281	203	83	567
Urban	219	123	91	433
Government	219	112	69	400
Private	283	214	103	600

ii) Classification based on Intelligence

The total sample and subsample formed on the basis of sex, locale and type of management were categorised into High Intelligent Group (HI), Average Intelligent Group (AI), Low Intelligent Group (LI) based on the scores of Intelligence. This categorisation was done using means and standard deviation as cut off points. Those subjects who obtained scores above M+1SD were considered as High Intelligent Group (HI) who got below M-1SD scores were considered as Low Intelligent (LI) group and those who obtained scores in between M+1SD and M-1SD were considered as Average Intelligent group. In the present study mean scores of Intelligence for the total sample, boys, girls, rural, urban, government, private are 39.433, 40.392, 38.474, 37.735, 41.656, 39.033, 39.700 respectively with standard deviation for the total sample boys, girls, rural, urban, government, private are 7.916, 7.554, 8.158, 8.218, 6.906, 8.569, 7.44 respectively.

The actual number of subjects falling under each group categorised on the basis of Intelligence is given in Table 3.9.

TABLE 3.10

Distribution of Sample Classified on the Basis of Intelligence for Total Sample and Relevant Subsamples

Sample	HI	AI	LI	Total
Total	381	409	210	1000
Boys	183	189	128	500
Girls	165	191	144	500
Rural	186	250	131	567
Urban	226	149	58	433
Government	143	167	90	400
Private	191	254	155	600

iii) Classification Based on Classroom Climate

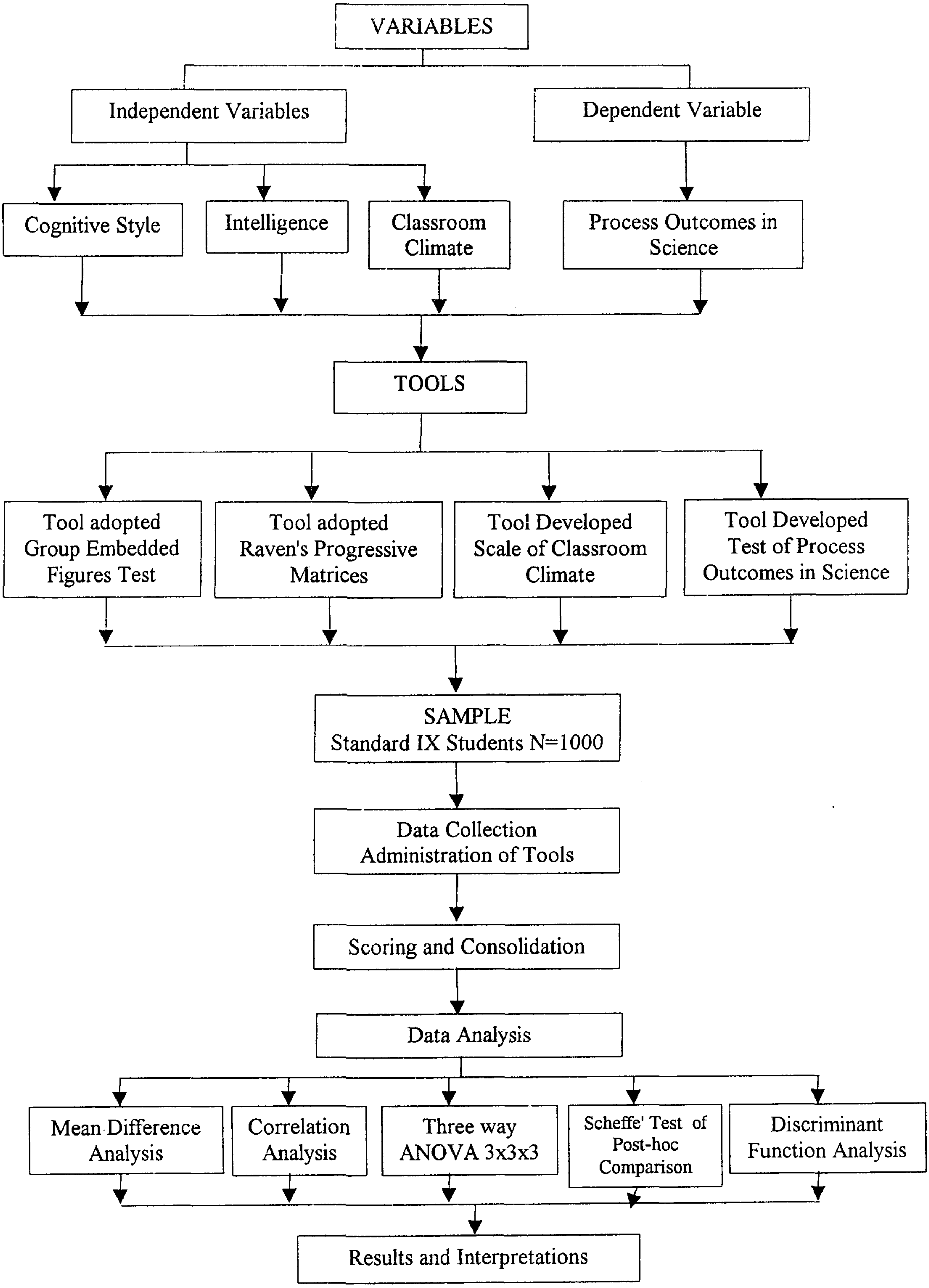
The sample is categorised into three on the basis of scores obtained in the Classroom Climate. For that the whole sample was divided into Favourable Classroom Climate group (FCC), Moderately Favourable Classroom Climate group (MFCC) and Less Favourable Classroom Climate group (LFCC) using mean scores in Classroom Climate and standard deviation as cut off point. The mean Classroom Climate score and its standard deviation was found to be 101.003 and 15.322 for the total sample, 99.448 and 15.957 for boys, 102.558 and 14.508 for girls, 101.929 and 14.616 for rural, for 99.790 and 16.136 for urban, 99.77 and 17.436 for government and 101.825 and 13.686 for the students of private schools. Distribution of the sample classified on the basis of Classroom Climate for total sample and relevant subsamples are given in Table 3.10.

TABLE 3.11

Distribution of sample classified on the basis of Classroom Climate for Total Sample and relevant Subsamples

Sample	FCC	MFC	LFCC	Total
Total	352	394	254	1000
Boys	186	173	141	500
Girls	159	227	114	500
Rural	215	216	136	567
Urban	137	176	120	433
Government	150	144	106	400
Private	202	250	148	600

Flowchart showing the summary of Methodology



ANALYSIS AND INTERPRETATION

Aruna P.K. “Influence of cognitive style intelligence and classroom climate on process outcomes in science of secondary school pupils of Kerala ” Thesis. Department of Education , University of Calicut, 2004

CHAPTER 4

ANALYSIS AND INTERPRETATION

ANALYSIS AND INTERPRETATION

This chapter describes the details of statistical analysis of the data collected by means of standardized tools. The data collected have been analysed statistically with reference to the objectives of the study.

Details of the analysis and discussion of results are presented under the major headings.

4.1. PRELIMINARY ANALYSIS

4.1.1. Preliminary Analysis of Test Scores

4.1.2. Investigation of Group Differences

4.2. MAJOR ANALYSIS

4.2.1. Estimation of Relationship Between Independent and Dependent Variables.

4.2.2. Investigation of Main and Interaction Effects of Independent Variables on Dependent Variable.

4.2.3. Prediction of High, Average and Low Groups of Process Outcomes in Science.

4.1. PRELIMINARY ANALYSIS

As the first step of analysis, the important statistical constants, namely mean, median, mode, standard deviation, skewness and kurtosis of the select independent and dependent variables were determined for the total sample and relevant subsamples formed on the basis of sex, locale and management.

4.1.1. PRELIMINARY ANALYSIS OF THE TEST SCORES

Preliminary analysis was carried out to get an appropriate set of summary statistics which may provide a quick impression of the main features of the data, which in turn may provide guidance as to how the analysis and interpretation should proceed. The score distributions of the Independent Variables and the Dependent Variable for the Total sample and relevant subsamples are presented in Table 4.1, 4.2, 4.3 and 4.4 respectively.

TABLE 4.1

Statistical Constants of the Independent Variable Cognitive Style for the Total Sample and Subsamples Formed on the Basis of Sex, Locale and Management

Variable	Total Sample N=1000							
	Statistical Constants	Total N=1000	Boys N=500	Girls N=500	Rural N=567	Urban N=433	Govt. N=400	Private N=600
Cognitive Style	Mean	9.036	10.776	7.296	8.926	9.180	8.835	9.170
	Median	8.000	11.000	7.000	9.000	8.000	8.000	9.00
	Mode	8.000	9.000	7.000	8.000	8.000	7.000	8.00
	S.D.	4.053	3.574	3.749	4.003	4.119	4.067	4.042
	Skewness	0.113	-0.176	0.567	0.036	0.201	0.213	0.047
	Kurtosis	-0.680	-0.739	0.265	-0.608	-0.789	-0.767	-0.598

TABLE 4.2

Statistical Constants of the Independent Variable Intelligence for the Total Sample and Subsamples Formed on the Basis of Sex, Locale and Management

Variable	Total Sample N=1000							
	Statistical Constants	Total N=1000	Boys N=500	Girls N=500	Rural N=567	Urban N=433	Govt. N=400	Private N=600
Intelligence	Mean	39.433	40.392	38.474	37.735	41.656	39.033	39.700
	Median	40.000	41.000	40.000	39.000	43.000	40.000	41.000
	Mode	40.000	36.000	40.000	36.000	43.000	40.000	40.000
	S.D.	7.916	7.554	8.158	8.218	6.906	8.569	7.44
	Skewness	-1.083	-1.132	-1.035	-0.795	-0.117	-0.870	-1.256
	Kurtosis	1.442	1.623	1.298	0.507	1.654	0.748	2.094

TABLE 4.3

Statistical Constants of the Independent Variable Classroom Climate for the Total Sample and Subsamples Formed on the Basis of Sex, Locale and Management

Variable	Total Sample N=1000							
	Statistical Constants	Total N=1000	Boys N=500	Girls N=500	Rural N=567	Urban N=433	Govt. N=400	Private N=600
Classroom Climate	Mean	101.003	99.448	102.558	101.929	99.790	99.77	101.825
	Median	103.000	103.000	103.000	103.000	103.000	102.000	103.000
	Mode	103.000	103.000	105.000	105.000	103.000	103.000	103.000
	S.D.	15.322	15.957	14.508	14.616	16.136	17.436	13.686
	Skewness	-1.108	-1.072	-1.097	-1.324	-0.863	-1.063	0.047
	Kurtosis	1.500	1.432	1.341	2.819	0.242	1.135	-0.598

TABLE 4.4

Statistical Constants of the Dependent Variable Process Outcomes in Science for the Total Sample and Subsamples Formed on the Basis of Sex, Locale and Management

Variable	Total Sample N=1000							
	Statistical Constants	Total N=1000	Boys N=500	Girls N=500	Rural N=567	Urban N=433	Govt. N=400	Private N=600
Process Outcomes in Science	Mean	24.157	23.196	25.118	23.208	25.400	24.035	24.238
	Median	25.000	24.000	26.000	24.000	26.000	26.000	25.000
	Mode	26.000	26.000	26.000	26.000	22.000	26.000	22.000
	S.D.	6.206	6.239	6.028	6.400	5.716	5.766	6.487
	Skewness	-0.430	-0.317	-0.506	-0.400	-0.376	-0.562	-0.374
	Kurtosis	-0.078	-0.361	-0.262	-0.195	-0.085	-0.410	0.014

From Tables 4.1, 4.2, 4.3 and 4.4 it can be seen that the statistical constants of the Independent Variables and the Dependent Variable are close approximations to values expected for normal distribution. The distributions were further examined for their shapes graphically which revealed that all distributions approximated to normality and are not badly skewed.

On the whole, it can be seen that the distribution of the independent and dependent variables do not depart markedly for the total sample and for the subsamples. For a large sample, slight non normality of the population does not seriously affect the probabilities of acceptance or rejection of hypothesis. The sample selected for the present study can be regarded as a fairly representative sample of the population.

4.1.2. INVESTIGATION OF GROUP DIFFERENCES

In this section of analysis, investigation of sex, locale and management differences for the select independent and dependent variables were computed. The intention was to find out whether any significant difference exists in the mean scores of Process Outcomes in Science for the samples of Boys and Girls, Rural and Urban, Government and Private Samples. For this purpose means and standard deviations of the variables were calculated separately and were subjected to two-tailed test of significance of differences. The whole sample were treated as large and independent.

4.1.2.1. Investigation of Gender Difference

In order to study the sex difference in the total sample, the means and standard deviation of independent variables (Cognitive Style, Intelligence, and Classroom Climate) and dependent variable (Process Outcome in Science) of Boys and Girls were subjected to two tailed test of significance of difference between means.

The data and results of t-test for the means of select independent and dependent variables for Boys and Girls in the Total Sample are presented in Table 4.5.

TABLE 4.5

Data and Results of the Test of Significance of Difference in Mean Scores of Independent and Dependent Variables Between Boys and Girls in Total Sample

Variables		Boys (N=500)		Girls (N=500)		C.R.	Level of Significance
		Mean	SD	Mean	SD		
a.	**Independent Variables**						
1)	Cognitive Style	10.776	3.574	7.296	3.749	15.020	0.01
2)	Intelligence	40.392	7.554	38.474	8.158	3.860	0.01
3)	Classroom Climate	99.448	15.957	102.558	14.508	3.220	0.01
b.	**Dependent Variable**						
1)	Process Outcomes in Science	23.196	6.239	25.118	6.028	4.950	0.01

From the Table 4.5 it can be inferred that the boys and girls differ significantly (at 0.01 level) in the mean scores of Independent Variables 1) Cognitive Style (2) Intelligence (3) Classroom Climate and dependent variable (1) Process Outcomes in Science, as critical ratios estimated for these variables are greater than 2.58, the minimum values required for significance at 0.01 level. This suggests that mean scores of these variables obtained for Boys and Girls are significantly different. High mean Scores were associated with boys suggesting the superiority of Boys over Girls in 'Cognitive Style' and 'Intelligence'. High mean scores were associated with the variables Classroom Climate and Process Outcome in Science for Girls suggesting the superiority of Girls over Boys in 'Classroom Climate' and 'Process Outcome in Science'. The result of t-test revealed that significant sex difference exists in independent variables 'Cognitive Style', 'Intelligence,' 'Classroom Climate,' and in the dependent variable, 'Process Outcomes in Science.'

4.1.2.2. Investigation of Locale Difference

The mean and standard deviations of independent variables (Cognitive Style, Intelligence and Classroom Climate) and the dependent variable (Process Outcomes in Science) of the Rural and Urban subjects of the Total Sample were subjected to two tailed test of significance of difference between means. The basic data for test of significance and the obtained critical ratios for Rural and Urban subjects are presented in Table 4.6.

TABLE 4.6

Data and Results of the Test of Significance of Difference in Mean Scores of Independent and Dependent Variables Between Rural and Urban students in the Total Sample

	Variables	Rural (N=567)		Urban (N=433)		C.R.	Level of Significance
		Mean	SD	Mean	SD		
a)	**Independent Variables**						
1)	Cognitive Style	8.926	4.003	9.180	4.119	0.98	NS
2)	Intelligence	37.735	8.218	41.656	6.906	8.19	0.01
3)	Classroom Climate	101.929	14.616	99.790	16.136	2.16	0.05
b)	**Dependent Variable**						
1)	Process Outcomes in Science	23.208	6.400	25.400	5.716	5.70	0.01

N.S. Not Significant

From Table 4.6 it can be observed that the Rural and Urban subjects differ significantly (at 0.01 level) in mean scores of

Independent Variables 'Intelligence' and dependent Variable 'Process Outcomes in Science' as critical ratios estimated for these variables are greater than 2.58, the minimum values required for significance at 0.01 level. This suggests that mean scores of these variables obtained for Rural and Urban subjects are significantly different. The locality of the school also has significant effect in the mean scores of Classroom Climate'. The obtained critical ratio was significant at 0.05 level. No significant difference was noticed for 'Cognitive Style' between Rural and Urban subjects even at 0.05 level. High mean scores are associated with Urban subjects for the variables 'Intelligence' and 'Process Outcomes in Science' when compared with Rural subjects. For 'Classroom Climate' high scores are associated with Rural subjects when compared with Urban subjects.

4.1.2.3. Investigation of Difference in the Type of Management

Test of significance of mean difference was applied on mean scores of the independent and dependent variables of Government and Private subjects and the results were studied.

Data and Results of the t-test are presented in Table 4.7.

TABLE 4.7

Data and Results of the Test of Significance of Difference in Mean Scores of Independent and Dependent Variables Between Government and Private School Pupils in the Total Sample

Variables		Government (N=400)		Private (N=600)		C.R.	Level of Signifi-cance
		Mean	SD	Mean	SD		
a) Independent Variables							
1)	Cognitive Style	8.835	4.067	9.170	4.042	1.28	N.S.
2)	Intelligence	39.032	8.569	39.700	7.444	1.27	N.S
3)	Classroom Climate	99.77	17.436	101.825	13.686	1.98	0.05
b) Dependent Variable							
1)	Process Outcomes in Science	24.035	5.766	24.238	6.487	0.52	N.S

N.S. Not Significant

Significant mean difference at 0.05 level was noticed between Government and Private subjects for the independent variable Classroom Climate. No significant difference was noticed between the means of the independent variables 'Cognitive Style' and 'Intelligence' and dependent variable 'Process Outcomes in Science' of Government and Private subjects even at 0.05 level. The Government and Private subjects do not differ significantly in the case of variables 'Cognitive Style', 'Intelligence' and Process Outcomes in Science, which imply that the Government and Private school subjects are identical with respect to these variables.

Discussion of Results

Summary of Sex, Locale and Type of Management differences for the Independent and Dependent Variables are presented in Table 4.8.

TABLE 4.8

Summary of Sex, Locale and Type of Management Differences for the Independent and Dependent Variables

Variables	C.R.		
	Sample		
	Boys X Girls	Rural X Urban	Government X Private
Independent Variables			
1. Cognitive Style	15.02**	0.98	1.28
2. Intelligence	3.86**	8.19**	1.27
3. Classroom Climate	3.22**	2.16*	1.98*
Dependent Variable			
1. Process Outcomes in Science	4.95**	5.70**	0.52

* P < 0.05; ** P < 0.01

Table 4.8 revealed significant difference between boys and girls with regard to their 'Cognitive Style' in the total sample. The superiority of Boys over Girls in 'Cognitive Style' has been substantiated by many classical studies such as the Witkin, *et al.* (1962); Grandall and Sinkeldan (1964); Karp and Konstadt (1971); Kagan (1976). Huss and Kayson (1985). Hughes (1978); Kalyani (1982); Tharakan (1987) and Arrington (1987) reported the absence of sex difference in Cognitive Styles. Significant difference was noticed between Boys and Girls with respect to their 'Intelligence' in the total sample studied. The works of Chedda and Sen (1981);

Ignatius (1983); Gupta *et al* (1993) support the findings of the present study on the sex difference with regard to 'Intelligence'. Investigation of sex difference also revealed significant difference between Boys and Girls with regard to their Classroom Climate and Process Outcomes in Science in the total sample. The results substantiate the former findings of Muraleedharan (1999); Reema ~~Baby~~ (2002); Shabana (2003); Soumya (2003).

No significant difference even at 0.05 level was found between Urban and Rural pupils with regard to their Cognitive Style. Tharakan (1987), Suresan (1997) reported the Locale difference in Cognitive Styles. Studies on Locale difference revealed significant difference at 0.01 level between Urban and Rural subjects for their 'Intelligence' in the total sample. In this case high mean scores was seen associated with Urban subjects. This findings is contrary to the studies of Ignatius (1983). The works of Varghese (1987) and Soumya (2003) supported this finding. Significant difference at 0.05 level was found between Urban and Rural pupils with regard to their Classroom Climate. The Dependent Variable Process Outcomes in Science showed the Locale difference at 0.01 level. Muraleedharan (1999), Reema ~~Baby~~ (2002) reported significant Locale difference in Process Outcomes in Science.

No significant difference even at 0.05 level was noticed between Government and Private subjects for the Independent Variables Cognitive Style and Intelligence. This finding is not in agreement with the findings of Devi (1997), Suresan (1997) and Soumya (2003). Significant mean difference at 0.05 level was noticed between Government and Private subjects for the variable Classroom Climate. Bowden *et al.* (1989) reported difference in type of management and Classroom Climate. Devi (1997), Muraleedharan (1999) and Baby (2002) reported that Private school children are higher in school environment than Government school children. No significant difference was noticed between means of dependent variable Process Outcomes in Science of Government and Private subjects even at 0.05 level. This findings is not in agreement with findings of Baby (2002), Joshi (2002) and Soumya (2003) who found significant difference between Government and Private school pupils in their Process Outcomes in Science.

4.2. MAJOR ANALYSIS

This section of the analysis includes the estimation of the relationship between Independent and Dependent variables, main and interaction effects of Independent Variables on Dependent Variable and Discriminant Function Analysis.

4.2.1. ESTIMATION OF RELATIONSHIP BETWEEN INDEPENDENT AND DEPENDENT VARIABLES

This part of the analysis was directed to examine the extent and nature of relationship between Independent variables and Dependent variable and also the interrelationship between independent variables. The investigator used the technique of Pearson's Product Moment Coefficient of Correlation to calculate the correlation as the dependent variable followed a normal distribution. It was seen that the variable Process Outcomes in Science is slightly negatively skewed. This can be overseened as the size of the sample taken is a large one. The independent variables of the study are Cognitive Style, Intelligence and Classroom Climate.

The extent of relation of each independent variable with dependent variable and also extent of inter relationship of independent variables were calculated for Total sample and relevant sub samples namely Boys, Girls, Rural, Urban, Government and Private. The relationship were discussed separately.

4.2.1.1. CORRELATION ANALYSIS BETWEEN INDEPENDENT AND DEPENDENT VARIABLES

In this section the relationship between Cognitive Style and Process Outcomes in Science, Intelligence and Process Outcomes in Science, Classroom Climate and Process Outcomes in Science is separately done for the Total sample, Boys, Girls, Rural, Urban, Government and Private.

Relationship between Cognitive Style and Process Outcomes in Science

The relationship between Cognitive Style and Process Outcomes in Science for the total sample and relevant subsamples were calculated. The values of 'r' was computed, followed by this, the investigator tested each 'r' for its significance (using Fischer's 't' test), found the 0.99 confidence intervals and shared variance of each 'r'. The details of correlation obtained between Cognitive Style and Process Outcomes in Science for Total sample and relevant sub samples namely Boys, Girls, Rural, Urban, Government and Private sample were Given in Table 4.9.

TABLE 4.9

Details of the Relationship Between Cognitive Style and Process Outcomes in Science for Samples of Total, Boys, Girls, Rural, Urban, Government and Private

Sample	N	Coefficient of correlation 'r'	t-value of 'r'	SEr	Confidence Interval at level 0.99		Shared Variance in Percentage
					Lower Limit	Upper Limit	
Total	1000	0.129**	4.103	0.031	0.048	0.209*	1.659
Boys	500	0.158**	3.554	0.044	0.045	0.270	2.474
Girls	500	0.280**	6.513	0.041	0.174	0.387	7.850
Rural	567	0.131**	3.286	0.041	0.030	0.243	1.873
Urban	433	0.110*	2.292	0.048	0.014	0.234	1.203
Government	400	0.026	0.521	0.050	-0.103	0.155	0.068
Private	600	0.190**	4.720	0.039	0.088	0.291	1.895

*P < 0.05; **P < 0.01.

The coefficient of correlation obtained between the Cognitive Style and Process Outcomes in Science for the Total sample (0.129), Boys (0.158), Rural (0.131) and Urban (0.110) are negligible and positive correlation. The positive sign indicates that the dependent and independent variables increase or decrease together.

The relationship between the variables are significant beyond 0.01 level for the samples of Total, Boys, Girls and Private. In case of Urban sample the relationship between the variables are significant at 0.05 level. The relationship between variables are not significant even at 0.05 level for the Government sample.

The confidence Interval ranges from -0.103 to 0.387 which shows that there is 0.99 probability of the population 'r' to lie in this interval.

Shared variance of Cognitive Style with Process Outcomes in Science varies from 0.068 to 7.850. The results shows that relationship between Cognitive Style and Process Outcomes in Science in significant, but verbally it can be interpreted as negligible and low relationship. The relationship between Cognitive Style and Process Outcomes in Science is real and positive.

Relationship between Intelligence and Process Outcomes in Science

The details of the correlation obtained between Intelligence and Process Outcomes in Science for total sample and relevant sub samples indicating direction, level of significance, population value at 0.99 level of confidence interval and percentage of overlap are given in Table 4.10.

TABLE 4.10

Details of the Relationship Between Intelligence and Process Outcomes in Science for Samples of Total, Boys, Girls, Rural, Urban, Government and Private

Sample	N	Coefficient of correlation 'r'	t-value of 'r'	SEr	Confidence Interval 0.99		Shared Variance in Percentage
					Lower Limit	Upper Limit	
Total	1000	0.221**	7.182	0.030	0.144	0.222	4.915
Boys	500	0.279**	6.458	0.041	0.171	0.380	7.728
Girls	500	0.214**	4.902	0.042	0.110	0.324	4.604
Rural	567	0.248**	6.102	0.039	0.147	0.250	6.183
Urban	433	0.080	1.672	0.047	-0.043	0.204	0.645
Government	400	0.183**	3.732	0.048	.059	0.309	3.383
Private	600	0.249**	6.306	0.030	0.171	0.329	6.235

** $P < 0.01$.

The Coefficient of Correlation obtained between the Intelligence and Process Outcomes in Science for the samples of total (0.221), Boys (0.279), Girls (0.214), Rural (0.248) and Private (0.249) are low and positive correlation. For the samples of Urban (0.080) and Government (0.183) have negligible positive correlation.

The coefficient of correlation is positive and real for samples Total, Boys, Girls, Rural, Urban, Government and Private. The positive sign indicates that dependent and independent variables increase or decrease together.

The relationship between the variables Intelligence and Process Outcomes in Science is significant beyond 0.01 level for the samples of Total, Boys, Girls, Rural, Government and Private. The relationship between the variables are not significant even at 0.05

level for Urban sample. For the samples of Total and subsamples Boys, Girls, Rural, Government and Private significant positive, real correlation exist between the two variables.

The confidence interval ranges from -0.043 to 0.380 which shows that there is 0.99 probability of the population 'r' to lie in this interval. The shared variance (Percentage overlap) of Intelligence with Process Outcomes in Science varies from 0.645 to 7.728.

Relationship between Classroom Climate and Process Outcomes in Science

The details of the correlation obtained between Classroom Climate and Process Outcomes in Science for Total Sample and relevant subsamples indicating direction, level of significance, population value at 0.99 level of confidence interval and percentage of overlap are given in Table 4.11.

TABLE 4.11

Details of the Relationship Between Classroom Climate and Process Outcomes in Science for Samples of Total, Boys, Girls, Rural, Urban, Government and Private

Sample	N	Coefficient of correlation 'r'	t-value of 'r'	SEr	Confidence Interval 'r'		Shared Variance in Percentage
					Lower Limit	Upper Limit	
Total	1000	0.065	1.062	0.032	-0.016	0.142	0.424
Boys	500	0.040	0.892	0.045	-0.075	0.155	0.159
Girls	500	0.155**	3.500	0.044	0.113	0.267	2.400
Rural	567	0.112**	2.688	0.042	0.005	0.220	1.263
Urban	433	0.030	0.630	0.048	-0.018	0.154	0.092
Government	400	0.060	1.206	0.050	-0.128	0.189	0.364
Private	600	0.069	1.699	0.041	-0.035	0.174	0.480

** $P < 0.01$.

The coefficient of correlation obtained between the Classroom Climate and Process Outcomes in Science for the samples of Total (0.065), Boys (0.040), Girls (0.155), Rural (0.112), Urban (0.030), Government (0.060) and Private (0.069) are negligible and positive.

The relationship between the variables are significant beyond 0.01 level for the samples of Girls and Rural. For the samples of Total, Boys, Urban, Government and Private the obtained 'r' is less than 0.05 level of significance.

The confidence Interval ranges from -0.128 to 0.267 which shows that there is a 0.99 probability of population 'r' to lie in this interval. The shared variance varies from 0.092 to 2.400.

4.2.1.2. Estimation of the Relationship between Independent Variables

The details of the intercorrelation between Independent Variables, Cognitive Style and Intelligence, Cognitive Style and Classroom Climate and Intelligence and Classroom Climate are computed separately as follows.

Relationship between Cognitive Style and Intelligence

The details of the correlation obtained between Cognitive Style and Intelligence for total sample and relevant subsamples indicating direction, level of significance, population value at 0.01 level confidence interval and percentage of overlap are given in Table 4.12.

TABLE 4.12

Details of the Relationship Between Cognitive Style and Intelligence for the Samples of Total, Boys, Girls, Rural, Urban, Government and Private

Sample	N	Coefficient of correlation 'r'	t-value of 'r'	SEr	Confidence Interval at 0.99 level		Shared Variance in Percentage
					Lower Limit	Upper Limit	
Total	.1000	0.311**	10.326	0.028	0.237	0.384	9.653
Boys	500	0.145**	3.263	0.045	0.029	0.260	2.093
Girls	500	0.416**	10.196	0.045	0.300	0.531	17.271
Rural	567	0.329**	8.286	0.037	0.233	0.425	10.836
Urban	433	0.292**	6.334	0.044	0.178	0.405	8.516
Government	400	0.356**	7.507	0.044	0.243	0.468	12.664
Private	600	0.275**	6.995	0.038	0.177	0.373	7.563

**P < 0.01

The coefficient of correlation obtained between the Cognitive Style and Intelligence for the samples of Total (0.311), Rural (0.329), Urban (0.292), Government (0.356) and Private (0.275) is low and positive correlation. For the samples of Girls (0.416) have substantial and positive correlation. In case of Boys (0.145) have negligible positive correlation.

The coefficient of correlation is positive and real for samples of Total, Girls, Rural, Urban, Government and Private. The positive sign indicates that the two variables Cognitive Style and Intelligence increase or decrease together.

The relationship between the variables Cognitive Style and Intelligence are significant beyond 0.01 level for the samples of Total, Boys, Girls, Rural, Urban, Government and Private.

The confidence intervals are ranging from 0.029 to 0.531 which shows that there is a 0.99 probability of the population 'r' to lie in this interval. Shared Variance of Cognitive Style with Intelligence varies from 2.093 to 17.271.

Relationship between Cognitive Style and Classroom Climate

The details of correlation obtained between Cognitive Style and Classroom Climate for Total sample and relevant subsamples indicating direction, level of significance, confidence interval at 0.99 level and percentage of overlap are given in Table 4.13.

TABLE 4.13

Details of the Relationship Between Cognitive Style and Classroom Climate for the Samples of Total, Boys, Girls, Rural, Urban, Government and Private

Sample	N	Coefficient of correlation 'r'	t-value of 'r'	SEr	Confidence Interval at 0.99 level		Shared Variance in Percentage
					Lower Limit	Upper Limit	
Total	1000	0.043	1.356	0.032	-0.038	0.124	0.1843
Boys	500	0.049	1.103	0.045	-0.115	0.164	0.243
Girls	500	0.059	1.321	0.045	-0.115	0.174	0.349
Rural	567	0.001	0.018	0.042	-0.108	0.109	0.000
Urban	433	0.090	1.895	0.048	-0.032	0.214	0.826
Government	400	0.063	1.255	0.049	-0.065	0.191	0.393
Private	600	0.032	0.781	0.041	-0.073	0.137	0.101

The coefficient of correlation obtained between Cognitive Style and Classroom Climate for the samples of Total (0.043), Boys (0.049), Girls (0.059), Rural (0.001), Urban (0.090), Government (0.063) and Private (0.032) are negligible but positive.

The coefficient of correlation obtained between Cognitive Style and Classroom Climate for the samples of Total, Boys, Girls, Rural, Urban, Government and Private are not significant even at 0.05 level of significance. This indicates that the Cognitive Style of all samples Total, Boys, Girls, Rural, Urban, Government and Private have negligible relation with Classroom Climate of students.

The confidence Interval ranges from -0.115 to 0.214 which shows that there is a 0.99 probability of population 'r' to lie in this interval.

Shared Variance of Cognitive Style with Classroom Climate varies from 0.000 to 0.826.

Relationship between Intelligence and Classroom Climate

The details of the correlation obtained between Intelligence and Classroom Climate for total sample and relevant subsamples indicating direction, level of significance, population value at 0.01 level of confidence interval and percentage of overlap are given in Table 4.14.

TABLE 4.14

Details of the Relationship Between Intelligence and Classroom Climate for the Samples of Total, Boys, Girls, Rural, Urban, Government and Private

Sample	N	Coefficient of correlation 'r'	t-value of 'r'	SEr	Confidence Interval at 0.99 level		Shared Variance in Percentage
					Lower Limit	Upper Limit	
Total	1000	0.035	1.111	0.032	-0.046	0.116	0.123
Boys	500	0.020	0.459	0.045	-0.095	0.136	0.042
Girls	500	0.078	1.756	0.044	-0.036	0.193	0.615
Rural	567	0.108**	2.594	0.042	0.001	0.215	1.178
Urban	433	0.028	0.599	0.048	-0.095	0.153	0.083
Government	400	0.014	0.292	0.050	-0.114	0.143	0.022
Private	600	0.050	1.229	0.041	-0.058	0.155	0.252

**P < 0.01.

The coefficient of correlation obtained between Intelligence and Classroom Climate for the samples of Total (0.035), Boys (0.020), Girls (0.078), Rural (0.108), Urban (0.028), Government (0.014) and Private (0.050) are negligible and positive correlation. In case of Rural sample 'r' is significant at 0.01 level of significance. The relationship between two variables Intelligence and Classroom Climate for the other samples such as Total, Boys, Girls, Urban, Government and Private is not significant even at 0.05 level of significance.

The confidence interval ranges from -0.114 to 0.215 which shows that there is a 0.99 probability of the population 'r' to lie in this interval.

Shared variance of Intelligence with Classroom Climate varies from 0.022 to 1.178.

Discussion of Results

The extent of relation of each independent variable with dependent variable and extent of relationship between each of the independent variable with other independent variables calculated for Total sample and relevant subsamples namely Boys, Girls, Rural, Urban, Government and Private are discussed in this section.

Summary of Coefficient of Correlation between Independent Variables and Process Outcomes in Science

Summary of Coefficient Correlation between Independent variables and Process Outcomes in Science for Total Sample and relevant subsamples based on Sex, Locale and Type of Management are presented in Table 4.15.

TABLE 4.15

Summary of Coefficient of Correlation Between Independent Variables and Process Outcomes in Science for Total sample and relevant subsamples based on Sex, Locale and Management

Sample	N	'r' between Cognitive Style and Process outcomes in Science	't' value of 'r'	'r' between Intelligence and Process Outcomes in Science	't' value of 'r'	'r' between Classroom Climate and Process Outcomes in Science	't' value of 'r'
Total	1000	0.129**	4.103	0.221**	7.182	0.065	1.062
Boys	500	0.158**	3.554	0.277**	6.458	0.040	-0.892
Girls	500	0.280**	6.513	0.214**	4.902	0.155**	3.499
Rural	567	0.131**	3.286	0.248**	6.102	0.112*	2.688
Urban	433	0.110*	2.292	0.080	1.672	0.030	0.630
Government	400	0.026	0.521	0.183**	3.732	0.060	1.206
Private	600	0.190**	4.720	0.249**	6.306	0.069	1.699

*P < 0.05; ** P < 0.01.

The correlation analysis revealed that the relationships between 'Cognitive Style and Process Outcomes in Science is Significant, Positive, real but negligible for the Total sample and subsamples Boys, Rural, Urban and Private. Girls sample showed significant positive, real and low relationship, Government sample showed positive but not significant negligible relationship between Cognitive Style and Process Outcomes in Science.

The correlation analysis suggested that the relationship between Intelligence and Process Outcomes in Science is significant, positive, real and low for the Total sample and subsamples Boys, Girls, Rural, Government and Private. Urban sample showed positive, negligible relationship between Intelligence and Process Outcomes in Science.

From the results of correlation analysis it can be seen that the relationship between Classroom Climate and Process Outcomes in Science is negligible and positive for the Total sample and subsamples Boys, Urban, Government and Private. But significant, positive, real and negligible relationship can be seen for the sample Rural and Girls at 0.01 level.

The summary of results revealed that though significant and positive relationship exists between Process Outcomes in Science and independent variables the strength of relationships are low or negligible. Among the independent variables, Cognitive Style influences Process Outcomes in Science most. The value of 'r' ranged from 0.026 to 0.280. Intelligence is the next variable which influences Process Outcomes in Science. The value of 'r' ranged from 0.080 to 0.277. The present study also revealed that there is only negligible influence of Classroom Climate on Process Outcomes in Science. The value of 'r' ranged from 0.030 to 0.155.

The correlation analysis revealed that the relationship between 'Cognitive Style' and 'Process Outcomes in Science' is significant, positive real but low. Similar findings were reported by Cox (1982); Padilla *et al.* (1983); Lavoie, (1989); Rubin and Noorman (1989). The correlation analysis suggested that the relationship between 'Intelligence' and 'Process Outcomes in Science' is significant. Positive, real and low for Total Sample and subsmples. Studies of Harnek and Parminder (1985), Mehna (1986), Bhargava (1983), Maree *et al.*, (2002) showed the same results. From the results of correlation analysis it can be concluded that the relationship between Classroom Climate and Process Outcomes in Science is significant and positive for the subsamples, Girls and Rural. Studies of Tatton (1983), Mintzes (1982), Fraser (1983); Byrne *et al.* (1986) showed positive significant relationship between Classroom Climate and Process Outcomes in Science. In case of subsamples Boys, Urban, Government and Private, the relationship between Classroom Climate and Process Outcomes in Science is found negligible. Jack *et al.* (1993); Muraleedharan (1997) and ~~Baby~~ Reema (2002) reported no relationship between Classroom Climate and Process Outcomes in Science.

Summary of Intercorrelation between Independent Variables

Intercorrelation between each of the independent variable with other independent variables for Total Sample and relevant subsamples based on Sex, Locale and Type of Management carried out and they are presented in Table 4.16.

TABLE 4.16

Summary of Interrelationship between each of the Independent Variable with other Independent variables for Total sample and Relevant Subsamples Based on Sex, Locale and Type of Management of Schools

Sample	N	'r' between Cognitive Style and Intelligence	't' value of 'r'	'r' between Cognitive Style and Classroom Climate	't' value of 'r'	'r' between Intelligence and Classroom Climate	't' value of 'r'
Total	1000	0.311**	10.326	0.043	1.356	0.035	1.111
Boys	500	0.145**	3.263	0.049	1.103	0.020	0.459
Girls	500	0.416**	10.196	0.059	1.321	0.078	1.756
Rural	567	0.329**	8.286	0.001	0.018	0.108**	2.595
Urban	433	0.292**	6.334	0.090	1.895	0.028	0.599
Government	400	0.356**	7.507	0.063	1.255	0.014	0.293
Private	600	0.275**	6.995	0.032	0.781	0.050	1.229

** $P < 0.01$.

The correlation analysis revealed that the relationship between 'Cognitive Style' and 'Intelligence' is significant, positive, real and low for the Total sample and subsamples Girls, Rural, Urban, Government and Private. Boys sample showed significant, positive and negligible relationship between Cognitive Style and Intelligence. The value of 'r' ranged from 0.145 to 0.416.

The correlation analysis suggested that relationship between Cognitive Style and Classroom Climate is Positive and negligible. There is no significant relationship between Cognitive Style and Classroom Climate for Total sample and subsamples based on Sex, Locale and Type of Management. The value of 'r' ranged from 0.001 to 0.090.

The correlation analysis suggested that the relationship between Intelligence and Classroom Climate is positive but negligible for the Total sample and the subsamples Boys, Girls, Urban, Government and Private. Rural sample showed significant positive and negligible relationship between Intelligence and Classroom Climate. The value of 'r' ranged from 0.020 to 0.108.

The correlation analysis revealed that the relationship between 'Cognitive Style' and 'Intelligence' is significant positive real and low for the Total sample and subsamples. Similar results were also found by Coates (1972), Coates and Bromberg (1973), Block and Block (1985), Kumar (1990). The correlation analysis suggested that no significant relationship exists between Cognitive Style and Classroom Climate. The correlation analysis also suggested that the relationship between Intelligence and Classroom Climate is negligible and not significant.

Marjoribanks (1978) study revealed that School Environment has correlation with Cognitive Performance in children. Sarojinis (1997) study also reported that School Environment and Cognitive Style, School Environment and Intelligence are significantly correlated.

4.2.2. INVESTIGATION OF MAIN AND INTERACTION EFFECTS OF SELECT INDEPENDENT VARIABLES ON DEPENDENT VARIABLE

The preliminary analysis shows that the distribution of scores of Process Outcomes in Science is following a near normal distribution. This part of the analysis was intended to find out the possible main effect and interaction effect of select independent variables namely Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science for the Total sample and relevant subsamples formed on the basis of Sex, Locale and Type of management of schools.

In order to study the Main effect and Interaction effect of three independent variables on dependent variable, Three Way Analysis of Variance was done using 3x3x3 factorial design.

Classification Procedure

As a first step the subjects were categorized (N=1000) into groups on basis of their level of Cognitive Style, Intelligence and Classroom Climate. The classification was done as described in methodology chapter.

The three levels of Cognitive Style are Field Independent (FI), Intermediate (INT) and Field Dependent (FD). The three levels of Intelligence are High Intelligent (HI), Average Intelligent (AI) and Low Intelligent (LI). The three levels of Classroom Climate are Favourable Classroom Climate. Moderately Favourable Classroom Climate and Less Favourable Classroom Climate Group. These three levels of each Independent variables were taken up to build 3x3x3 factorial design of three way ANOVA.

The Computer Programme, SPSS, Statistical Package for Social Sciences (Einspruch, 1998) was made use of. Due to unequal number of cases in the treatment cells, the programme for unequal numbers was used for processing the data.

The computation was done in such a way that the Sum of squares along with their corresponding Degrees of freedom, the Mean squares of variance and F-value were obtained. The tabled values of F-ratios were consulted to ascertain the significance of Main effect and Interaction effect.

When F-values for the Main effect of particular Independent variable on specific dependent variable was found significant, Scheffe' Test of Multiple comparison was applied to findout the groups which differ significantly.

In order to study the main effect and interaction effect of select independent variables namely 'Cognitive Style,' 'Intelligence' and Classroom Climate on Process Outcomes in Science of the Total Sample and Subsamples formed on the basis of Sex, Locale and type of Management of Schools, Seven ANOVA were undertaken.

4.2.2.1. Investigation of Main Effect, First Order and Second Order Interactions of Select Independent Variables on Process Outcomes in Science for Total Sample and Sub samples formed on the basis of Sex, Locale and Type of Management

The main effect, first order and second order interactions of Cognitive Style, 'Intelligence' and Classroom Climate on 'Process Outcomes in Science' were studied separately for Total Sample and subsamples of Boys, Girls, Rural, Urban, Government and Private. The details of results and discussions are presented in this section.

4.2.2.1.1. Investigation of Main Effect, First Order and Second Order Interaction of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science for Total Sample (N = 1000)

The main and interaction effects of Cognitive Style Intelligence and Classroom Climate on Process Outcomes in Science was studied by conducting Three Way Analysis of Variance with unequal cell frequencies using 3x3x3 factorial design.

ANOVA is done at three levels viz., main effects, first order interactions and second order interactions. In case of main effects, the effect of single Independent Variable on the Dependent Variable is determined. On the other hand first order interaction better explains the combined effect of two Independent Variables on the Dependent Variable. In second order interaction ANOVA is carried further to see the interaction effect of three Independent Variables in combination on the Dependent Variable.

The analysis was done in such way that the sum of quares of variance and corresponding F-values for the main effect and interaction effects were computed. The tabled values of F-ratios were consulted to find out the significance of main effect, first order and second order interactions.

The data and result of Main effect and Interaction effect of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science for the Total sample are presented in Table 4.17.

TABLE 4.17

Summary of Three Way ANOVA of Process Outcomes in Science by Cognitive Style by Intelligence by Classroom Climate for Total Sample (N=1000)

Source of Variation	Sum of squares	Degrees of Freedom	Mean Squares of Variance	F-value	Level of Significance
Cognitive Style	433.139	2	216.569	5.960	0.01
Intelligence	702.177	2	351.088	9.661	0.01
Classroom Climate	71.226	2	35.613	0.980	NS
Cognitive Style X Intelligence	376.803	4	94.201	2.592	0.05
Cognitive Style X Classroom Climate	247.045	4	61.761	1.700	N.S
Intelligence X Classroom Climate	60.137	4	15.034	.414	NS
Cognitive Style X Intelligence X Classroom Climate	421.261	8	52.658	1.449	NS
Within Cells	35358.161	973	36.339		
Total	37669.949	999			

NS – Not Significant

Main Effects of Cognitive Style

From Table 4.17 Summary of ANOVA for total sample (N=1000), it can be noted that the F-value for the Main effect of Cognitive Style on Process Outcomes in Science is .5.960 and this is greater than tabled value (4.62) for 2,973 of degrees of freedom at 0.01 level of significance. Therefore the main effect of 'Cognitive Style' on Process Outcomes in Science is significant for the Total sample. This suggests that the mean score of Process Outcomes in Science differ significantly between the three levels of Cognitive Style viz., Field Independent, Intermediate Orientation and Field Dependent.

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Main Effect of Intelligence

The F-value obtained for main effect of Intelligence on Process Outcomes in Science is 9.661, which is greater than the tabled value for corresponding degrees of freedom at 0.01 level of significance. The F-value for 2df (2,973) is 4.62. This suggests that the mean score of Process Outcomes in Science differ significantly between three levels of the variable, Intelligence viz., High Intelligent group, Average Intelligent group and Low Intelligent group.

Main Effect of Classroom Climate

The F-value obtained for the main effect of 'Classroom Climate' on Process Outcomes in Science is 0.980 which is less than the tabled value for corresponding degrees of freedom, even at 0.05 level. The F-value for 2df (2, 973) is 3.00. This suggests that the main effect of Classroom Climate on Process Outcomes in Science is not significant.

First order Interaction of Independent Variables

Interaction effect means the combined effect of Independent Variables on the Dependent Variables. Each Independent Variable consist of three different levels and the different combination of Independent Variables may or may not produce changes in the Dependent Variable.

In the case of first order interactions, the interaction of two Independent Variable viz., Cognitive Style and Intelligence on the Dependent Variable, Process Outcomes in Science is carried out.

Table 4.17 indicates that the F-value obtained for the interaction effect of Cognitive Style X Intelligence on Process Outcomes is 2.592. This is greater than 2.39, the tabled F-value for significance at 0.05 level for (4,973) degrees of freedom. This implies that the joint effect of variables Cognitive Style X Intelligence on Process Outcomes in Science is significant at 0.05 level. This reveals that mean scores of Process Outcomes in Science of pupils with three levels of 'Cognitive Style' (Field Independent, Intermediate Orientation, Field dependent) are different for pupils of High Intelligence, Average Intelligence and Low Intelligence.

First order interaction of the Independent Variables on 'Process Outcomes in Science' were studied for the combinations, Cognitive Style X Classroom Climate, Intelligence X Classroom Climate. The F-ratios estimated for first order interaction were found to be 1.7 and 0.414 respectively. None of the value is significant even at 0.05 level of significance.

Second order Interaction of Independent Variables

The second order interaction involves the variation produced by the combined effect of three Independent Variables on Dependent variable. Table 4.17 shows that there is no significant F-ratio for the three way interaction of Cognitive Style X Intelligence X Classroom Climate on Process Outcomes in Science for the total sample. The F-value is 1.449 for 8,973 degrees of freedom which is not significant even at 0.05 level.

Discussion

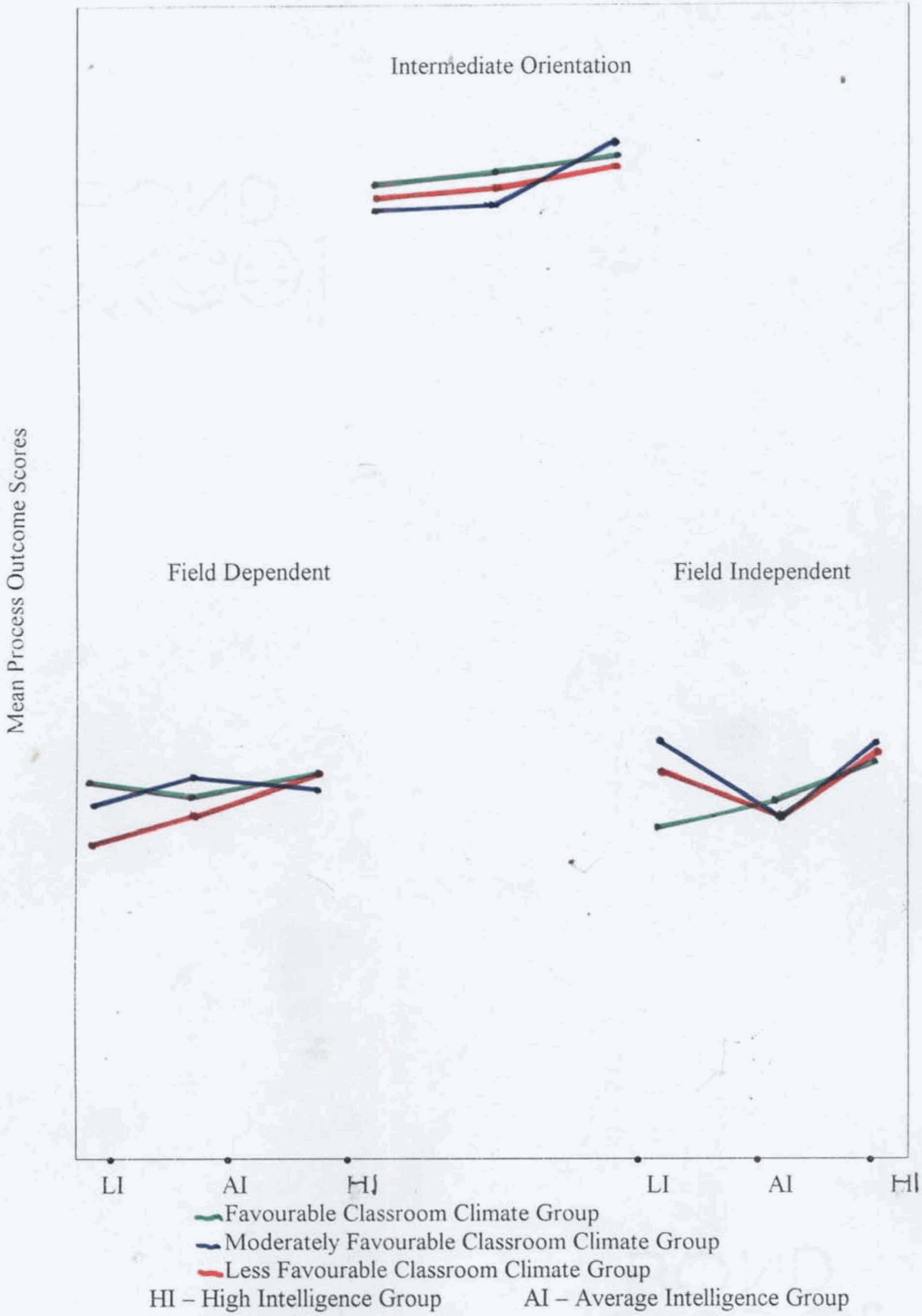
It can be seen from the results of three way ANOVA that the mean scores of 'Process Outcomes in Science' for Total sample differ significantly with changes in three levels of 'Cognitive Style' and three levels of 'Intelligence' but do not vary with changes in three levels of 'Classroom Climate.' The performance of the sample in the Process Outcomes in Science can be attributed to the cross over effect of the pairs two variables Cognitive Style X Intelligence. At the same time the performance of the sample in Process Outcomes in Science cannot be attributed to the cross over effect of any pairs of the select variables, Cognitive Style X Classroom Climate, Intelligence X Classroom Climate or combined effect of all three independent variables. Cognitive Style X Intelligence X Classroom Climate. So it is revealed that variation in Process Outcomes in Science for the Total sample is independent of the combined effect of the variable Cognitive Style X Intelligence X Classroom Climate.

Graphical Representation of Interaction Effects in Total Sample

In the present study, investigator studied the pattern of relationships between the three levels of independent variables, Cognitive Style, Intelligence, Classroom Climate and mean scores of Process Outcomes in Science. Graphs provide easy reference to interaction effect, and it highlights the depth of combined effect of Independent Variables on the Dependent Variable.

The mean scores of dependent variable 'Process Outcomes in Science' were plotted as ordinate of the graph and three categories of Intelligence (High, Average and Low Intelligent groups) as the abscissa. The three groups of Classroom Climate (Favourable Classroom Climate, Moderately Favourable Classroom Climate, Less Favourable Classroom Climate) were represented by three different lines on graph and back ground being the three levels of Cognitive Style viz., Field Independent, Intermediate Orientation and Field Dependent.

The pattern of the interaction effect in Total sample are given in Figure 4-1.



HI – High Intelligence Group AI – Average Intelligence Group
LI – Low Intelligence Group

FIGURE 4-1 **Interaction Effect of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science for Total Sample**

The graphical representation of interaction given in Figure 4-1 shows the pattern of relationship among the mean scores of 'Process Outcomes in Science' of students belonging to three levels of 'Cognitive Style', 'Intelligence' and Classroom Climate.

The High Intelligence groups irrespective of different levels of 'Cognitive Style' and 'Classroom Climate' shows marked advantage over Average Intelligence and Low Intelligence group in their mean scores of 'Process Outcomes in Science'.

Process Outcomes in Science is high for those who have with Intermediate Orientation, Moderately Favourable Classroom Climate and High Intelligence. The conclusion is that when Intelligence is high the students need only Intermediate Orientation and Moderately Favourable Classroom Climate to yield better Process Outcomes in Science.

The pattern of relationship in three-way ANOVA for Total sample shows a tendency of interaction effect when statistically significant interaction effect is not obtained. The observed interaction effect in pattern of relationship may be due to the fact that, the interaction found in the graph is statistically negligible or below 0.05 level of significance. Even though it is statistically negligible , when graphically plotted it is much evident and projected.

Post-hoc Comparison of Group Means

This part of analysis was done as a post-hoc comparison of means of relevant groups for the independent variables showing significant main effects on Process Outcomes in Science. Group differences in 'Process Outcomes in Science' was investigated whenever significant F-values were obtained in three way ANOVA.

As per ANOVA Table 4.17 the Independent Variable Cognitive Style and Intelligence were found to have significant main effect on Dependent Variable. To identify the groups which create the main effect, Scheffe' test of Post-hoc comparison was applied.

Results of comparison between mean scores of Process Outcomes in Science based on three levels of Cognitive Style and Intelligence are given in Table 4.18.

TABLE 4.18

Result of Scheffe's Test of Post-hoc Comparison Between Mean of Process Outcomes in Science Based on three Groups of Cognitive Style and Intelligence for Total Sample (N=1000)

Independent Variable	Groups Compared	Means		F	Values of F'		Level of Significance
		M_1	M_2		0.05	0.01	
Cognitive Style	FI – INT	25.837	23.512	16.748	6.00	9.24	0.01
	FI – FD	25.837	24.000	11.899	6.00	9.24	0.01
	INT – FD	23.512	24.000	1.294	6.00	9.24	NS
Intelligence	HI – AI	25.349	23.829	12.553	6.00	9.24	0.01
	HI – LI	25.349	22.633	27.490	6.00	9.24	0.01
	AI – LI	23.829	22.633	5.460	6.00	9.24	N.S

FI – Field Independent
INT – Intermediate Orientation
FD – Field Dependent
HI – High Intelligence
AI – Average Intelligence
LI – Low Intelligence

For the variable Cognitive Style, the F-ratios obtained for FI – INT, FI-FD and INT-FD groups in Process Outcomes in Science for the Total sample are 16.748, 11.899 and 1.294 respectively significant mean difference at 0.01 level is noticed for FI-INT and FI-FD groups where the obtained F-ratios exceed the limit set for F' at 0.01 level of significance. No significant mean difference in 'Process Outcomes in Science' exists between INT-FD groups since the F-ratios is less than the value of F' even at 0.05 level.

Results of Table 4.18 shows that the F-ratios obtained for HI – AI, HI – LI and AI – LI groups in Process Outcomes in Science for the Total sample are 12.553, 27.490, 5.460 respectively. Significant mean difference at 0.01 level is noticed for HI-AI and HI-LI groups where the obtained F-ratios exceed the limit set of F' at 0.01 level of significance. No significant mean difference in Process Outcomes in Science exists between AI-LI groups since the F-ratio is less than the value of F even at 0.05 level.

4.2.2.1.2. Main Effect, First order and Second order Interaction of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science for Boys (N=500)

The main effect, first order and second order interaction of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science was studied for Boys. The results of three way ANOVA are presented in Table 4.19.

TABLE 4.19

Summary of Three-way ANOVA of Process Outcomes in Science by Cognitive Style by Intelligence by Classroom Climate for Boys (N=500)

Source of Variation	Sum of squares	Degrees of Freedom	Mean Squares of Variance	F-value	Level of Significance
Cognitive Style	349.533	2	174.766	4.852	0.01
Intelligence	510.038	2	255.019	7.079	0.01
Classroom Climate	18.488	2	9.244	.257	N.S
Cognitive Style X Intelligence	129.754	4	32.439	.901	N.S
Cognitive Style X Classroom Climate	210.523	4	52.631	1.461	N.S
Intelligence X Classroom Climate	24.912	4	6.228	.173	N.S
Cognitive Style X Intelligence					
Classroom Climate	462.107	.8	57.763	1.604	N.S
Within cells	17038.727	473	36.023		
Total	18744.082	499			

N.S. Not Significant.

Main Effect of Cognitive Style

Table 4.19 shows that the F-value for main effect of Cognitive Style on Process Outcomes in Science is 4.852 and this is greater than tabled value (4.66) for 2,473 degrees of freedom at 0.01 level of significance. Therefore the main effect of 'Cognitive Style' on Process Outcomes in Science is Significant and that the mean scores of Process Outcomes in Science of pupils of three levels of Cognitive Style, viz., Field Independent and Intermediate Orientation and Field Dependent differ significantly.

Main Effect of Intelligence

The F-value obtained for the main effect of Intelligence on Process Outcomes in Science is 7.079. This exceeds the tabled F-value required for significance (3.02) at 0.05 level and (4.66) at 0.01 levels for 2,473 degrees of freedom. Therefore the main effect of 'Intelligence' on Process Outcomes in Science is highly significant. That is the variable Intelligence has a significant main effect on Process Outcomes in Science and that the mean scores of Process Outcomes in Science of pupils of three levels of Intelligence viz., High Intelligence, Average Intelligence and Low Intelligence differ significantly.

Main Effect of Classroom Climate

The F-value obtained for main effect of Classroom Climate on Process Outcomes in Science is 0.257. This is less than tabled F-value (4.66) for 2,473 degrees of freedom at 0.05 level of significant. Therefore the main effect of 'Classroom Climate' on Process Outcomes in Science is not significant.

First Order Interaction of Independent Variables

The first order interaction of Cognitive Style X Intelligence, Cognitive Style X Classroom Climate, Intelligence X Classroom Climate were studied. The F-values are found to be 0.901, 1.46 and 0.173 respectively. No significant first order interaction exists for any of the combination of variables even at 0.05 level. So it can be concluded that Process Outcomes in Science is independent of the effect of First order interaction of Independent variables.

Second order Interaction of Independent Variables

The second order interaction of the Independent Variables on Process Outcomes in Science is not found to be significant even at 0.05 level as F-value is 0.604 for 8,473 degrees of freedom.

Discussion

Results of three way ANOVA reveal that the mean scores of Process Outcomes in Science of the pupils in Boys sample are significantly different in three levels of 'Cognitive Style' (FI, INT, FD) and three levels of Intelligence (HI, AI, LI). Classroom Climate cannot be considered as contributing factors to the performance variation in 'Process Outcomes in Science'. Further it can be concluded that variation in 'Process Outcomes in Science' of Boys is independent of combination of variables mainly Cognitive Style X Intelligence, Intelligence X Classroom Climate, Cognitive Style X Classroom Climate or Cognitive Style X Intelligence X Classroom Climate.

Graphical Representation of Interaction Effect in Boys

To study the interaction effect graphically the mean scores of dependent variable 'Process Outcomes in Science' were plotted as ordinate of the graph and three categories of Intelligence (HI, AI, LI) as abscissa. The three groups of Classroom Climate (HCC, MCC, LCC) were represented by three different lines on graphical back ground being the three levels of Cognitive Style viz., FI, INT nd FI. The graphs for the Boys are given in Figure 4-2.

FIGURE 4-2 **Interaction Effect of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science for Boys**

From the graph, it is observed that HI groups irrespective of different levels of 'Cognitive Style' and 'Classroom Climate' shows marked advantage over AI and LI groups in their mean scores of 'Process Outcomes in Science'.

Average Intelligence with Field dependent coupled with Low Classroom Climate yielded better Process Outcomes Scores in Science.

Low Intelligence with Field Independent coupled with Average Classroom Climate gave better Process Outcomes Scores in Science.

Post-hoc Comparison of Group Means

The results of three-way ANOVA carried for Boys confirmed that the Independent Variables Cognitive Style and Intelligence were found to have significant main effect on Dependent Variable. To identify the groups which create the main effect Scheffe' Test of Post-hoc Comparison was applied.

Result of Comparison between mean scores of Process Outcomes in Science based on three levels of Cognitive Style and Intelligence is given in Table 4.20.

TABLE 4.20

Result of Scheffe's Test of Post-hoc Comparison Between Mean of Process Outcomes in Science Based on three Groups of Cognitive Style and Intelligence for Total Sample (N=500)

Independent Variable	Groups Compared	Means		F	Values of F'		Level of Significance
		M_1	M_2		0.05	0.01	
Cognitive Style	FI – INT	25.024	23.831	16.346	6.00	9.24	0.01
	FI – FD	25.024	24.126	11.629	6.00	9.24	0.01
	INT – FD	23.831	24.126	1.161	6.00	9.24	NS
Intelligence	HI – AI	24.989	22.730	13.171	6.00	9.24	0.01
	HI – LI	24.989	21.320	28.149	6.00	9.24	0.01
	AI – LI	22.730	21.320	4.151	6.00	9.24	N.S

FI – Field Independent
INT – Intermediate Orientation
FD – Field Dependent
HI – High Intelligence
AI – Average Intelligence
LI – Low Intelligence

Results of Table 4.20 shows that for Boys significant mean difference at 0.01 level is noticed for FI – INT and FI-FD where respective F-ratios (16.346, 11.629) are greater than the value of F' required at 0.01 level of significance. No significant means difference in 'Process Outcomes in Science exists between INT-FD groups since the F-ratio is less than value of F' even at 0.05 level.

For Boys significant mean difference at 0.01 level is noticed for HI-AI and HI-LI where respective F-ratios (13.171, 28.149) are greater than the value of F' required at 0.01 level of significance. No significant mean difference in 'Process Outcomes in Science' exists between AI-LI groups since the F-ratio is less than value of F' even at 0.05 level.

4.2.2.1.3. Main Effect, First order and Second Order Interactions of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science for Girls (N=500)

The main effect, first order and second order interactions of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science was studied for Girls in Total Sample.

The results of Three way ANOVA are presented in Table 4.21.

TABLE 4.21

Summary of Three-way ANOVA of Process Outcomes in Science by Cognitive Style by Intelligence by Classroom Climate for Girls (N=500)

Source of Variation	Sum of squares	Degrees of Freedom	Mean Squares Variance	F-value	Level of Significance
Cognitive Style	149.293	2	74.647	2.207	N.S
Intelligence	121.758	2	60.879	1.800	N.S
Classroom Climate	14.174	2	7.087	0.210	N.S
Cognitive Style X Intelligence	21.411	4	5.353	0.158	N.S
Cognitive Style X Classroom Climate	230.420	4	57.605	1.703	N.S
Intelligence X Classroom Climate	53.089	4	13.272	0.392	N.S
Cognitive Style X Intelligence					
Classroom Climate	180.262	.8	22.533	0.666	N.S
Within cells	15994.893	473	33.816		
Total	16765.3	499			

N.S. Not Significant.

Main Effect of Cognitive Style

Table 4.21 shows that F-value for main effect of Cognitive Style on Process Outcomes in Science in 2.207 that is less than tabled value (3.02) for 2,473 degrees of freedom at 0.05 level of significance: Therefore the main effect of Cognitive Style on Process Outcomes in Science is not significant.

Main effect of Intelligence

The F-value obtained for main effect of Intelligence on Process Outcomes in Science is 1.800 that is less than tabled value (3.02) for 2,473 degrees of freedom at 0.05 level of significance. Therefore the main effect of Cognitive Style on Process Outcomes in Science is not significant.

Main effect of Classroom Climate

The F-value obtained for main effect of Classroom Climate on Process Outcomes in Science is 0.210 that is less than tabled value (3.02) for 2,473 degrees of freedom even at 0.05 level of significance. Therefore the main effect of Classroom Climate on Process Outcomes in Science is not significant.

First order Interaction of Independent Variables

The three independent variables were examined for first order interactions. No significant two-way interaction were found as the F-values (0.158, 1.703, 0.392) are not significant even at 0.05 level for corresponding degrees of freedom.

Second Order Interaction of Independent Variables

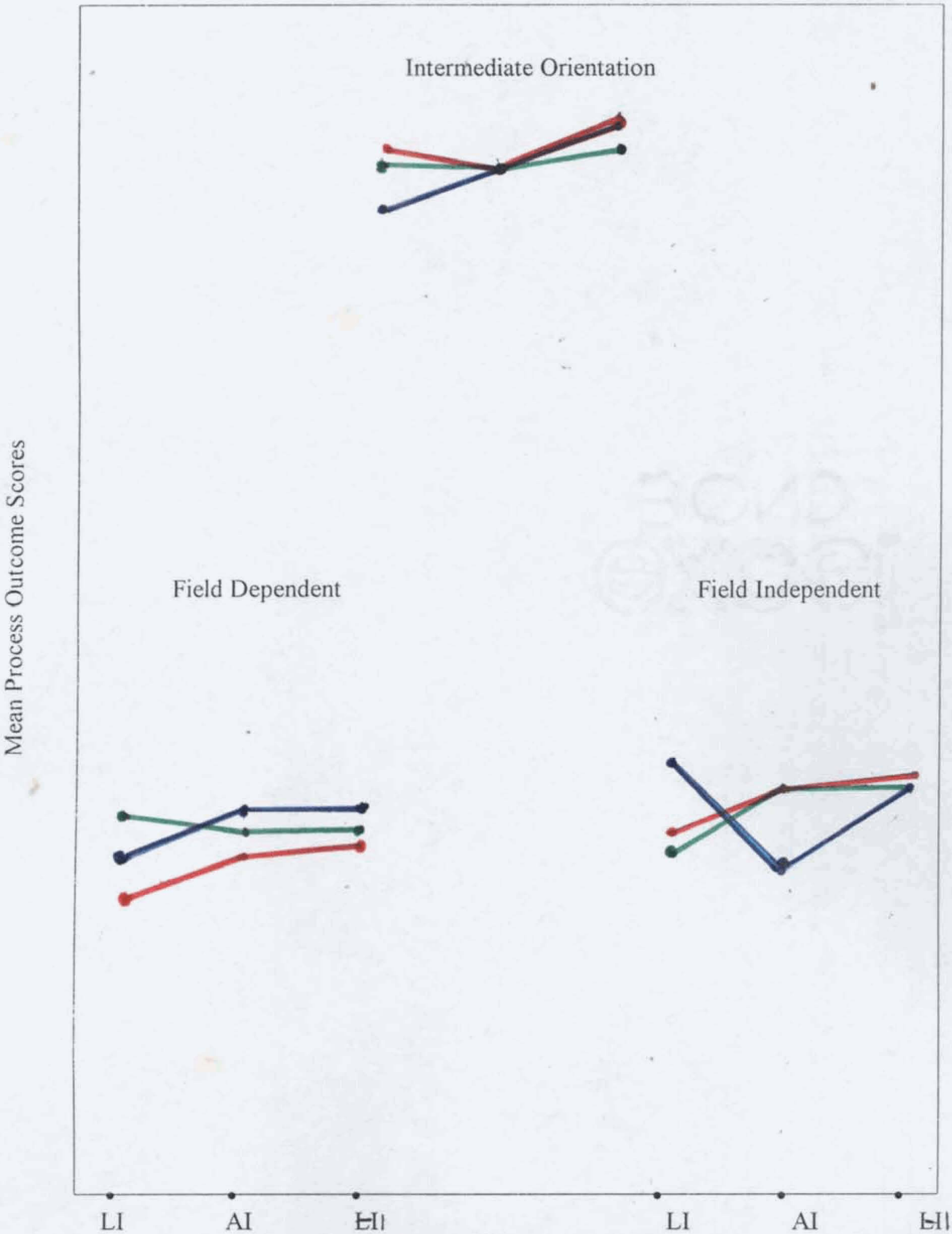
In the combination of variables Cognitive Style X Intelligence X Classroom Climate, the second order interaction was studied. No significant second order interaction is noticed as the F-value obtained (0.666) is less than tabled value.

Discussion

The results of three way ANOVA revealed that the performance of Girls sample on 'Process Outcomes in Science' can be considered independent of Cognitive Style, Intelligence, Classroom Climate and in combination of all three variables.

Graphical Representation of Interaction Effect in Girls

To examine the pattern of interaction effect graphically, the mean scores of 'Process Outcomes in Science' were plotted as ordinate of the graph and three categories of Intelligence (HI, AI, LI) as abscissa. The three groups of Classroom Climate (HCC, MCC, LCC) were represented by three different lines on graph and background being the three levels of 'Cognitive Style' viz., FI, INT and FI. The graphs for the Girls are given in Figure 4-3.



— Favourable Classroom Climate Group
— Moderately Favourable Classroom Climate Group
— Less Favourable Classroom Climate Group

HI – High Intelligence Group AI – Average Intelligence Group

LI – Low Intelligence Group

FIGURE 4-3 **Interaction Effect of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science for Girls**

From the graph it is observed that HI groups irrespective of different levels of 'Cognitive Style' and Classroom Climate' shows marked advantage over AI and LI groups in their mean scores of Process Outcomes in Science.

Field Independent group with favourable Classroom Climate group, coupled with Low Intelligence yielded high Process Outcomes score in Science.

The pattern of relationship in Three way ANOVA for the Girls show a tendency of interaction effect when statistically significant interaction effect is not obtained. Even though it is statistically negligible, or below 0.05 level of significance, when graphically potted it is much evident and projected.

4.2.2.1.4. Main Effect, First order and Second order Interactions of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science for Rural Sample (N=567)

The main effect, first order and second order interaction of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science was studied for Rural students in total sample.

The results of three way ANOVA are presented in Table 4.22.

TABLE 4.22

Summary of Three-way ANOVA of Process Outcomes in Science by Cognitive Style by Intelligence by Classroom Climate for Rural Sample (N=567)

Source of Variation	Sum of squares	Degrees of Freedom	Mean Squares Variance	F-value	Level of Significance
Cognitive Style	117.940	2	58.970	1.504	N.S
Intelligence	385.775	2	192.887	4.920	0.01
Classroom Climate	126.844	2	63.422	1.618	N.S
Cognitive Style X Intelligence	125.265	4	31.316	0.799	N.S
Cognitive Style X Classroom Climate	45.231	4	11.308	0.288	N.S
Intelligence X Classroom Climate	82.240	4	20.560	0.524	N.S
Cognitive Style X Intelligence X Classroom Climate	197.146	8	24.643	0.629	N.S
Within cells	2.1169.082	540	39.202		
Total	22249.523	566	417.665		

N.S. Not Significant.

Main Effect of Cognitive Style

Table 4.22 shows that F-value for main effect of Cognitive Style on Process Outcomes in Science is 1.504 that is less than tabled value (3.02) for 2,540 degrees of freedom at 0.05 level of significance. There fore the main effect of Cognitive Style on Process Outcomes in Science is not significant.

Main Effect of Intelligence

The F-values obtained for main effect of Intelligence on Process Outcomes in Science is 4.920 and this is greater than tabled value (4.62) for 2,540 degrees of freedom at 0.01 level of significance. Therefore the main effect of Intelligence on Process Outcomes in Science is significant. This suggest that the mean score of Process Outcomes in Science differ significantly between three levels of the variable Intelligence viz., High Intelligence group, Average Intelligence group and Low Intelligence group.

Main effect of Classroom Climate

The F-value obtained for main effect of Classroom climate on Process Outcomes in Science is 1.618 that is less than tabled value (3.02) for 2,540 degrees of freedom at 0.05 level of significance. Therefore the main effect of Classroom Climate on Process Outcomes in Science is not significant.

First order Interaction of Independent Variables

First order interaction of independent variables on 'Process Outcomes in Science' were studied for the combination, Cognitive Style X Intelligence, Cognitive Style X Classroom Climate and Intelligence X Classroom Climate. F-ratios estimated for first order interactions were found to be 0.799, 0.288, 0.524 respectively. These values are not significant even at 0.05 level for the corresponding degrees of freedom.

Second order Interaction of Independent Variables

Second order interaction of Cognitive Style X Intelligence X Classroom Climate on 'Process Outcomes in Science was explored. The F-ratio obtained as per Table 4.22 is 0.629 which is less than the tabled value (1.95) indicating no significant second order interaction for the respective degrees of freedom even at 0.05 level.

Discussion

The results of three way ANOVA revealed that the performance of Rural pupils on 'Process Outcomes in Science' is significantly different for three levels of 'Intelligence'. But the performance variation can be considered independent of 'Cognitive Style' and 'Classroom Climate' and in combination of all three variables.

Graphical Representation of Interaction Effect in Rural Sample

To examine the pattern of interaction effect graphically the mean scores of 'Process Outcomes in Science' were plotted on ordinate of the graph and three categories of Intelligence (HI, AI, LI) as abscissa. The three groups of Classroom Climate (HCC, MCC, LCC) were represented by three different lines on graph and background being the three levels of Cognitive Style viz., FI, INT and FI. The pattern of relationship of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science for Rural Sample is represented in Figure 4-4.

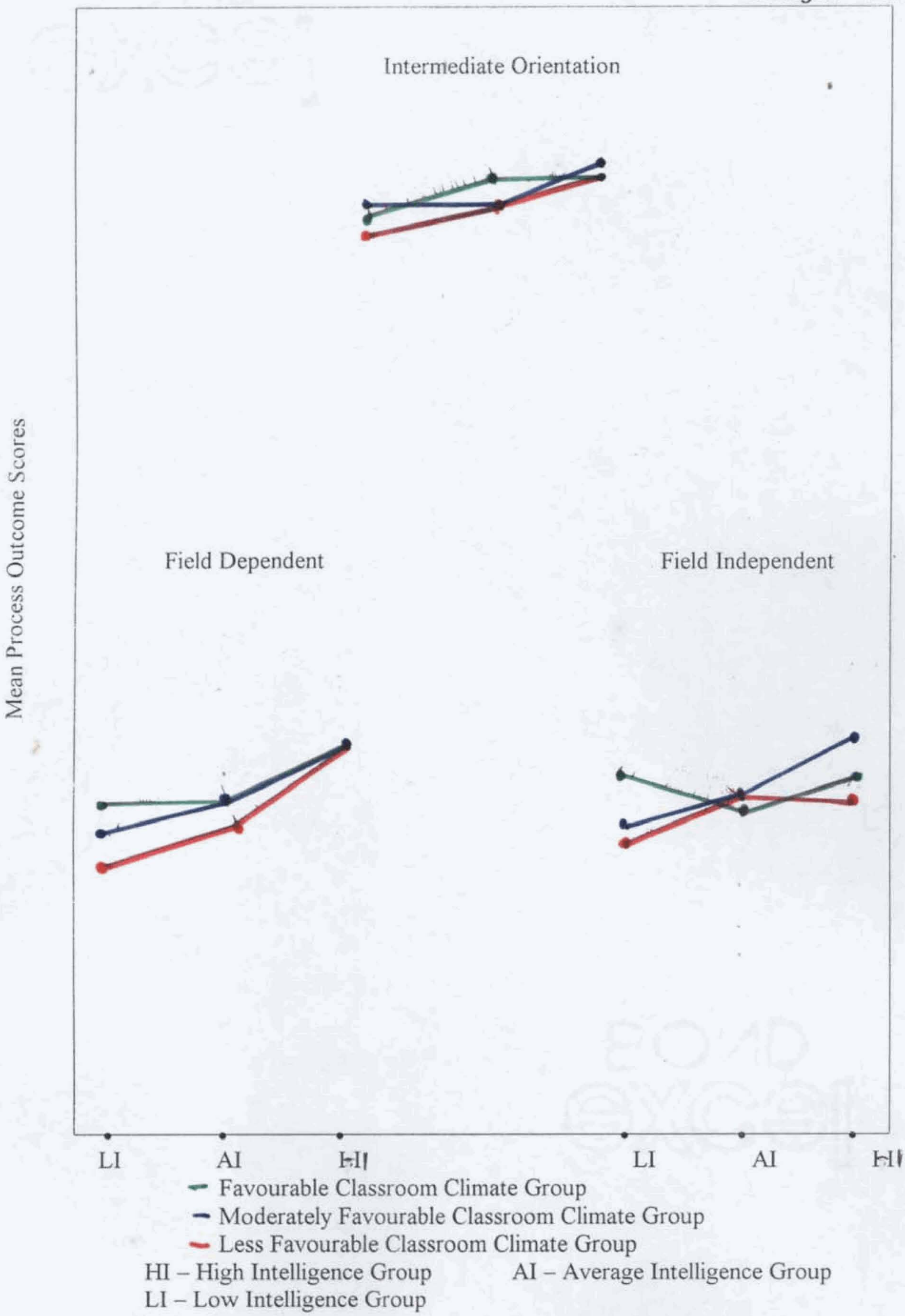


FIGURE 4-4 **Interaction Effect of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science for Rural Sample**

From the graph, it is observed that HI groups irrespective of different levels of 'Cognitive Style' and 'Classroom Climate' shows marked advantage over AI and LI groups in their mean scores of 'Process Outcomes in Science'.

Average Intelligence with Field dependent coupled with Moderately Favourable Classroom Climate yielded better Process Outcomes in Science.

Low Intelligence with Field independent coupled with Low Classroom Climate gave better Process Outcomes in Science.

Post-hoc Comparison of Group Means

The details of Three way ANOVA conducted for Rural Sample revealed that only the Independent variable Intelligence is found to have main effect on Dependent variables. Scheffe' test of post-hoc comparison is applied to identify the pairs of groups which differ significantly in their Mean scores of Process Outcomes in Science.

The details of Scheffe Test conducted for Rural Sample is given in the Table 4.23.

TABLE 4.23

Result of Scheffe's Test of Post-hoc Comparison Between Mean of Process Outcomes in Science Based on three Groups of Intelligence for Rural Sample (N=567)

Independent Variable	Groups Compared	Means		F	Values of F'		Level of Signi-ficance
		M_1	M_2		0.05	0.01	
Intelligence	HI – AI	24.523	23.1920	4.808	6.00	9.24	N.S
	HI – LI	24.522	21.374	19.425	6.00	9.24	0.01
	AI – LI	23.192	21.374	7.248	6.00	9.24	0.05

HI – High Intelligence
AI – Average Intelligence
LI – Low Intelligence

According to table 4.23, no significant mean difference in Process Outcomes in Science exists between HI-AI groups since the F-ratios (4.808) is less than the value of F' even at 0.05 level. Significant mean difference at 0.01 level is noticed for HI-LI group where the obtained F-ratio (19.425) exceed the limit set for F' at 0.01 level of significance. Significant mean difference at 0.05 level is noticed for AI – LI group were the obtained F-ratio (9.248) exceed the limit set for F' at 0.05 level.

4.2.2.1.5. Main effect, First order and Second order Interaction of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science for Urban Sample (N=433)

The main effect, first order and second order interactions of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science was studied for Urban students in total sample.

The results of Three Way ANOVA are presented in Table 4.24.

TABLE 4.24

Summary of Three-way ANOVA of Process Outcomes in Science by Cognitive Style by Intelligence by Classroom Climate for Urban Sample (N=500)

Source of Variation	Sum of squares	Degrees of Freedom	Mean Squares of Variance	F-value	Level of Significance
Cognitive Style	22.836	2	11.418	0.357	N.S
Intelligence	12.069	2	6.034	0.189	N.S
Classroom Climate	10.575	2	5.287	0.165	N.S
Cognitive Style X Intelligence	69.700	4	17.425	0.545	N.S
Cognitive Style X Classroom Climate	306.720	4	76.680	2.398	0.05
Intelligence X Classroom Climate	28.075	4	7.019	0.220	N.S
Cognitive Style X Intelligence X Classroom Climate	452.068	8	56.508	1.767	N.S
Within cells	12981.646	406	31.974		
Total	13883.689	432	212.345		

N.S. Not Significant.

Main Effect of Cognitive Style

The result of Three way ANOVA listed in Table 4.24 show that F-value for main effect of Cognitive Style on Process Outcomes in Science is 0.357 this is less than the tabled value (3.02) for 2,406 degrees of freedom at 0.05 level of significance. Therefore the main effect of Cognitive Style on Process Outcomes in Science is not significant.

Main effect of Intelligence

The F-value obtained for main effect of Intelligence on Process Outcomes in Science is 0.189 and this is less than the tabled value (3.02) for 2,406 degrees of freedom at 0.05 level of significance. Therefore the main effect of Intelligence on Process Outcomes in Science is not significant.

Main effect of Classroom Climate

The F-value obtained for main effect of Classroom Climate on Process Outcomes in Science is 0.165 and this is less than the tabled value (3.02) for 2,406 degrees of freedom at 0.05 level of significance. Therefore the main effect of Classroom Climate on Process Outcomes in Science is not significant.

First order Interactions of Independent Variables

The F-value obtained for interaction effect of Cognitive Style and Intelligence on Process Outcomes in Science is 0.545. This is less than the tabled value (2.39) for 4,406 degrees of freedom at 0.05 level of significance. The joint effect of variables Cognitive Style and Intelligence on Process Outcomes in Science is not significant.

The F-value obtained for interaction effect of Cognitive Style and Classroom Climate on Process Outcomes in Science is 2.398. This is greater than tabled F-value (2.38) for 4,406 degrees of freedom at 0.05 level of significance. This suggests that the joint effect of variables Cognitive Style and Classroom Climate on Process Outcomes in Science is significant at 0.05 level.

No significant first order interaction is noticed for the combination of variables Intelligence X Classroom Climate even at 0.05 level, F-values being 0.220.

Second Order Interaction of Independent Variables

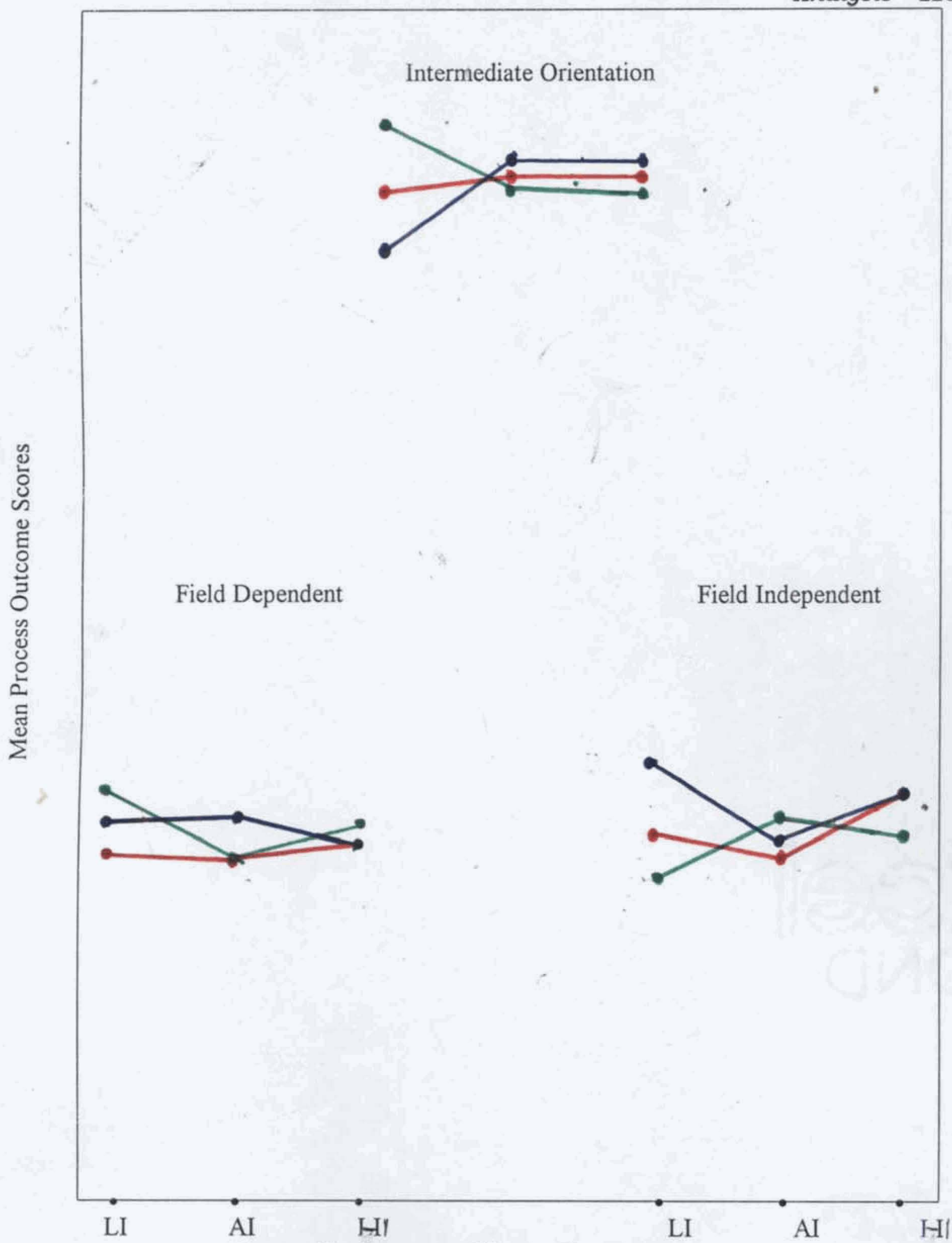
In the combination of Variables Cognitive Style X Intelligence X Classroom Climate, Second order interaction was studied. No significant second order interaction is noticed as the F-value obtained is (1.767) which is less than table value.

Discussion

It can be seen from the results of the Three way ANOVA that mean scores of 'Process Outcomes in Science' for the Urban sample do not vary with changes in the levels of Cognitive Style, Intelligence and Classroom Climate. Further it can be concluded that variation in 'Process Outcomes in Science' of Urban pupil is dependent on the combination of variables Cognitive Style X Classroom Climate but independent of the combination of variables namely Cognitive Style X Intelligence and Intelligence X Classroom Climate or Cognitive Style X Intelligence X Classroom Climate.

Graphical Representation of Interaction Effect in Urban Sample

To examine the pattern of interaction effect graphically the mean scores of 'Process Outcomes in Science' were potted as ordinate of the graph and three categories of Intelligence (HI, AI, LI) as abscissa. The three groups of Classroom Climate (HCC, MCC, LCC) were represented by there different lines on graph and background being the three levels of Cognitive Style viz., FI, INT and FD. The graphs for the Urban sample is given in Figure 4-5.



— Favourable Classroom Climate Group
— Moderately Favourable Classroom Climate Group
— Less Favourable Classroom Climate Group

HI – High Intelligence Group AI – Average Intelligence Group
LI – Low Intelligence Group

FIGURE 4-5 **Interaction Effect of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science for Urban Sample**

From the graph it is observed that LI groups irrespective of different levels of 'Cognitive Style' and 'Classroom Climate' shows marked advantage over HI and AI groups in their mean scores of 'Process Outcomes in Science'.

High Intelligent, Favourable Classroom Climate coupled with Intermediate Orientation produced high score in Process Outcomes in Science.

4.2.2.1.6. Main effect, First order and second order Interactions of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science for Government sample (N=400)

The main effect, first order and second order interactions of Cognitive Style, Intelligence and Classroom Climate on Process Outcome in Science was studied for Government School students in total sample. The results of three way ANOVA are presented in Table 4.25.

TABLE 4.25

Summary of Three-way ANOVA of Process Outcomes in Science by Cognitive Style by Intelligence by Classroom Climate for Government Sample (N=400)

Source of Variation	Sum of squares	Degrees of Freedom	Mean Squares Variance	F-value	Level of Signi-ficance
Cognitive Style	58.275	2	29.137	0.914	N.S
Intelligence	86.720	2	43.360	1.360	N.S
Classroom Climate	28.733	2	4.366	0.451	N.S
Cognitive Style X Intelligence	334.249	4	83.562	2.621	0.05
Cognitive Style X Classroom Climate	216.456	4	54.114	1.697	N.S
Intelligence X Classroom Climate	38.034	4	9.508	0.298	N.S
Cognitive Style X Intelligence X Classroom Climate	382.608	8	47.826	1.500	N.S
Within cells	11892.018	393	31.882		
Total	13037.093	399			

N.S. Not Significant.

Main Effect of Cognitive Style

Table 4.25 shows that F–value for main effect of Cognitive Style on Process Outcomes in Science is 0.914. That is less than tabled value (3.02) for 2,373 degrees of freedom at 0.05 level of significance. Therefore the main effect of Cognitive Style on Process Outcomes in Science is not significant.

Main Effect of Intelligence

The F-value obtained for main effect of Intelligence on Process Outcomes in Science is 1.360 and this is less than tabled value (3.02) for 2,373 degrees of freedom at 0.05 level of significance. Therefore the main effect of Intelligence on Process Outcomes in Science is not significant.

Main effect of Classroom Climate

The F-value obtained for main effect of Classroom Climate on Process Outcomes in Science is 0.451 and this is less than the tabled value (3.02) for 2,373 degrees of freedom at 0.05 level of significance. Therefore the main effect of classroom climate on Process Outcomes in not significant.

First Order Interaction of Independent Variables

The influence of three independent variables in pairs namely, Cognitive Style X Intelligence, Cognitive Style X Classroom Climate and Intelligence X Classroom Climate was examined for first order interaction. For the pair of variables, Cognitive X Intelligence, significant first order interaction is noticed at 0.05 level (F=2.621). For the other two combination, the F-ratios are not found to be significant even at 0.05 level of significance, Therefore, no significant first order interaction exists between Cognitive Style X Classroom Climate and Intelligence X Classroom Climate.

Second order Interactions of Independent Variables

The second order interaction of three independent variables on 'Process Outcomes in Science' was explored. Since F-value (1.500) is less than the tabled value for the corresponding degrees of freedom, the second order interaction of variables is not significant.

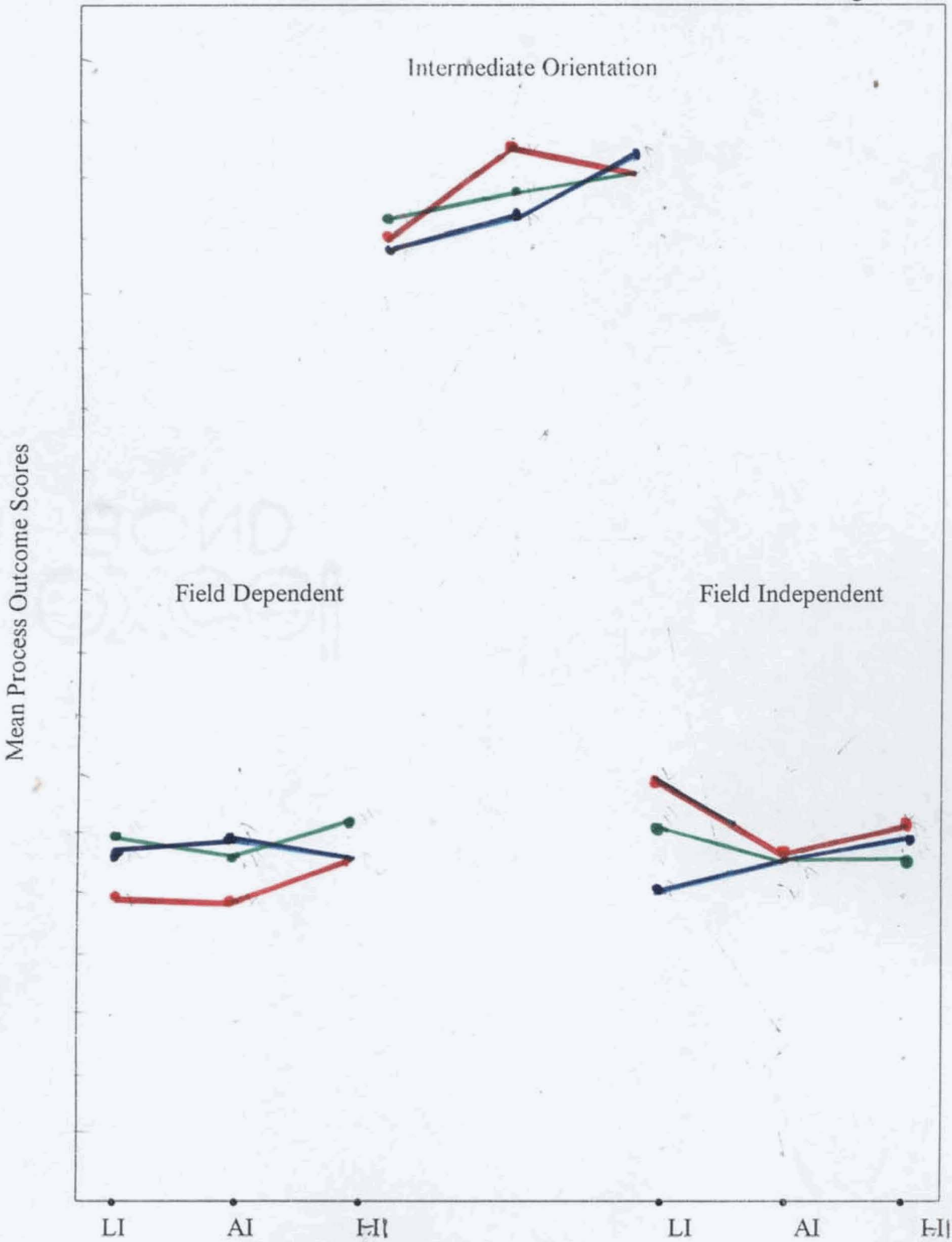
Discussion

It can be seen from the results of three way ANOVA that the mean scores of 'Process Outcomes in Science' for Government sample do not vary with changes in the levels of 'Cognitive Style, Intelligence and Classroom Climate. Further it can be concluded that the variation in 'Process Outcomes in Science' of Government Sample is dependent of the combination of variables namely, Cognitive Style X Intelligence but independent of the combination of the variables namely Cognitive Style X Classroom Climate and Intelligence X Classroom Climate or Cognitive Style X Intelligence X Classroom Climate.

Graphical Representation of Interaction Effect in Government Sample

To understand the nature of interaction of the Independent Variables on the Dependent Variable, the pattern is represented graphically and examined the mean Process Outcomes in Science on the graph. Scores are plotted as ordinate and three levels of Intelligence (HI, AI, and LI) as abscissa. The lines on the graph being three levels of Classroom Climate and the background represents three levels of Cognitive Style.

The graphical representation for Government Sample are given in Figure 4-6.



- Favourable Classroom Climate Group
- Moderately Favourable Classroom Climate Group
- Less Favourable Classroom Climate Group

HI – High Intelligence Group AI – Average Intelligence Group
LI – Low Intelligence Group

FIGURE 4-6 **Interaction Effect of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science for Government Sample**

As seen in Figure 4-6, maximum mean Process Outcomes in Science score is obtained for the combination of FI-LI-LFCC. In other words pupils having Field Independent Cognitive Style along with Low Intelligence and Low Classroom Climate yielded high Process Outcomes score in Science.

It is also seen that maximum means Process Outcomes in Science Score is also obtained for the combination of INT-AI-LFCC.

But High Intelligence group show better performance by adopting FI coupled with HCC group.

4.2.2.2.1.7. Main effect, First order and second order Interactions of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science for Private Sample (N=600)

The main effect, first order and second order interaction of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science was studied for Private Sample. The results of Three way ANOVA are Presented in Table 4.26.

TABLE 4.26

Summary of Three-way ANOVA of Process Outcomes in Science by Cognitive Style by Intelligence by Classroom Climate for Private School Pupil (N=600)

Source of Variation	Sum of squares	Degrees of Freedom	Mean Squares of Variance	F-value	Level of Signi-ficance
Cognitive Style	613.427	2	306.713	8.019	0.01
Intelligence	970.801	2	485.400	12.690	0.01
Classroom Climate	16.673	2	8.337	0.218	N.S
Cognitive Style X Intelligence	319.060	4	79.765	2.085	0.05
Cognitive Style X Classroom Climate	81.160	4	20.290	0.530	N.S
Intelligence X Classroom Climate	64.883	4	16.221	0.424	N.S
Cognitive Style X Intelligence X Classroom Climate	385.592	8	48.199	1.260	N.S
Within cells	21916.932	573	38.249		
Total	24368.528	.599	1003.174		

N.S. Not Significant.

Main Effect of Cognitive Style

Table 4.26 shows that F-value for main effect of Cognitive Style on Process Outcomes in Science is 8.019 that is greater than tabled value (4.62) for 2,573 degrees of freedom at 0.01 level of significance. Therefore the main effect of Cognitive Style on Process Outcomes in Science is significant at 0.01 level.

Main effect of Intelligence

The F-value obtained for main effect of Intelligence on Process Outcomes in Science is 12.690 and this is greater than tabled value (4.62) for 2,573 degrees of freedom at 0.01 level of significance. Therefore the main effect of Intelligence on Process Outcomes in Science is significant at 0.01 level.

Main effect of Classroom Climate

The F-value obtained for main effect of Classroom Climate on Process Outcomes in Science is 0.218 and this is less than the tabled value (2.38) for 2,573 degrees of freedom at 0.05 level of significance. Therefore the main effect of Classroom Climate on Process Outcomes in Science is not significant.

First Order Interaction of Independent Variables

The F-value obtained for interaction effect of Cognitive Style and Intelligence on Process Outcomes in Science was examined. Since F-value (2.085) is greater than tabled value 4,573 degrees of freedom at 0.05 level of significance, the combined effect of the two independent variables on Process Outcomes in Science for Private School students is significant beyond 0.05 level.

The first order interaction of Cognitive Style X Classroom Climate and Intelligence X Classroom Climate were also analysed. The F-value are found to be 0.530 and 0.424 respectively. Therefore no significant first order interaction exists for the two combination of variables even at 0.05 level.

Second order Interaction of Independent Variables

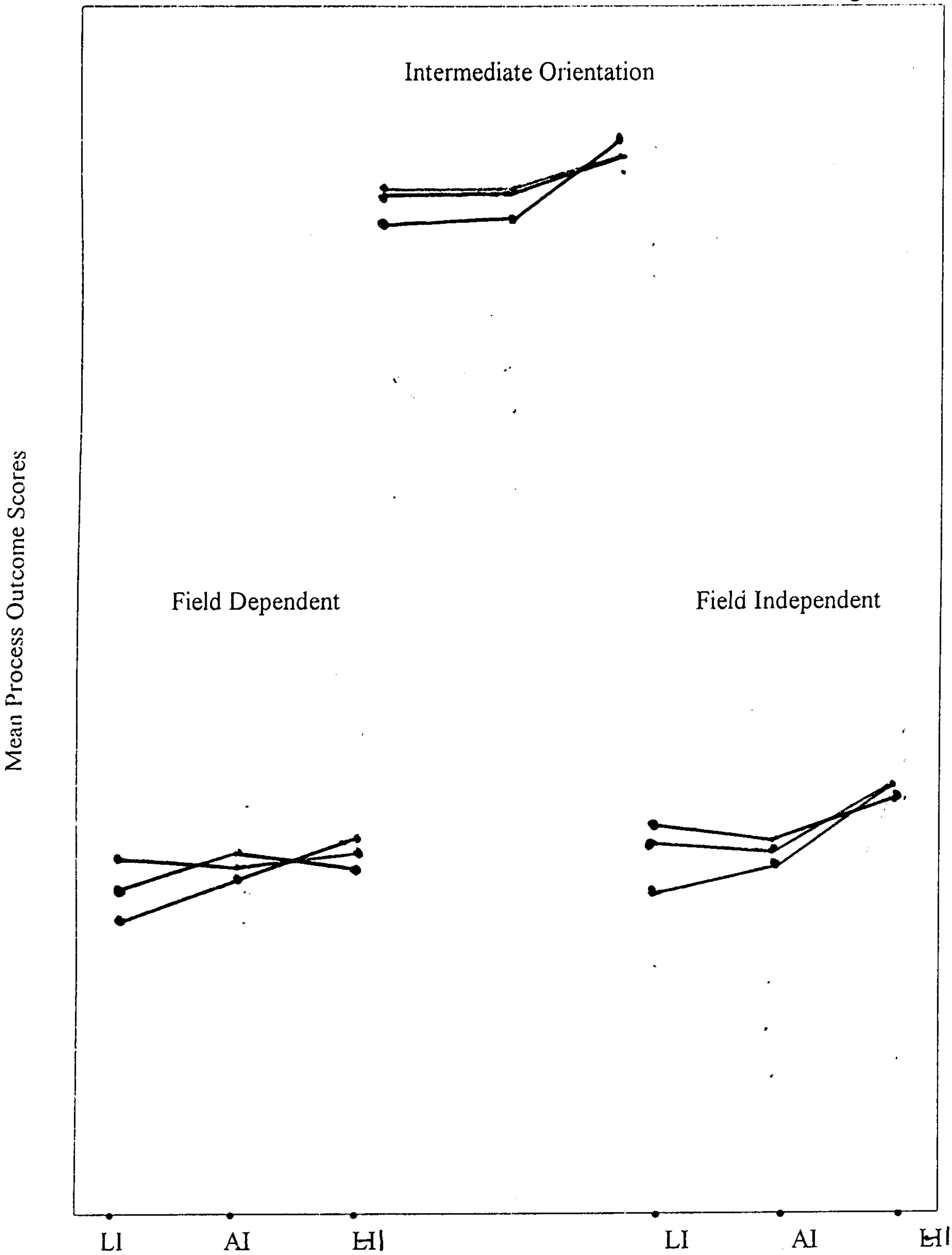
The second order interaction of three independent variables on Process Outcomes in Science was examined. F-value (1.260) is less than tabled value at 0.05 level for corresponding degrees of freedom. So the interaction effect due to the three select independent variables on 'Process Outcomes in Science is not significant.

Discussion

It can be seen from the results of three way ANOVA that the mean scores of 'Process Outcomes in Science' for Private sample differ significantly with changes in three levels of 'Cognitive Style' and three levels of 'Intelligence' but not vary with the changes in levels of Classroom Climate. Further it can be concluded that variation in 'Process Outcomes in Science' of Private sample is dependent of the combination of variables namely Cognitive Style X Intelligence but independent of the combination of variables Cognitive Style X Classroom Climate and Intelligence X Classroom Climate or Cognitive Style X Intelligence X Classroom Climate.

Graphical Representation of Interaction effect of Private Sample

To a great extent graphical representation are helpful to draw conclusion for the interaction effect. On the basis of the graphical representation the investigator tried to describe the nature of interaction. The graphical representation for the interaction of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science for Private sample were attempted and given in Figure 4-7.



- Favourable Classroom Climate Group
- Moderately Favourable Classroom Climate Group
- Less Favourable Classroom Climate Group

HI – High Intelligence Group   AI – Average Intelligence Group
LI – Low Intelligence Group

FIGURE 4-7 **Interaction Effect of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science for Private Sample**

Figure 4-7 shows the result of three way ANOVA conducted for Private sample. From the graph it is observed that HI groups irrespective of different levels of 'Cognitive Style' and 'Classroom Climate' shows marked advantage over AI and LI groups in the mean scores of 'Process Outcomes in Science'.

AI with INT group coupled with Favourable Classroom Climate group yielded better Process Outcomes score in Science. AI with FI group coupled with Moderately Favourable Classroom Climate produced better Process Outcomes Score in Science.

Better Process Outcomes score in Science is noticed with the combination LI-FI MFCC group.

Post-hoc Comparison of Group Means

The out put result of three way ANOVA carried for Private sample confirmed that only the Independent Variables Cognitive Style X Intelligence is found to have main effect on Dependent Variable. Scheffe test of post-hoc comparison is applied to identify the pairs of groups which differ significantly in their Mean Process Outcomes score in Science.

TABLE 4.27

Result of Scheffe's Test of Post-hoc Comparison Between Mean of Process Outcomes in Science Based on three Groups of Cognitive Style and Intelligence for Private Sample (N=600)

Independent Variable	Groups Compared	Means		F	Values of F'		Level of Signi-ficance
		M_1	M_2		0.05	0.01	
Cognitive Style	FI – INT	27.117	23.429	29.711	6.00	9.24	0.01
	FI – FD	27.117	23.802	21.688	6.00	9.24	0.01
	INT – FD	23.429	23.802	0.441	6.00	9.24	NS
Intelligence	HI – AI	26.308	23.799	17.959	6.00	9.24	0.01
	HI – LI	26.308	23.407	34.076	6.00	9.24	0.01
	AI – LI	23.799	22.407	4.883	6.00	9.24	N.S

Significant mean difference at 0.01 level was found for FI-INT and FI-FD groups of Private sample. The respective F-ratios (24.71, 21.688) are greater than value of F' required at 0.01 level of significance. No significant difference was noticed for INT-FD groups since the obtained F-ratio (0.441) is less than value of F' required for 0.05 level of significance.

In Private sample significant mean difference at 0.01 level was found for HI-AI and HI-LI groups the respective F-ratios (17.959, 34.076) are greater than value of F' required at 0.01 level of significance. No significant difference was noticed for AI-LI groups since the obtained ratio (4.883) is less than value of F' required for 0.05 level of significance.

DISCUSSION OF THE RESULTS OF THREE-WAY ANOVA

To study the single effects and interaction effects of select independent variables namely 'Cognitive Style', 'Intelligence', and 'Classroom Climate' on Process Outcomes in Science, Seven ANOVA were undertaken. The results of all seven ANOVA were summarized, corresponding F-values were consolidated and presented in Table 4.28 for clarity.

TABLE 4.28

Summary of Three-way ANOVA of Process Outcomes in Science by Cognitive Style by Intelligence by Classroom Climate

	Main Effects F-ratios			First order Interactions F-ratios			Second order Interaction F-ratios
Sample	Cognitive Style	Intelligence	Classroom Climate	Cognitive Style X Intelligence	Cognitive style X Classroom Climate	Intelligence X Classroom Climate	Cognitive Style X Intelligence X Classroom Climate
Total (N=1000)	5.960**	9.661**	0.980	2.592*	1.700	0.414	1.449
Boys (N=500)	4.852**	7.079**	0.257	0.901	1.461	0.173	1.604
Girls (N=500)	2.207	1.800	0.210	0.158	1.703	0.392	0.666
Rural (N=567)	1.504	4.920**	1.618	0.799	0.288	0.524	0.629
Urban (N=433)	0.357	0.189	0.165	0.545	2.398*	0.220	1.767
Government (N=400)	0.914	1.360	0.451	2.621*	1.697	0.298	1.500
Private (N=600)	8.019**	12.690**	0.218	2.085*	0.530	0.424	1.260

**P<0.05; ** P<0.01

Summary of three way ANOVA

Regarding the influence of Cognitive Style on 'Process Outcomes in Science' it is found that Cognitive Style has highly significant main effect in Total Sample and subsamples namely Boys, and Private sample. The main effect of 'Cognitive Style' on Process Outcomes in Science' was found to be significant in Three out of seven ANOVA undertaken. Therefore it may be considered that variation in 'Process Outcomes Science' of secondary school pupils is dependent on changes in Cognitive Style. When group differences with regard to mean scores in 'Process Outcomes in Science' were studied, the superiority of Field Independent Group (FI) and Intermediate Orientation Groups (INT) were evident in all comparison as higher means were associated with FI and INT groups. Marked difference between the extreme groups (FI-FD) is also evident in graphical representation of results. The similar findings of positive influence of 'Cognitive Style' and Academic Achievement were reported by Halpin and Peterson (1981) Varma (1991); Ganiher (1993); O'Brien and Terrance (1994); Sreevasthava and Priyamvada (1995); Kumar (1997); Suresan (1998); Valsala (2000). 'Intelligence' was found to have significant main effect on 'Process Outcomes in Science' in the Total sample, Boys, Rural and Private school sample. The main effect of 'Intelligence' on Process Outcomes in Science' was found to be significant in four out of seven ANOVA undertaken. Therefore, it may be considered that variation in 'Process Outcomes in Science' of secondary school students is dependent on changes in 'Intelligence'. When group differences with regard to mean 'Process Outcomes in Science Scores' were studied, the superiority of High Intelligence Groups (HI) and Average Intelligence Groups (AI) were evident in all the comparisons as higher means were associated with HI and AI groups. Marked difference between the extreme Groups (HI-AI) is also evident in graphical representation of results. The findings of the present study may be considered to be in agreement with multitude of research in India and abroad that stress the influence of 'Intelligence' on academic achievement Parsi (1972); Swean (1984); Barrington (1988); Faux (1992); Gupta *et al.* (1993); Valsala (2000); Saumya (2003). The work of Bhargava (1983) support the findings of present study that the Intelligence has effect on the Process Outcomes in Science. At the same time when influence of 'Cognitive Style' and 'Intelligence' are compared on the basis of their main effects and subsequent investigation of group differences it could be concluded that 'Intelligence' is a stronger determinant of 'Process Outcomes in Science' than Cognitive Style. 'Classroom Climate' was found to have no significant main effect on 'Process Outcomes in Science' for the total sample and subsamples. Therefore variation in 'Process Outcomes in Science' of secondary school students can not be attributed to variation in levels of 'Classroom Climate. Similar findings of negative influence of 'Classroom Climate' with Academic Achievement were reported by Tallon (1983); Christian (1984); Jade *et al* (1993); Muraleedhran (1999); Baby Reena (2002). Therefore it may be concluded that variation in 'Process Outcomes in Science' of Secondary School Students is independent on changes in 'Classroom Climate of Secondary School students. This findings is in contrary to the studies of Fraser and Byrene (1985); Padhi (1992); Mary and Roger (1994); Suresan (1999); Santhakumari (1999) that reveal a positive influence of 'Classroom Climate' on 'Process Outcomes in Science'.

First order interaction was found to be significant only in the Total sample and subsample Government where over effect of 'Cognitive Style' and 'Intelligence' was obtained. In case of Urban sample significant first order interaction was found where a cross over effect of 'Cognitive Style' and 'Classroom Climate' was obtained. This finding is in agreement with the finding of Suresan (1999). Significant second order interaction was not obtained for Total Sample and subsamples. In case of FI and INT groups a High intelligence or Average intelligence facilitates performance in Process Outcomes in Science. Similar findings were reported by Block and Block (1973); Block and Hardy (1987).

Summary of the Investigation of Group Differences

The Post-hoc comparison with regard to the mean Process Outcomes in Science of the three levels of Cognitive Style and Intelligence are discussed in this part. The comparison were done for Total sample and subsamples viz., Boys, Rural and Private. The comparison were employed with respect to the three groups based on the Independent Variables which have significant main effect on the relevant Dependent Variable. Since none of the variables yielded significant main effect for Girls and Urban sample, it is excluded from the discussion.

Group Difference based on Cognitive Style

Mean and F-values obtained for the Independent Variable Cognitive Style in the Scheffe' test of post-hoc comparison are consolidated, summarized and presented in Table 4.29.

TABLE 4.29

Result of Scheffe's Test of Multiple Comparison Between Means of Process Outcomes in Science for Total sample Boys and Private Based on Three Groups of Cognitive Style

Sample	Groups Compared	Means		F	Values of F'		Level of Significance
		M_1	M_2		0.05	0.01	
Total (N=1000)	FI – INT	25.8372	23.5123	16.7482	6.00	9.24	0.01
	FI – FD	25.8372	24.00	11.8991	6.00	9.24	0.01
	INT – FD	23.5123	24.00	1.2937	6.00	9.24	NS
Boys (N=500)	FI – INT	25.0242	22.8313	14.3461	6.00	9.24	0.01
	FI – FD	25.0242	22.1260	14.6294	6.00	9.24	0.01
	INT - FD	22.8313	22.1260	1.1613	6.00	9.24	N.S
Private (N=600)	FI – INT	27.1165	23.4299	24.7109	6.00	9.24	0.01
	FI – FD	17.1165	23.8021	21.6884	6.00	9.24	0.01
	INT – FD	23.4299	23.8021	0.4413	6.00	9.24	NS

Note: FI – Field Independent
INT – Intermediate Orientation
FD – Field Dependent
NS – Not Significant

Multiple comparison with regard to mean Process Outcomes in Science Scores of students belonging to three levels of Cognitive Style namely FD, INT, FI revealed the following.

For Total sample significant mean difference exists for FI-INT and FI-FD Groups in Process Outcomes in Science. Similar results were obtained for the sub-samples of Boys and Private school pupils. Significant differences in mean scores of Process Outcomes in Science were obtained for six out of nine groups compared. In subsamples of Girls, Rural, Urban and Government School Pupils FI-INT, FI-FD and INT-FD Groups are not found to be significantly different.

From the results of multiple comparison it can be concluded that significant mean difference exists between FI-INT and FI-FD groups in all the three comparison. No significant difference is associated with INT – FD Groups. It is evident that performance of students in FI-INT and FI – FD Groups are dissimilar and their mean scores of 'Process Outcomes in Science' vary when the level of Cognitive Style changes. Among the three Cognitive Style groups compared, FI-INT groups are advantageous group.

Group Differences based on Intelligence

Means and F-values obtained for the Independent variable Intelligence in Scheffe Test of Post-hoc Comparison are consolidated summarized and presented in Table 4.30.

TABLE 4.30

Summary of Scheffe's Test of Multiple Comparison Between Means of Process Outcomes in Science for Total Sample, Boys, Rural and Private Based on Three Groups of Intelligence

Independent Variable	Groups Compared	Means		F	Values of F'		Level of Signi-ficance
		M_1	M_2		0.05	0.01	
Total (N=100)	HI – AI	25.3491	23.8289	12.5530	6.00	9.24	0.01
	HI – LI	25.3491	22.6333	27.4900	6.00	9.24	0.01
	AI – LI	23.8289	22.6333	5.4601	6.00	9.24	NS
Boys (N=500)	HI – AI	24.9891	22.7302	13.1714	6.00	9.24	0.01
	HI – LI	24.9891	21.3202	28.1489	6.00	9.24	0.01
	AI – LI	22.7302	21.3202	4.1525	6.00	9.24	N.S
Rural (N=567)	HI – AI	24.5215	23.1920	4.8084	6.00	9.24	N.S
	HI – LI	24.5215	21.3740	19.4250	6.00	9.24	0.01
	AI – LI	23.1920	21.3740	7.2480	6.00	9.24	0.05
Private (N=600)	HI – AI	26.3089	23.7992	17.9598	6.00	9.24	0.01
	Hi – LI	26.3089	22.4065	34.0763	6.00	9.24	0.01
	AI – LI	23.7992	22.4065	4.8831	6.00	9.24	N.S

Note HI – High Intelligent
AI – Average Intelligent
LI – Low Intelligent
N.S – Not Significant

The multiple comparison using Scheffe procedure undertaken for mean scores of 'Process Outcomes in Science' of pupils of Total Sample and subsamples belonging to the three levels of 'Intelligence' namely HI, AI and LI revealed the following.

Significant mean difference in 'Process Outcomes in Science' was noticed between HI –AI, HI – LI groups of the Total samples and subsamples of Boys and Private. In subsampels of Girls, Urban and Government school pupils HI-AI, HI-LI and AI-LI groups are not found to be significantly different.

From the results of multiple comparison it can be concluded that significant mean difference exists between HI-AI and HI-LI groups. Out of the four comparisons, no significant difference is associated with AI-LI groups. It is evident that performance of students in HI-AI and HI-LI Groups are dissimilar and their mean scores of 'Process Outcomes in science vary when the level of Intelligence changes. Pupils of AI –LI groups are similar in their performance in 'Process Outcomes in Science'.

4.3.10. Discussion on Graphical Representation of Interaction Effects

Graphical Representation of the Interaction effects of Cognitive Style, Intelligence and Classroom Climate revealed the following.

First order interaction is noticed for the combined effect of Cognitive Style X Intelligence for the Total sample and Government sample. From the graph it is clear that Intermediate Orientation group benefit by adopting Average Intelligence irrespective their Classroom Climate. Total sample, Boys and Rural sample yielded high mean Process Outcomes Score in Science for the combination of INT – HI irrespective of Classroom Climate. The Girls sample, Urban and Government sample yielded high mean Process Outcomes Score in Science for the combination of FI – LI.

So it is evident that interaction exist between Cognitive Style X Intelligence. This finding is further substantiated by the results of ANOVA for Total sample and Government sample. In these samples significant F-values were obtained for the combined effect of Cognitive Style X Intelligence.

Pupils with Field Independent Cognitive Style benefit from adopting Favourable Classroom Climate. This trend is observed in

Total sample, Rural, Urban and Government Sample. For the interaction of Cognitive Style X Classroom Climate most of the graphs yield better Process Outcomes Score with the combination FI - MFCC. This interaction is specifically seen in Urban sample where significant F-value is obtained for the combined effect of Cognitive Style X Classroom Climate.

Though three way interaction is not found to be significant, the graphical representation of the pattern of relationship in three-way ANOVA for Total sample and subsampels showed a tendency of interaction effect. The observed interaction effect in pattern of relationship may be due to the fact that, the interaction found in the graph is statistically negligible or below 0.05 level of significance. Even though it is statistically negligible, when graphically plotted it is much evident and projected. The combination of INT - LI - FCC yielded enhanced Process Outcomes in Science.

4.2.3. PREDICTION OF HIGH AVERAGE AND LOW GROUPS OF PROCESS OUTCOMES IN SCIENCE ON THE BASIS OF A SELECT SET OF INDEPENDENT VARIABLES (DISCRMINATING VARIABLES)

In this section discriminant function analysis (Direct method) was performed to predict High, Average and Low groups of Process Outcomes in Science on the basis of a select set of Independent Variables (Discriminating Variables) namely Cognitive Style, Intelligence and Classroom Climate. The evaluation of assumptions of normality of sampling distribution and homogeneity of variance and co-variance, matrices were done. The discriminant co-efficient for each variable were calculated. Details of discriminant function analysis and discussion of results are presented below.

4.2.3.1. Preliminary Analysis

As a first step to Discriminant Function. Analysis number of cases by groups defined by Dependent Variable Process Outcomes in Science is found out and is given below.

Dependent Variable	Group	Unweighted	Weighted
Process Outcomes in Science	High	166	166
	Average	695	695
	Low	139	139
Total		1000	1000

Analysis of Group Difference

Before moving on to main analysis, a preliminary exploration of the data was done to bring out the group means and group standard deviations of the select set of Independent Variables for the three groups of High, Average and Low groups of Process Outcomes in Science. Details of group means and group standard deviation, Wilk's Lambda and Univariate F-ratio shows the F-values for the difference between High, Average and Low groups of Process Outcomes in Science on each of the three independent variables for the total sample. They are presented in Table 4.31.

TABLE 4.31

Group-Mean, Group-Standard deviation, Wilk's Lambda and F-values for the Difference between High, Average and Low Groups of Process Outcomes in Science

Independent Variable	High Process Outcomes in Science Group		Average Process Outcomes in Science Group		Low Process Outcomes in Science Group		Total Sample 1000		Wilk's Lambda	F-value
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D		
Cognitive Style	9.548	3.776	9.148	4.022	7.863	4.333	9.036	4.053	0.985	7.506
Intelligence	42.253	6.268	39.532	7.658	35.568	9.334	39.433	7.916	0.946	28.66
Classroom Climate	102.56	12.914	101.066	16.057	98.173	15.881	100.913	15.589	0.994	3.128

From the table 4.31 it can be observed that the values of Wilk's Lambda for the independent variables namely Cognitive Style Intelligence and Classroom Climate were found to be 0.985, 0.946 and 0.994 respectively suggesting a significant difference in mean scores of three groups. The F-value also revealed that significant difference exist in the mean scores of independent variables Cognitive Style and Intelligence between High, Average and Low groups of Process Outcomes in Science as the obtained F-value exceeded the F-value for (2,997) degrees of freedom.

4.2.3.2. Correlation Among Discriminating Variables

As the preliminary step to discriminant function analysis Pooled Groups Correlation Matrix of the Independent Variables was estimated and are shown in Table 4.32.

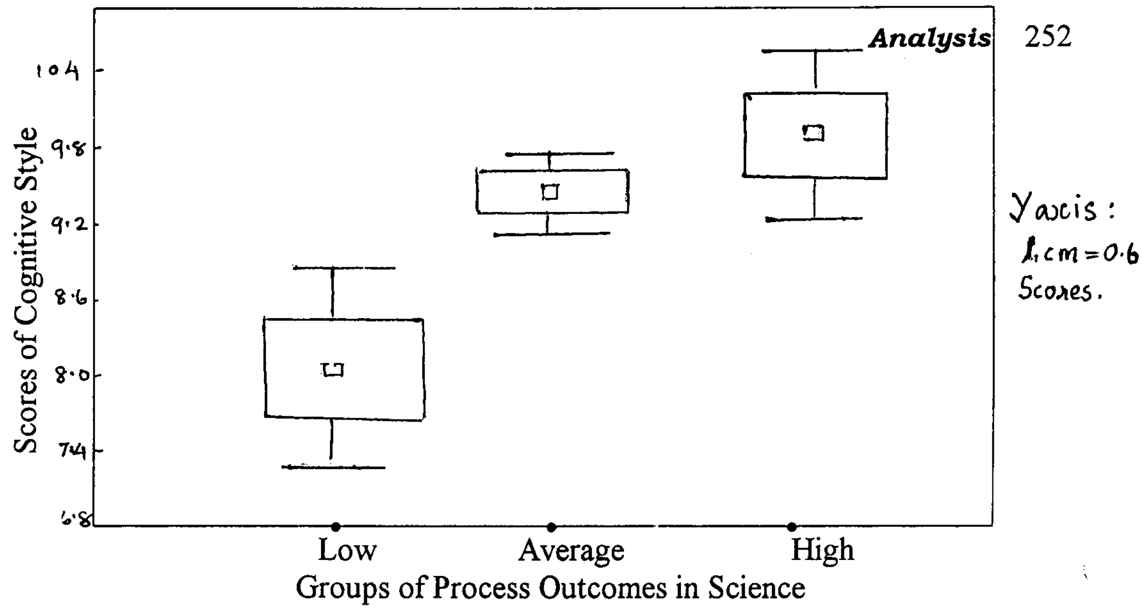
TABLE 4.32

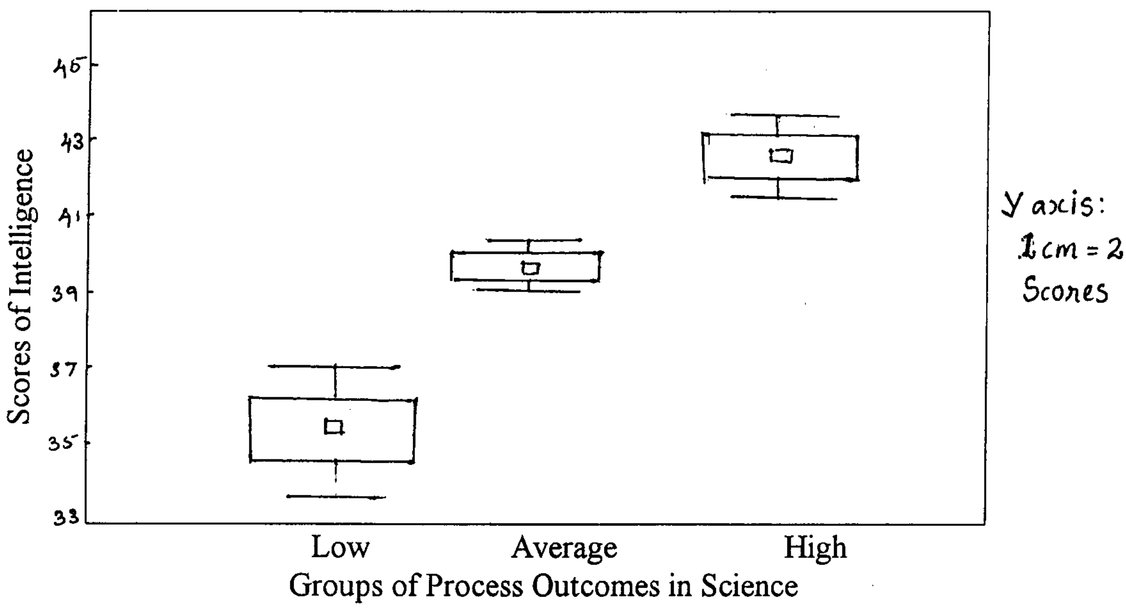
Correlation Matrix of the Three Discriminating Variables namely Cognitive style, Intelligence and Classroom Climate

Discriminating Variables	X_1	X_2	X_3
Cognitive Styles (X_1)	1.00		
Intelligence (X_2)	0.294	1.00	
Classroom Climate (X_3)	-0.053	0.017	1.00

From the Table 4.32 it can be observed that Correlation Coefficient 'r's range from -0.053 to 0.294. The correlation between Cognitive Style and Intelligence is positive and Significant (r=0.294) but low. The relationship between Cognitive Style and Classroom Climate is not significant even at 0.05 level (r=-0.053). The relationship between Intelligence and Classroom Climate is negative and not significant even at 0.05 level (r-0.017).

The distribution of the independent variables were further examined using Box Plots Diagram of the Independent Variables. The Box Plots Diagram of the Independent Variables for High, Average and Low groups of Process Outcomes in Science is presented in Figure 4-8.





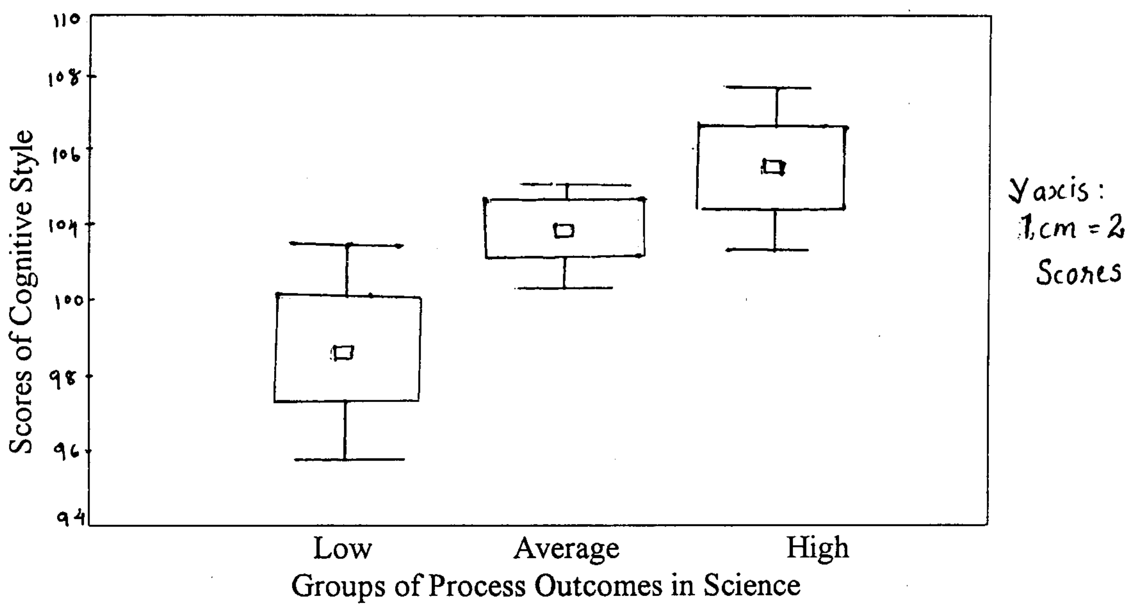


FIGURE 4-8 Box-Plots Diagrams of the Independent Variables for High, Average and Low Groups of Process Outcomes in Science

The small box in the middle of the box represents the mean value of Cognitive Style, Intelligence and Classroom Climate. The box itself embraces the middle 50 percent the scores while the extension (known as Whiskers) connect the largest and smallest values that are not categorized as outliers or extreme values. From the figure it can be concluded that Intelligence is the highest discriminating variable compared to other variables Cognitive Style and Classroom Climate.

4.2.3.2. Assumptions Underlying the Discriminant Function Analysis

1. The distribution of dependent variable and independent variable in the population from which samples are drawn is normal.

2. The second assumption is homogeneity of co-variance ie. all co-variance are equal.

The normality of the variables are necessary condition for multivariate normality of the population. The second assumption was verified by Box's M. Test, and Group Variance were further examined for their shapes graphically using Box Plot Diagrams of the Independent Variables. To test homogeneity of covariance matrices Box's M test was done. Pooled Co-variance Matrix is obtained by averaging the co-variance matrices of three groups High, Average and Low groups of Process Outcomes in Science. To test equality of group co-variance matrices the very sensitive test, Box's M Test was conducted and are presented in Table 4.33 and 4.34.

TABLE 4.33

Covariance Matrix of Three Discriminating Variables namely Cognitive Style, Intelligence and Classroom Climate Box's M Test for Equality of Covariance Matrices

Discriminating Variables	X_1	X_2	X_3
Cognitive Styles (X_1)	16.218		
Intelligence (X_2)	9.109	59.377	
Classroom Climate (X_3)	-3.316	2.083	242.002

TABLE 4.34

Box's M Test for Equality of Covariance Matrices

Groups	Covariance Matrix Rank	Natural Log of determinant of Covariance Matrix
High Process Outcomes in Science Group	3	12.767
Average Process Outcomes in Science Group	3	12.312
Low Process Outcomes in Science Group	3	11.321
Pooled within Covariance Matrices	3	12.265
Box's M Test (53.559)	Approximate F (4.430)	Degrees of freedom (12,706036.40)

Table 4.34 shows that the value of Box's M Test (F=4.430) which is greater than 2.18 the table value of F-required for significant at 0.01 level for (12, 706036.4) degrees of freedom suggesting a significant difference in Covariance matrices of the groups confirming homogeneity of Co-variance matrices. This assumptions underlying discriminant function analysis was satisfied to a great extent.

4.2.3.3. Discriminat Functions

Canonical Discriminant Function Co-efficient

In this section unstandardised and standardized canonical discriminant function co-efficinets were computed. Discriminant function co-efficient discriminates effectively between High, Average and Low groups of Process Outcomes in Science on the basis of combination of discriminating variables. Here there are three groups. So there are two discriminant function contributing to overall relationship. Unstandardised and standardized function co-efficients are presented in Table 4.35.

TABLE 4.35

Standardised and Unstandardised Canonical Discriminant Function Coefficient

Discriminating Variables	Standardised Canonical Discriminant Function Coefficient		Unstandardised Canonical Discriminant Function Coefficient	
	Function I	Function II	Function I	Function II
Cognitive Style	0.228	0.994	0.057	0.247
Intelligence	0.857	-0.568	0.111	-0.074
Classroom Climate	0.304	0.221	0.020	0.014
Constant			-6.884	-0.753

From Table 4.35 it can be observed that there is one set of discriminant function and second set of coefficients for second discriminant function. To solve for Standardised Discriminant function score for Ist function.

$$D_1 = 0.228 \times Z_1 + 0.857 \times Z_2 + 0.304 \times Z_3$$

and second function

$$D_2 = 0.994 \times Z_1 + -0.568 \times Z_2 + 0.221 \times Z_3$$

where Z_1, Z_2 and Z_3 are the individual's standardized score obtained for three discriminating variables namely Cognitive Style (Z_0), Intelligence (Z_2) and Classroom Climate (Z_3). To solve for unstandardised Discriminant function score for First function $D_1 = 0.057 \times X_1 + 0.111 \times X_2 + 0.020 \times X_3 - 6.884$ and second function $D_2 = 0.247 \times X_1 + -0.074 \times X_2 + 0.014 \times X_3 - 0.753$ where X_1, X_2 and X_3 are individual's score obtained for three discriminating variables namely Cognitive Style (X_1), Intelligence (X_2) and Classroom Climate (X_3).

4.2.3.4. Group Centroids

Just as D_1 can be calculated for each case a mean value of D_1 can be calculated for each group. Group means on D_1 are called Centroids. Group Centroids of the two Discriminant functions (Function I and Function 2) for three groups High, Average and Low Process Outcomes in Science are given in Table 4.36.

TABLE 4.36

Canonical Discriminant Function Evaluated at Group means (Group Centroids)

Group	Function I	Function II
High Process Outcomes in Science Group	0.376	-0.043
Average Process Outcomes in Science Group	-0.020	0.023
Low Process Outcomes in Science Group	-0.551	-0.058

If we plot discriminant function plot using group Centroids, the discriminant function form axes and centroids of groups are plotted along the axes. The discriminant function plots of function first revealed that there is big difference between the Centroids of the High achievers and Centroids of Average and Low achieves along discriminant function axis. From this it can be concluded that first function distinguishes ~~Average~~ High achieves from ~~High~~ Average achieves and Low achievers. Discriminant function plot of the second function revealed that there is not much difference between the centroids of three groups. This suggest that function second does not separate the three groups effectively. Centroids of three Process Outcomes in Science groups on the two discriminate functions are given in Figure 4-9.

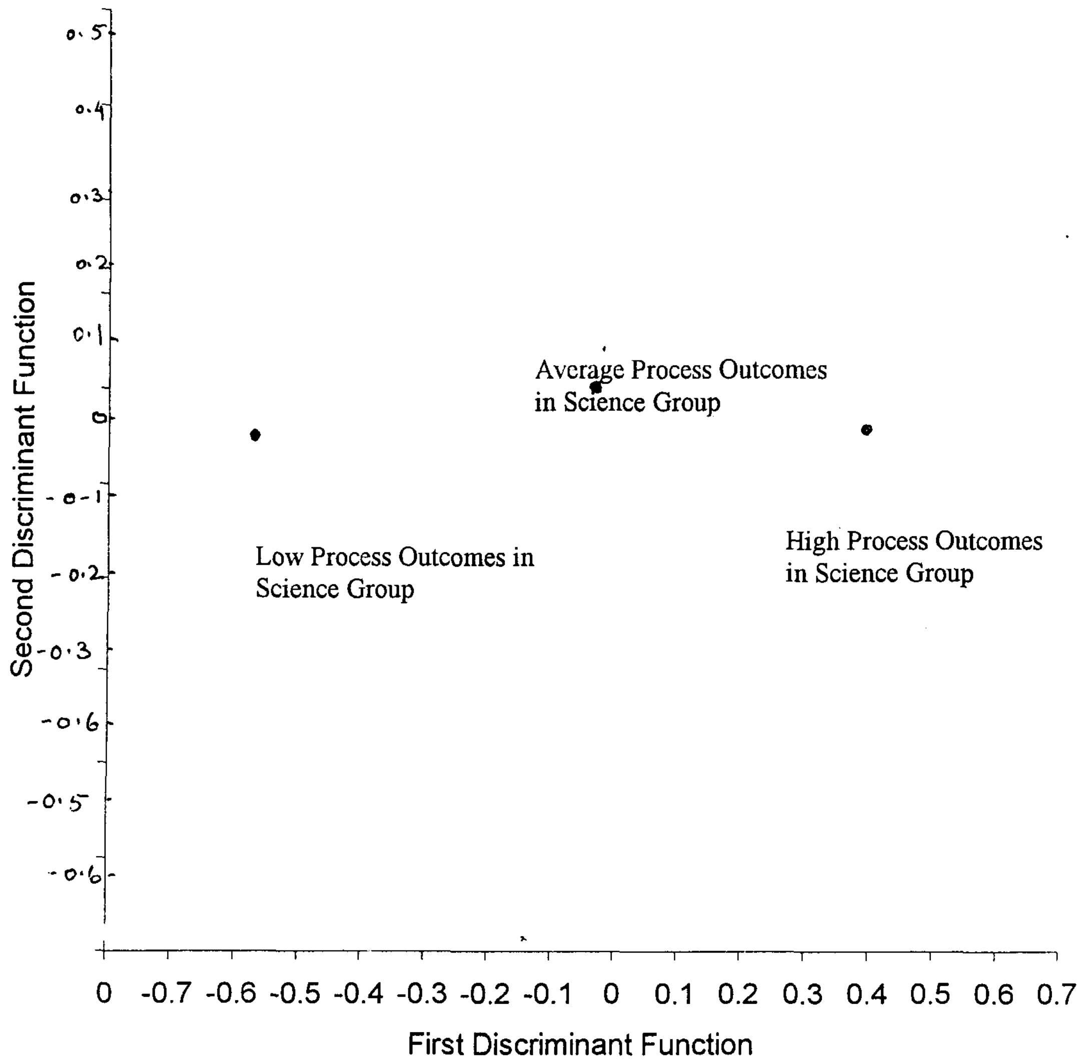


FIGURE 4-9 *Discriminant Function Plots of the Function 1 and* Function 2 (Centroids of three Process Outcomes in Science Groups on the two discriminant functions)

4.2.3.5. Summary of Canonical Discriminant Function

The primary goal of Discriminant function analysis is to discover and interpret the combination discriminating variables (discriminant functions) that separate groups in various ways. The effectiveness of the discriminant function can be interpreted using eigen values, percent of variance, canonical correlation, Wilk;s Lambda and chisqure values. Chisquare values indicate reliable relationship between groups and discriminating variables. Canonical correlation give the correlation between the discriminating variables and function. Summary of Canonical discriminant functions are presented in Table 4.37.

TABLE 4.37

Summary of Canonical Discriminant Functions

Function	Eigen value	Percentage of Variane	Cummulative Percentage	Canonical Correlation	Wilk's Lambda	Chisquare	DF	Level of Significance
1	0.066	98.3	98.3	0.249	0-937	64.966	6	0.01
2	0.001	1.7	100.0	0.034	0.997	1.172	2	N.S

Table 4.37 shows the effectiveness of Discriminat Functions. The Eigen value is 0.066 indicates relative proportion of between group variability accounted for the function 98.3 percent of the between group variability is accounted for by first discriminant function. The value of Canonical correlation (loading) 0.249 indicates that there is low relationship between the discriminant function and discriminating variables. The chi-square value X^2 = 64.966, $P < 0.01$ indicate high reliable relationship between groups and discriminating variables that the first discriminant function is significant to discriminate High Process Outcomes in Science group from other two groups. After removal of first function there was no strong association between groups and prediction X^2 = 1.172,

P>0.05. The two discriminant function accounted for 98.3 percent and 1.7 percent respectively of the between group variability.

4.2.3.6. Correlation between Discriminating Variables and Standardised and Unstandardised Canonical Discriminat function

Pooled within groups correlation between discriminating variables and Standardized Discriminant Function variables ordered by absolute size of correlation between function are presented in Table 4.38.

TABLE 4.38

**Pooled within Groups Correlation
Between Discriminating Variables and
Standardised Canonical Discriminant Function**

Discriminating Variables	Function 1	Function 2
Intelligence	0.932*	-0.273
Classroom Climate	0.307*	0.158
Cognitive Style	0.465	0.815*

*Largest absolute Correlation between each variable and any discriminant function

Table 4.38 shows loading Matrix of correlation between discriminating variables and two discriminant function. The discriminating variables Intelligence (0.932) is highly correlated with function 1 and Classroom Climate (0.307) has low correlation with function 1. Cognitive Style (0.465) has substantial correlation with function 1 and high correlation with function 2. The loading matrix also suggest that best discriminating variables that distinguishing between High, Average and Low groups of Process Outcomes in

Science (for the first function) is Intelligence and for second function is Cognitive Style.

4.2.3.7. Classification

If there are only two groups discriminant function scores cn be used to classify cases into groups. With three groups classification is possible from the discriminant function as follows. Three classification equations developed for three groups by applying the basic classification equation.

Fisher's Linear Discriminant Function Coefficients are used to assign new cases into three groups, High, Average and Low groups of Process Outcomes in Science. Fisher's Linear discriminant function coefficients are given in Table 4.39.

TABLE 4.39

Classification Function Coefficients
(Fishers Linear Discriminant Functions)

Variables	High Process Outcomes in Science Group	Average Process Outcomes in Science Group	Low Process Outcomes in Science Group
Cognitive Style	0.311	0.310	0.262
Intelligence	0.649	0.604	0.545
Classroom Climate	0.422	0.417	0.405
Constant	-38.659	-34.770	-32.548

Using Fischer's Function Coefficients, a case is assigned to the groups for which it has the highest classification score. Three classification equation, one for each group is calculated for the each case by applying classification equation. For each case the classification equations for three groups are as follows.

$$C_1 = 0.311 \times X_1 + 0.649 \times X_2 + 0.422 \times X_3 - 38.659$$

$$C_2 = 0.310 \times X_1 + 0.604 \times X_2 + 0.417 \times X_3 - 34.770$$

$$C_3 = 0.262 \times X_1 + 0.545 \times X_2 + 0.405 \times X_3 - 32.548$$

where X_1, X_2 and X_3 are the individual's scores obtained for three discriminating variables namely Cognitive Style (X_1) Intelligence (X_2) and Classroom Climate (X_3). Each case is assigned to the group for which it has the highest classification score. In the same way calculated the predicted group membership of the full data and compared to the actual group membership. The number and percentage of cases correctly classified and number and nature of errors of classification belonging to the groups High, Average and Low groups of Process Outcomes in Science using discriminant functions are given in Table 4.40.

TABLE 4.40

Classification Matrix of the Cases Correctly Classified and Misclassified

Actual group	Predicted Group Membership			
	1 High	2 Average	3 Low	Total
High Process Outcomes in Science Group	0 (0%)	166 (100%)	0 (0%)	166
Average Process Outcomes in Science Group	0 (0%)	689 (99.1%)	6 (9%)	695
Low Process Outcomes in Science Group	0 (0%)	133 (95.7%)	6 (4.3%)	139

Table 4.40 shows that the percent of grouped cases correctly classified is 69.5 percent with misclassification rate of 30.5 percent which is an index of effectiveness of discriminant function. This

implies that if the Fischer's function coefficients are used to assign new cases into three groups High, Average and Low Process Outcomes in Science, the function will classify the cases with the misclassification rate of 30.5 percent.

Discussion

Discriminant function Analysis (Direct method) was performed to predict High, Average and Low groups of Process Outcomes in Science. The maximum number of discriminant function was two. To solve for standardized Discriminant function score for first function D_1 = 0.228 x Z_1 + 0.857 x Z_2 + 0.304 z Z_3 and Second function D_2 = 0.994 x Z_1 + -0.568 x Z_2 + 0.221 x Z_3 where Z_1, Z_2 and Z_3 are the individual standardized score obtained for three discriminating variables.

To solve for unstandardised discriminant function score for the First function D_1 = 0.057 x X_1 + 0.111 x X_2 + 0.020 x X_3 -6.884 and Second function D_2 = 0.247 x X_1 + 0.074 x X_2 + 0.014 x X_3 -0.75 where X_1, X_2 and X_3 are individuals scores obtained for three discriminating variables namely Cognitive Style (X_1), Intelligence (X_2) and Classroom Climate (X_3). Fisher's Linear Discriminant Function Coefficients are used to assign new cases into three groups, high average and low groups of Process Outcomes in Science. Classification results showed that the percent of grouped cases correctly classified is 69.5 percent with misclassification rate of 30.5 percent.

SUMMARY OF PROCEDURE FINDINGS AND IMPLICATIONS

Aruna P.K. “Influence of cognitive style intelligence and classroom climate on process outcomes in science of secondary school pupils of Kerala ” Thesis. Department of Education , University of Calicut, 2004

CHAPTER 5

SUMMARY OF PROCEDURE FINDINGS AND IMPLICATIONS

15

SUMMARY OF PROCEDURE FINDINGS AND IMPLICATIONS

The present study was to determine the influence of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science of secondary school pupils. The main purpose of scientific research is to derive verifiable generalizations or conclusions based on the results obtained in the study. Major findings derived by the study, conclusions drawn, educational implications of the findings and suggestions for further research in the area are reported in this chapter along with a brief review of the methodology used for the study.

5.1. METHODOLOGY IN RETROSPECT

5.1.1. STATEMENT OF THE PROBLEM

The study was entitled as INFLUENCE OF COGNITIVE STYLE INTELLIGENCE AND CLASSROOM CLIMATE ON PROCESS OUTCOMES IN SCIENCE OF SECONDARY SCHOOL PUPILS OF KERALA.

5.1.2. VARIABLES SELECTED FOR THE STUDY

The variables selected for the study are presented below.

5.1.2.1. Independent Variables

The Independent Variables selected for the study are:

i) Cognitive Style
ii) Intelligence
iii) Classroom Climate

5.1.2.2. Dependent Variable

Process Outcomes in Science is treated as Dependent Variable for the present investigation.

5.1.2.3. Basal Variables

Basal variables selected for the study are Sex, Locale and Type of Management of Schools.

5.1.3. OBJECTIVES

The present study has the following objectives.

5.1.3.1. To compare the mean scores of Independent Variables **Cognitive Style, Intelligence, Classroom Climate** and the Dependent Variable **Process Outcomes in Science** between the sample of Boys and Girls in the Total sample.

5.1.3.2. To compare the mean scores of Independent Variables **Cognitive Style, Intelligence, Classroom Climate** and the Dependent Variable **Process Outcomes in Science** between the sample of Rural and Urban in the Total sample.

5.1.3.3. To compare the mean scores of Independent Variables **Cognitive Style, Intelligence, Classroom Climate** and the Dependent Variable **Process Outcomes in Science** between the sample of Government and Private in the Total sample.

5.1.3.4. To estimate the relationship between Independent Variable **Cognitive Style** and the Dependent Variable **Process Outcomes in Science** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Private and Government.

5.1.3.5. To estimate the relationship between Independent Variable **Intelligence** and the Dependent Variable **Process Outcomes in Science** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Private and Government.

5.1.3.6. To estimate the relationship between Independent Variable **Classroom Climate** and the Dependent Variable **Process Outcomes in Science** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Private and Government.

5.1.3.7. To estimate the relationship between Independent Variables **Cognitive Style** and **Intelligence** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

5.1.3.8. To estimate the relationship between Independent Variables **Cognitive Style** and **Classroom Climate** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

5.1.3.9. To estimate the relationship between Independent Variables **Intelligence** and **Classroom Climate** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

5.1.3.10. To study the main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils for Total Sample.

5.1.3.11. To study the main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils for Boys Sample.

5.1.3.12. To study the main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils for Girls Sample.

5.1.3.13. To study the main and interaction effects of **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils for Rural Sample.

5.1.3.14. To study the main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils for Urban Sample.

5.1.3.15. To study the main and interaction effects of **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils for Government Sample.

5.1.3.16. To study the main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils for Private Sample.

5.1.3.17. To predict High, Average and Low groups of **Process Outcomes in Science** using select set of Independent Variables (Discriminating Variables) **Cognitive Style, Intelligence** and **Classroom Climate**.

5.1.4. HYPOTHESES

The hypotheses formed and tested are the following.

5.1.4.1. There will be significant difference in the means scores of Independent Variables **Cognitive Style, Intelligence, Classroom Climate** and the Dependent Variable **Process Outcomes in Science** between the sample of Boys and Girls in the Total sample.

5.1.4.2. There will be significant difference in the means scores of Independent Variables **Cognitive Style, Intelligence, Classroom Climate** and the Dependent Variable **Process Outcomes in Science** between the sample of Rural and Urban in the Total sample.

5.1.4.3. There will be significant difference in the means scores of Independent Variables **Cognitive Style, Intelligence, Classroom Climate** and the Dependent Variable **Process Outcomes in Science** between the sample of Government and Private in the Total sample.

5.1.4.4. There will be significant relationship between Independent Variable **Cognitive Style** and the Dependent Variable **Process Outcomes in Science** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

5.1.4.5. There will be significant relationship between Independent Variable **Intelligence** and the Dependent Variable **Process Outcomes in Science** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

5.1.4.6. There will be significant relationship between Independent Variable **Classroom Climate** and the Dependent Variable **Process Outcomes in Science** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

5.1.4.7. There will be significant relationship between Independent Variables **Cognitive Style** and **Intelligence** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

5.1.4.8. There will be significant relationship between Independent Variables **Cognitive Style** and **Classroom Climate** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

5.1.4.9. There will be significant relationship between Independent Variables **Intelligence** and **Classroom Climate** for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

5.1.4.10. The main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils will be significant for the total sample.

5.1.4.11. The main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils will be significant for the Boys Sample.

5.1.4.12. The main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on

Process Outcomes in Science of Secondary School Pupils will be significant for the Girls sample.

5.1.4.13. The main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils will be significant for the Rural sample.

5.1.4.14. The main an interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils will be significant for Urban Sample.

5.1.4.15. The main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils will be significant for Government Sample.

5.1.4.16. The main and interaction effects of Independent Variables **Cognitive Style, Intelligence** and **Classroom Climate** on **Process Outcomes in Science** of Secondary School Pupils will be significant for Private Sample.

5.1.4.17. High, Average and Low groups of **Process Outcomes in Science** can be predicted using Independent Variables (Discriminating Variables) **Cognitive Style, Intelligence** and **Classroom Climate.**

5.1.5. METHODOLOGY

The methodology of present study is outlined as below.

5.1.5.1. Sample

The present study was conducted on a representative sample of 1000 pupils of standard IX of secondary schools of Quilon, Alapuzha, Ernakulam, Kottayam, Kozhikode and Malappuram revenue districts of Kerala representing South, Central and North Kerala. The sample was selected by proportionate stratified sampling technique, giving due representation to factors like sex, locality and management category of the schools.

5.1.5.2. Tools Used

All the variables were measured using standardized tools of acceptable reliability and validity. For Cognitive Style and Intelligence the investigator used available standardized tools. Scale of Classroom Climate was developed and standardized by the investigator. Process Outcomes in Science was developed and standardized by the investigator. The tools used are the following.

(1) Group Embedded Figures Test (GEFT) (Oltman *et al.*, 1971).
(2) Standard Progressive Matrices Test (SPMT) (Raven, 1958).
(3) Scale of Classroom Climate (SCC) (Usha & Aruna, 1999).
(4) Test of Process Outcomes in Science (TPOS) (Aruna, 1999).

5.1.5.3. Statistical Techniques Used

The main statistical techniques employed for the present investigation are given below.

(i) Preliminary Analysis like mean, median, mode, standard deviation, quartile deviation, skewness and kurtosis.

(ii) Two tailed Test of Significance of Difference between Mean Scores of Large Independent Samples.

(iii) Pearson's Product Moment Coefficient of Correlation.

(iv) Three way ANOVA with 3x3x3 Factorial Design.

(v) ANOVA followed by Scheffe' Test of Post-hoc comparison.

(vi) Discriminant Function Analysis (Direct Method).

5.2. MAJOR FINDINGS OF THE STUDY

The major findings of the study are given in this section. This part consists of the results of the investigation of Sex difference in Independent and Dependent variables, Locale difference in Independent and Dependent variables, Management difference in Independent and Dependent Variables, Correlation Analysis between Independent and Dependent variables, Main and Interaction effects of Independent variables on Dependent Variables and Discriminant Function Analysis - Direct Method.

5.2.1. SEX DIFFERENCE IN INDEPENDENT AND DEPENDENT VARIABLES

The details of results of Test of Significance of Difference between Means to study Sex difference on the Independent and Dependent Variables are given as follows.

Independent Variables	t-value	Level of significance
1) Cognitive style	15.02	0.01
2) Intelligence	3.86	0.01
3) Classroom Climate	3.22	0.01
Dependent Variables		
1) Process outcomes in Science	4.95	0.01

The results indicate that significant Sex difference exists for the Independent Variables Cognitive Style, Intelligence, Classroom

Climate and the Dependent Variable Process Outcomes in Science at 0.01 level of significance.

5.2.2. LOCALE DIFFERENCE IN INDEPENDENT AND DEPENDENT VARIABLES

The details of results of Test of Significance of Difference between Means to study Locale difference on Independent and Dependent Variables are presented as follows.

Independent Variables	t-value	Level of significance
Cognitive style	0.98	NS
Intelligence	8.19	0.01
Classroom Climate	2.16	0.05
Dependent Variables		
Process outcomes in Science	5.70	0.01

No significant difference even at 0.05 level was found between Urban and Rural pupils with regard to their 'Cognitive Style'. Significant Locale difference could be observed at 0.01 level between Urban and Rural subjects for their Intelligence. Significant difference at 0.05 level was found between Urban and Rural pupils with regard to their Classroom Climate. Dependent Variable, Process Outcomes in Science showed significant Locale difference at 0.01 level of significance.

5.2.3. DIFFERENCE IN TYPE OF MANAGEMENT ON INDEPENDENT AND DEPENDENT VARIABLES

The details of results of Test of Significance of Difference between Means to study difference in type of Management on Independent and Dependent Variables are presented as follows.

Independent Variables	t-value	Level of significance
1) Cognitive style	1.28	NS
2) Intelligence	1.27	NS
3) Classroom Climate	1.98	0.05
Dependent Variables		
1) Process outcomes in Science	0.52	NS

No significant difference even at 0.05 level was found between Government and Private pupils with regard to their 'Cognitive Style' and 'Intelligence'. Significant difference in Type of Management could be observed at 0.05 level between Government and Private school pupils for their Classroom Climate. No significant difference even at 0.05 level was found between Government and Private school pupils with regard to their Process Outcomes in Science.

5.2.4. RESULTS OF CORRELATION ANALYSIS BETWEEN INDEPENDENT AND DEPENDENT VARIABLES

5.2.4.1. Results of Correlation Analysis Between Independent Variables and Process outcomes in Science

Details of results of Correlation analysis between Independent variables and Process Outcomes in Science for the Total sample and Subsamples are presented as follows.

Sample	N	'r' between POS and Cognitive Style	't' value of 'r'	'r' between POS and Intellige-nce	't' value of 'r'	'r' between POS and Classroom Climate	't' value of 'r'
Total	1000	0.129	4.103**	0.221	7.182**	0.065	1.062
Boys	500	0.158	3.554**	0.279	6.458**	0.040	0.892
Girls	500	0.280	6.513**	0.214	4.902**	0.155	3.499**
Rural	567	0.131	3.286**	0.248	6.102**	0.112	2.686**
Urban	433	0.110	2.292*	0.080	1.672	0.030	0.630
Govern-ment	400	0.026	0.521	0.183	3.732**	0.060	1.206
Private	600	0.190	4.720**	0.249	6.306**	0.069	1.699

*P < 0.05; ** P < 0.01.

The correlation analysis revealed that the relationship between 'Cognitive style and Process Outcomes in Science is significant, positive, real but negligible for Total sample and subsamples Boys, Rural, Urban and Private school students. Girls sample showed significant, positive, real and low relationship, Government sample showed no significant relationship between Cognitive Style and Process Outcomes in Science.

The correlation between Intelligence and Process outcomes in Science is significant, positive and low for Total sample and subsamples Boys, Girls, Rural, Government and Private. Urban sample showed no significant relationship between Intelligence and Process outcomes in Science.

The correlation analysis revealed that the relationship between Classroom Climate and Process Outcomes in Science is negligible and positive but not significant even at 0.05 level for the samples Total Boys, Urban, Government and Private. Significant Positive real but negligible relationship can be seen for the samples of Girls and Rural.

5.2.4.2. Results of Inter correlations between Independent Variables

Results of Intercorrelation between Independent variables for the Total sample and Subsamples are presented as follows.

Sample	N	'r' between Cognitive Style and Intelli-gence	't' value of 'r'	'r' between Cognitive Style and Class-room Climate	't' value of 'r'	'r' between Intelligence and Classroom Climate	't' value of 'r'
Total	1000	0.311	10.326**	0.043	1.356	0.035	1.111
Boys	500	0.145	3.263**	0.049	1.103	0.020	0.459
Girls	500	0.416	10.196**	0.059	1.321	0.078	1.756
Rural	567	0.329	8.286**	0.001	0.018	0.108	2.595**
Urban	433	0.292	6.334**	0.090	1.895	0.028	-0.599
Govern-ment	400	0.356	7.507**	0.063	1.255	0.014	0.292
Private	600	0.275	6.995**	0.032	0.781	0.050	1.229

*P < 0.05; ** P < 0.01.

The correlation analysis revealed that the relationship between 'Cognitive Style and 'Intelligence is significant, positive, real and low for the Total sample and subsamples Girls, Rural, Urban, Government and Private. Boys sample showed significant, positive and negligible relationship between Cognitive Style and Intelligence.

It is also seen that the relationship between Cognitive Style and Classroom Climate is positive and negligible, but not significant even at 0.05 level for Total sample and subsamples Boys, Girls, Rural, Urban, Government and Private.

5.2.5. RESULTS OF THREE-WAY ANOVA FOR PROCESS OUTCOME IN SCIENCE

Results of Main effects and Interaction effects of Independent variables on Process Outcomes in Science were studied for total sample and subsamples formed on the basis of sex, locale and Type of Management. This is done with help of statistical technique three way ANOVA with 3x3x3 factorial design.

Main Effect of Independent Variables

The main effect of Independent Variables viz., Cognitive Style and Intelligence on Process Outcomes in Science are discussed in this part. No significant main effect was obtained for the variable Classroom Climate.

Main effect of Cognitive style

The results of three-way ANOVA show that Cognitive Style is having significant main effect on Process Outcomes in Science. Main effect is noticed only for the samples Total, Boys and Private. The obtained significant F-values of Three-way ANOVA of Cognitive Style on Process Outcomes in Science are presented as follows.

Sample	N	F-value	Level of Significance
Total	1000	5.960	0.01
Boys	500	4.852	0.01
Private	600	8.019	0.01

Main Effect of Intelligence

Intelligence showed significant main effect on 'Process Outcomes in Science' in Total, Boys, Rural and Private Sample. The significant F-values showing main effect are presented as follows:

Sample	N	F-value	Level of significance
Total	1000	9.661	0.01
Boys	500	7.079	0.01
Rural	567	4.920	0.01
Private	600	12.690	0.01

Interaction Effect of Independent Variables

The Interaction effect of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science was studied using 3x3x3 design of Three-way ANOVA. The results of two-way interaction effects and Three-way interaction effects are described briefly.

Two-way Interactions

There are three types of two-way interaction viz., Cognitive style x Intelligence, Cognitive style x Classroom climate and Intelligence x Classroom Climate.

Two way interaction was found to be significant only in the Total sample and the subsample Government and Private where a cross over effect of Cognitive Style x Intelligence was obtained. The significant F-ratio for the two-way interaction of Cognitive Style x Intelligence is as follows.

Sample	N	F-value Cognitive Style x Intelligence	Level of significance
Total	1000	2.592	0.05
Government	400	2.621	0.05
Private	600	2.085	0.05

Two-way interaction was found to be significant for Urban sample where a cross over effect of Cognitive Style x Classroom Climate was obtained. The findings is substantiated by the graphs of Urban sample. The significant F-ratios of the two way interaction for Cognitive Style x Classroom Climate are presented as follows.

Sample	N	F-value Cognitive style x Classroom climate	Level of significance
Urban	433	2.398	0.05

No significant two way interaction was obtained for the variables Intelligence x Classroom Climate for the Total sample or any of the subsamples.

Three way Interaction

The result of Three-way Interaction of Cognitive Style x Intelligence x Classroom Climate revealed that it is not significant on the Dependent Variable Process Outcomes in Science. The F-ratios obtained for the Total sample, Boys, Girls, Rural, Government and Private are not significant even at 0.05 level.

5.2.6. GROUP DIFFERENCE IN MEAN SCORES OF PROCESS OUTCOMES IN SCIENCE

Different groups formed on the basis of the three levels of the Independent Variables that are significantly different with regard to their mean Process Outcomes in Science were identified by Scheffe Test of Multiple Comparison. Group difference was studied separately and are presented below.

Group Difference in Mean Scores of Process Outcomes in Science Among Different Levels of Cognitive Style

The Post-hoc comparison with regard to the mean scores of Process Outcomes in Science of three level of cognitive style (FI, INT, FD) for Total sample and subsamples viz., Boys, Rural and Private were made through Scheffe' test to identify the groups which differ significantly. Since none of the variables yielded significant main effect for Girls and urban sample, it is excluded from the comparison. The F-values obtained in Scheffe' test is given below.

Sample	Groups compared	F-value	Level of Significance
Total (N=1000)	FI - INT	16.788	0.01
	FI - FD	11.899	0.01
	INT - FD	1.294	N.S
Boys (N = 500)	FI - INT	14.346	0.01
	FI - FD	14.629	0.01
	INT - FD	1.161	N.S
Private (N = 600)	FI - INT	24.711	0.01
	FI - FD	21.688	0.01
	INT - FD	0.441	N.S.

FI – Field Independent
INT – Intermediate
FD – Field Dependent
NS – Not significant

The Post-hoc comparison using Scheffe' procedure undertaken for mean scores of 'Process Outcomes in Science' showed that significant mean difference exists between F1 - INT and F1 - FD group in Total, Boys and Private sample. In all the three comparison. In three comparison no significant difference is associated with INT - FD Groups. Among the three Cognitive Style groups compared, F1 and INT groups are advantageous groups.

Group Difference in Mean Scores of Process Outcomes in Science Among Different Level of Intelligence

The Post-hoc comparison with regard to mean scores of Process Outcomes in Science of three level of Intelligence (HI, AI, LI) for Total sample and subsamples Boys, Rural and Private were made through Scheffe' test to identify the groups which differ significantly. Since main effect of Intelligence on Process Outcomes in Science was not found significant for subsamples Girls, Urban and Government, they are not included for comparison. The F-values obtained in the Scheffe' test are given below.

Sample	Groups compared	F-value	Level of Significance
Total (N=1000)	HI – AI	12.553	0.01
	HI - LI	27.490	0.01
	AI - LI	5.460	N.S
Boys (N = 500)	HI - AI	13.171	0.01
	HI - LI	28.149	0.01
	AI - LI	4.153	N.S
Private (N = 600)	HI - AI	17.960	0.01
	HI - LI	34.076	0.01
	AI - LI	4.883	N.S.
Rural (N = 567)	HI – AI	4.808	N.S.
	HI – LI	19.425	0.01
	AI – LI	7.248	0.05

HI – High Intelligence
AI – Average Intelligence
LI – Low Intelligence
NS – Not Significant

Results of Post-hoc comparison using Scheffe' procedure revealed that significant mean difference exists between groups compared, HI - AI. HI-LI, AI - LI. Significant mean Process Outcomes in Science score is found in Eight out of Twelve groups compared. Among the three Intelligent groups compared HI - LI groups are the advantageous groups.

5.2.7. RESULTS OF DISCRIMINANT FUNCTION ANALYSIS

Discriminant function Analysis (Direct method) was performed to predict High, Average and Low groups of Process Outcomes in Science. The maximum number of discriminant function was two. To solve for Standardised Discriminant function score for First function $D_1 = 0.228 \times Z_1 + 0.857 \times Z_2 + 0.304 \times Z_3$ and Second Function $D_2 = 0.994 \times Z_1 + - 0.568 \times Z_2 + 0.221 \times Z_3$ where Z_1, Z_2 and Z_3 are the individuals standardised score obtained for three discriminating variables.

To solve for Unstandardised Discriminant function score for the First function $D_1 = 0.057 \times X_1 + 0.111 \times X_2 + 0.020 \times X_3 - 6.884$ and Second function $D_2 = 0.247 \times X_1 + -0.074 \times X_2 + 0.014 \times X_3 = -0.753$ where X_1, X_2, X_3 are individual's scores obtained for three discriminating variables namely Cognitive style (X_1), Intelligence (X_2) and Classroom Climate (X_3) Fisher's Linear discriminant function coefficient are used to assign new cases into three groups High, Average and Low groups of Process Outcomes in Science. Classification results showed that the percent of grouped cases correctly classified is 69.5% with misclassification rate of 30.5% which is an index of effectiveness of discriminant function.

Classification Matrix of cases correctly classified and misclassified is given as follows.

Actual group	Predicted Group Membership			
	1	2	3	Total
High Process outcomes in Science group	0 (0%)	166 (100%)	0 (0%)	166
Average Process Outcomes in Science Group	0 (0%)	689 (99.1%)	6 (9%)	695
Low Process Outcomes in Science group	0 (0%)	133 (95.7%)	6 (4.3%)	139

5.3. TENABILITY OF HYPOTHESES

1. The first hypothesis states that there will be significant difference in the mean scores of independent variables Cognitive Style, Intelligence, Classroom Climate and Dependent Variable Process Outcomes in Science between the sample of Boys and Girls in the Total sample.

The t-test analysis revealed that significant Sex difference was noticed in the independent variables Cognitive Style, Intelligence Classroom Climate and in the dependent variable Process Outcomes in Science. Thus the first hypothesis is fully substantiated.

2) Second hypothesis state that there will be significant difference in the means scores of select independent variables Cognitive Style, Intelligence, Classroom Climate and Dependent variable Process outcomes in Science between the sample of Rural and Urban in the total sample.

The t-test analysis revealed significant Locale difference exists in the independent variables Intelligence, Classroom Climate and in the dependent variable Process Outcomes in Science. The locality of school has no significant effect on the Cogntiive Style. Thus the Second hypothesis is substantiated to a great extent.

3. The third hypothesis states that there will be significant different in means scores of independent variables Cognitive Style Intelligence and Classroom Climate and Dependent variable Process Outcomes in Science between the samples of Government and Private.

The t-test revealed that significant difference exists in the type of management and the independent variable Classroom Climate. The type of Management has low contribution in the development of the other two independent variables Cognitive Style, Intelligence and Dependent variable Process Outcomes in Science. Thus the third hypothesis is substantiated to a low extent.

4) The fourth hypothesis states that there will be significant relationship between independent variable Cognitive Style and Dependent variable Process Outcomes in Science in the total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

The correlational analysis found significant relationship existing between the independent variable Cognitive Style and dependent variable Process Outcomes in Science in the Total sample and relevant subsamples Boys, Girls, Rural, Urban and Private. The value of 'r' for Government sample is not significant. This suggest that the fourth hypothesis almost substantiated.

5) The fifth hypothesis state that there will be significant relationship between independent variable Intelligence and dependent variable Process Outcomes in Science in the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

The coefficient of correlation obtained between the independent variable Intelligence has significant and positive correlation with Process Outcomes in Science in the Total sample and relevant subsampels Boys, Girls, Rural, Government and Private. For the Urban sample the value of 'r' is not significant. Thus fifth hypothesis is also substantiated.

6. The sixth hypothesis states that there will be significant relationship between independent variable Classroom Climate and dependent variable Process Outcomes in Science in the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

The correlation analysis revealed that the independent variable Classroom Climate has significant and positive correlation with Process Outcomes Science only for the Total sample and the subsamples Girls and Rural. Hence this sixth hypothesis is substantiated to a lesser extent.

7. The seventh hypothesis states that there will be significant relationship between independent variables Cognitive Style and Intelligence in the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

The coefficient of correlations obtained between Independent Variables Cognitive style and Intelligence was significant and positive in the Total sample and relevant subsmaples Boys, Girls, Rural, Urban, Government and Private. Thus the seventh hypothesis is fully substantiated.

8. The eighth hypothesis state that there will be significant relationship between independent variables Cognitive style and Classroom Climate in the Total sample and relevant

subsamples Boys, Girls, Rural, Urban, Government and Private.

The coefficient of correlations obtained between Independent Variables Cognitive Style and Classroom Climate is not significant but negligible for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private. Thus the eight hypothesis is not substantiated.

9. The ninth hypothesis states that there will be significant relationship between independent variables Intelligence and Classroom Climate in the Total sample relevant subsamples Boys, Girls, Rural, Urban, Government and Private.

The coefficient of correlations obtained between independent variables Intelligence and Classroom Climate is not significant and is negligible for the Total sample and relevant subsamples Boys, Girls, Rural, Urban, Government and Private. Thus the Ninth hypothesis is rejected.

10. The tenth hypothesis states that the main and interaction effects of independent variables Cognitive style, Intelligence and Classroom Climate and Dependent variables Process Outcomes in Science will be significant for the Total sample.

Three way analysis of variance revealed that among the three independent variables, the two independent variables, Cognitive style and Intelligence have significant main effect on Process Outcomes in science. It was also found that First order interaction effects of independent variables Cognitive Style x Intelligence on Process Outcomes in Science is significant at 0.05 level. Thus the tenth hypothesis is substantiated to a certain extent.

11. The eleventh hypothesis states that the main and interaction effects of independent variables Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science will be significant for the Boys sample

Three way analysis of variance revealed that among the three independent variables the two independent variables Cognitive Style and Intelligence have significant main effect on Process Outcomes in Science. There is no significant first order or second order interaction effects of the independent variables on the dependent variable. Thus the eleventh hypothesis is substantiated to a certain extent.

12. The twelfth hypothesis states that the main and interaction effect of dependent variable Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science will be significant for the Girls sample.

Three way analysis of variance revealed that the three independent variables Cognitive style, Intelligence and Classroom Climate have no significant main effect on Process Outcome in Science. It was also found that the First order Interaction effect and second order interaction effect of the Independent variables on Process Outcomes in Science is not significant. Therefore the twelfth hypothesis is rejected.

13. The thirteenth hypothesis states that the main and interaction effect of independent variable Cognitive Style, Intelligence and Classroom Climate on Process in Science will be significant for the Rural sample.

Three way analysis of variance revealed that among the three independent variables, Intelligence has significant main effect on Process Outcomes in Science. It was found that first order

Interaction effect and second order interaction effect of independent variables on Process Outcomes in Science is not significant. Thus the thirteenth hypothesis is a substantiated to a low extent.

14. The fourteenth hypothesis states that the main effect and interaction effects of independent variables Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science will be significant for the Urban sample.

From the analysis of variance, it was found that the three independent variables Cognitive style, Intelligence and Classroom Climate have no significant main effect on Process Outcomes in Science for the urban group. It was found that First order interaction effects of independent variables Cognitive style x Classroom Climate on Process Outcomes in Science is significant at 0.05 level. The three way interaction is found not significant. Thus the fourteenth hypothesis is substantiated to a low extent.

15. The fifteenth hypothesis states that the main effect and interaction effects of independent variables Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science will be significant for the Government sample.

Three way analysis of variance revealed that the independent variables Cognitive Style, Intelligence and Classroom Climate have no significant main effect on Process Outcomes in science for the Government sample. It was also found that one of the first order interaction effects of independent variables, i.e., Cognitive Style x Intelligence on Process Outcomes in Science is found significant. Thus the fifteenth hypothesis is substantiated to a low extent.

16. The sixteenth hypothesis states that the main effect and interaction effects of independent variables Cognitive Style,

Intelligence and Classroom Climate on Process Outcomes in Science will be significant for the Private sample.

From the statistical analysis of the variance it was found that the among three independent variables two independent variables Cognitive style and Intelligence have significant main effect on Process Outcomes in Science for the Private sample. It was found that first order interaction effects and second order interaction effect of independent variables on Process Outcomes in Science is not significant. Thus the sixteenth hypothesis is substantiated to a low extent.

17. The seventeenth hypothesis states that High, Average, and Low groups of Process Outcomes in Science can be predicted using select set of independent variables (Discriminating Variables) Cognitive Style, Intelligence and Classroom Climate.

Discriminant Function Analysis yielded two discriminant equation for predicting group membership on High, Average and Low Process Outcomes in Science in terms of significant Discriminating variables of Process Outcomes in Science. The Discriminant function equations classified the cases with 69.5 percent cases correctly classified with the misclassification rate 30.5 percent. Thus the seventeenth hypothesis is fully substantiated.

5.4. CONCLUSION

The major objective of the study is to find out the influence of Cognitive Style, Intelligence and Classroom Climate on Process Outcomes in Science of secondary school pupils. This was found out by making minor objectives. The objectives were tested through different statistical techniques like 't' test, Coefficient of Correlation, Three way analysis of variance and Discriminant function analysis.

From the analysis of 't' test it was found that there are Sex, Locale and Management differences among the Independent and Dependent Variables. By correlation analysis it was found that Cognitive Style and Intelligence have positive significant correlation with Process Outcomes in Science. The major findings of the study is that Cognitive Style and Intelligence have significant effect on Process Outcomes in Science. Pupils in majority of subsample shows marked difference in their Process Outcomes in Science based on their Cognitive Style and Intelligence. The findings that the main effect of Cognitive Style on Process Outcomes in Science is significant, implies that the level of Process Outcomes in Science is different for different levels of Cognitive Style. Further the difference in mean scores of Process Outcomes in Science is significantly higher for Intermediate group and Field Independent group, when compared with Field-Dependent group of pupils.

Again it was found that Intelligence has significant Main effect on Process Outcomes in Science. That is the Process Outcomes in Science varies significantly among different levels of Intelligence.

The Classroom Climate shows no significant effect on Process Outcomes in Science. Pupils with High Classroom Climate shows only Average and below Average mean scores of Process Outcomes in Science and pupils with Low Classroom Climate shows high mean scores in Process Outcomes in Science. The Discriminant Function analysis done revealed that the combination of three Discriminating Variables (two discriminant function) could discriminate significantly between High, Average and Low groups of Process Outcomes in Science with 69.5 percent as the index of correct classification with misclassification rate 30.5 percent.

5.5. EDUCATIONAL IMPLICATIONS OF THE STUDY

On the basis of the major findings of the study it will be useful to examine the implications of the study on the existing educational practices. The major findings show that independent variables Cognitive Style and Intelligence have significant effect on Process Outcomes in Science.

On the basis of above findings the investigator put forward the following suggestions with regard to each significant independent variables for the improvement of the present educational practices.

Educational Implications of the Independent Variable, Cognitive Style

One major finding of the study is that Cognitive Style has significant effect on Process Outcomes in Science. That is Field Independent, Intermediate Orientation and Field dependent pupils differ in Process Outcomes in Science. In the correlational analysis it was found that Cognitive Style has significant and positive correlation with Process Outcomes in Science. By Three-way Analysis of Variance it was observed that main effect of Cognitive Style on Process Outcomes in Science is significant. All these imply that when level of Cognitive Style is high, the level of Process Outcomes in Science will be high and vice versa. Mean Scores of Process Outcomes in Science is significantly higher for Field Independent and Intermediate Orientation groups.

Rinding, Glass and Douglas (1993) termed cognitive styles as "a fairly fixed characteristic of an individual and are static and relatively in-built features of the individual". Kagan *et al.* (1964) have shown that children's learning of concepts is related to style.

Cognitive Style influences acquisition of new materials as well as utilization of already required knowledge.

In the present study the investigator used the Cognitive Style – Field Independent/Field Dependent notion of Witkin's (1963). People who are able to operate in an analytic manner are said to be Field-Independent and people who are able to operate in more global manner are called Field-Dependent. Field-Independent individuals are emotionally independent and high achievers.

There are certain characteristics agreed upon by experts in the field, by which a teacher can identify a Field-Independent/Field-Dependent child. The following are some of them:

(1) People who were Field Independent tended to score higher on IQ tests, learning of concepts.

(2) Field Independent pupils are analytical and intellectual in approach somewhat distinct from others emotionally independent, high achievers.

(3) Field independent individuals have abstract thinking.

(4) Field Independent individuals are best in disciplines such as science, mathematics, engineering, technical and mechanical actions.

Field-Dependent children do best with interpersonal areas requiring social skills such as teaching, social welfare, etc.

The types of Cognitive Style are evident in the variety of tasks, it becomes important for teachers to examine the performance of students in relation to their Cognitive Style.

(1) Teachers should learn to recognise and observe different types of Cognitive Style and according to this teacher must plan the teaching process suitable to the Cognitive Style of students.

(2) Suitable in-service training course should be given to teachers, which will enable them to teach science according to Cognitive Style of their pupils.

(3) Teacher should make use of available instructional materials, teaching methods, Audio-visual aids and equipments, and develop analytical thinking.

(4) Helping the students to identify their own style of learning, train them to capitalize on their strength and develop weaker part of their learning style.

Teacher should consider individual differences of students, their needs and interest while planning a lesson. Teacher can categorise the students according to their Cognitive Styles.

GEFT should be used to find out Field Dependent and Field Independent pupils. Special instructional strategies should provide to the Field Dependent to strengthen their Cognitive Style. Field-Independent pupils provide more differentiating experiences, the teaching learning activity may include enough chances to conduct experiments and observation.

Considering the findings appropriate steps can be taken by teachers while designing instructional strategies and evaluation techniques to improve academic subjects of the pupil. Suitable inservice course should be given to teachers which will enable them to teach science according to diagnose specific Cognitive Style of all students. Science environmental stimuli are very important in determining the cognitive style of the individual, the teacher can attempt to give maximum learning experiences to within and outside the classroom situation.

Educational Implications of the Independent Variable Intelligence

The finding with regard to the independent variable Intelligence is that it has significant effect on Process Outcomes in Science. The findings that main effect of Intelligence on Process Outcomes in Science is significant, implies that level of Process Outcomes in Science is different for different levels of Intelligence. Mean scores of Process Outcomes in Science is significantly higher for high Intelligence and average Intelligence group.

The classical writers and investigators on human intelligence asserted that Intelligence is something inherent and is fixed. But research findings are abundant in the area to establish the possibility of a substantial increase in the level of Intelligence among children. Adoptive studies conducted by Shodak and Skey (1949); intervention studies by Lazzar and Darlington (1982), Wasik, *et al.* (1990), studies on the effect of schooling by Reinert (1969), Ceci (1990) and Stelz, *et al.* (1995) provides evidences for possibility to change the human intellectual capacity to considerable extent.

Teachers can provide proper environment in the classroom to improve the intelligence of the pupils. Some suggestions for improving Intelligence are following:

(1) For the development of Intelligence, teachers and parents should provide proper environment both at home and at schools.

(2) Intelligence Test should be used to find out High Intelligent, Average Intelligent and Low Intelligent pupils. Teacher should

consider intellectual differences of students, their needs and interests while planning a lesson.

(3) The skill of doing problem solving method is to be acquired by children through earnest participation in learning activities. Therefore students should be provided with task requiring different mental processes and operations involving inductive and deductive reasoning abilities supplemented by illustrative examples.

(4) Depending on the scope and nature of content, teacher should adopt information processing models of teaching on major instructional strategies for developing cognitive abilities.

(5) Suitable inservice training course should be given to teachers which will enable them to teach science according to the Intelligence of their pupil and it would be worthwhile to diagnose specific Intelligence of all students.

Educational Implications of Independent Variable Classroom Climate

The study revealed that Classroom Climate has no significant main effect on Process Outcomes in Science. That is Process Outcomes in Science does not vary among students of different levels of Classroom Climate.

The study of the relationship between Process Outcomes in Science and Classroom Climate throws light to many miserable realities as the present day Classroom Climate are not upto the mark for learning purposes. The teacher, principal and the management of the school should take necessary measures to improve Classroom Climate which is suitable to subjects.

The study has also revealed that Rural pupils have better Classroom Climate than Urban pupil. Inorder to make the classroom an ideal classroom for learning science the teachers and other experts have certain roles ot play; such as to present content in a problematic way, provide opportunities for students to involve in activities, situation for applying scientific principles in their day to day life. So the teachers of urban school should try to improve the climate of the class.

Different functions affect the classroom climate like teacher-student relationship, physical facilities of the school, administrative structure of school and relationship among students. During the teacher training programme more emphasis should be given to develop the skill of classroom management among trainees. Inservice courses for teachers will help in attaining this goal.

Necessary steps should taken to provide better physical facilities for schools. Schools of backward area suffer from the lack of physical facilities. Head of the institution directly influences the nature of administration in a school. Heads of institution should be given adequate training to develop administrative capabilities. Another factor affecting the Classroom Climate is inter-relationship among students. Starting guidance centre in schools will help to develop a healthy relationship among students. As the study reveals this type of climate is seen more in Rural private schools. So others also should consider this matter.

The study revealed students expectations of better academic activities in schools. Maximum use of Laboratory facilities and improvisation of teaching aids improved students achievement and will help to inculcate desirable attitude and thereby developing learning environment. When science lessons are taught teachers can encourage his pupil to take simple illustrative as well as investigative experiments. Availability of popular periodicals and journals in Science and Mathematics, organising science clubs, fairs and exhibitions etc. may provide suitable environment for learning science. Classroom instruction should include activities like discussion symposium etc. which demand active involvement of students in the learning process. There is significant difference in perceiving the Classroom Climate by Boys and Girls. So the psychological environment for learning should be provided for effective learning.

Educational Implications of Dependent Variable Process Outcomes in Science

From the study it was revealed that boys and girls are not identical with respect to skill involved in 'Process Outcomes in Science'. It is found that in Process Outcomes in Science, Boys are superior to Girls. This means differential experiences have to be provided in teaching and learning of science for boys and girls for maximising Process Outcomes in Science.

The result also showed locale difference in Process Outcomes in Science. The urban subjects were found to have advantages over rural subjects. It may be possible that urban pupils are utilising profitably life experiences that they have, which result in better Process Outcomes in Science. On the other hand urban pupils are more conscious of gains that get in academic achievement. So it is important to give opportunity to reveal subjects for processing data respective to problems.

The private school subjects score high in Process Outcomes in Science than Government school pupils. It implies that Private school provides such a teaching learning process to improve the Process Outcomes in Science of pupils.

Science education is unique in the elementary school curriculum in demand for instructional materials. The activity oriented curriculum with its process objectives demands a broad assortment of material for study and appropriate laboratory equipment to support independent investigation activity.

Based on the results obtained from the present study some of the practical suggestions offered will be helpful for teachers as well as those who are interested in the development of our nation in the field of science and technology.

(1) Laboratory and library facilities should be improved so as to enable the students to develop their potentials to the maximum. Where it is not possible to maintain a special fully equipped science laboratory at the school, a kit containing the most needed materials may be transported from classroom to classroom. In some school districts a well-equipped mobile science laboratory has been developed using a van or bus. science as a process as well as a product should be given importance

(2) A good science programme must have the following:

(a) A wide range of measuring devices (thermometers, barometers, balances, hydrometers, galvanometers, rulers, beakers).

(b) Microscope and related equipment.

(c) Tools (construction tools, pumps, pulleys, motors, scissors, dissecting instruments).

(d) Chemicals and related equipment.

(d) Living things (plants, small animals, fish, simple life forms).

(e) Laboratory facilities (running water, gas supply for heat, small pressure chambers, miscellaneous (dry cells, bulbs, lenses, thermostat, bunson burner, acquaria, terraria, etc.).

(3) Science fairs and science exhibition are to be conducted inorder to pinpoint the resourceful and talented pupils. Science club activities be made compulsory in all secondary schools.

(4) 'Learning by doing' teaching strategy should be adopted which learn children free to question, explore and investigate social preference in the modern science program. Guided discovery strategy should be adopted in teaching science programme.

(5) Science courses for teachers may be organized to cope them up with the development of science and newer methods of science teaching.

(6) The process of learning can be made easier by introducing activity oriented lessons, by individual and group feed backward by introducing new methods of learning such Metacognitive strategies (Brown, 1978), Co-operative Learning (Johnson and Johnson, 1975; Slavin, 1990) etc. Students can be made aware of different strategies of product as well as process aspects of Science.

5.6. SUGGESTIONS FOR FURTHER RESEARCH

In the light of the experiences and findings gained through this study, the following topics are suggested for further research.

(1) Replication of the study in other states of the country so that possible differences in findings resulted from cultural variations can be known.

(2) The same study can be extended to central schools and secondary schools affiliated to C.B.S.E.

(3) Replication of the study with additional Independent Variables including Cognitive, Affective and Socio-familial variables which predict Achievement of Science at secondary school pupils.

(4) The same study can be extended to subjects like Maths, English and other Humanities to cover a wider field of study.

(5) Make content analysis of science text books at secondary school level for determining the scope of the development of the significant predictions of Process Outcomes in Science.

(6) The study can be extended to investigate the role of teacher in developing scientific attitude and acquisition of various skills in the pupils.

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APPENDICES

APPENDIX I A

STANDARD PROGRESSIVE MATRICES

SETS A,B,C,D, & E

Name ....   Ref. No...............

Place ....   Date ....

Age ....   Birthday ....

Test begun ....   Test ended ....

A			B			C			D			E		
1			1			1			1			1		
2			2			2			2			2		
3			3			3			3			3		
4			4			4			4			4		
5			5			5			5			5		
6			6			6			6			6		
7			7			7			7			7		
8			8			8			8			8		
9			9			9			9			9		
10			10			10			10			10		
11			11			11			11			11		
12			12			12			12			12		

Time	Total	Grade

APPENDIX I B

STANDARD PROGRESSIVE MATRICES TEST

SCORING KEY

	SET				
	A	B	C	D	E
1	4	2	8	3	7
2	5	6	2	4	6
3	1	1	3	3	8
4	2	2	8	7	2
5	6	1	7	8	1
6	3	3	4	6	5
7	6	5	5	5	1
8	2	6	1	4	6
9	1	4	7	1	3
10	3	3	6	2	2
11	4	4	1	5	4
12	5	5	2	6	5

APPENDIX - II A

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

SCALE OF CLASSROOM CLIMATE
(DRAFT)

Dr. P. USHA & ARUNA. P.K.

നിർദ്ദേശങ്ങൾ

താഴെ കൊടുത്തിരിക്കുന്ന പ്രസ്താവനകൾ നിങ്ങളുടെ ക്ലാസ് മുറിയിലെ പഠനവുമായി ബന്ധപ്പെട്ടവയാണ്. ഇതിൽ പറയുന്ന കാര്യങ്ങൾ നിങ്ങളുടെ യഥാർത്ഥ ക്ലാസ്മുറിയെ സംബന്ധിച്ചിടത്തോളം എത്രമാത്രം ശരിയാണെന്ന് തീരുമാനിക്കുക. ആ പ്രതികരണമാണ് ഉത്തരക്കടലാസ്സിൽ രേഖപ്പെടുത്തേണ്ടത്. 1 മുതൽ 8 വരെയുള്ള പ്രസ്താവനകൾക്ക് ഉണ്ട്/ഇല്ല (അതെ/അല്ല) എന്നു രണ്ടുവീതം പ്രതികരണങ്ങൾ കൊടുത്തിരിക്കുന്നു. 9 മുതൽ 80 പരെയുള്ള പ്രസ്താവനകൾക്ക് 1. എല്ലായ്പ്പോഴും 2. ചിലപ്പോൾ മാത്രം. 3. ഒരിക്കലുമില്ല. എന്നീ മൂന്നു പ്രതികരണങ്ങൾ കൊടുത്തിരിക്കുന്നു.

ഉത്തരക്കടലാസുകൾ പ്രത്യേകം തന്നിട്ടുണ്ട്. പ്രസ്താവനകൾ വായിച്ച് ഉത്തരക്കടലാസിലെ അതേ നമ്പറിനു നേരെയുള്ള ഉചിതമായ ഏതെങ്കിലും ഒരു പ്രതികരണത്തിനു നേരെയുള്ള കോളത്തിൽ X ചിഹ്നം രേഖപ്പെടുത്തുക. എല്ലാ പ്രസ്താവനകൾക്കും പ്രതികരണം രേഖപ്പെടുത്താൻ ശ്രദ്ധിക്കണം.

1. ക്ലാസ് മുറിയിൽ ആവശ്യത്തിന് ബഞ്ചും ഡസ്ക്കും ഉണ്ട്.
2. എല്ലാ കുട്ടികൾക്കും കാണുവാൻ കഴിയുന്ന വിധത്തിലാണ് ബോർഡ് സ്ഥാപിച്ചി
രി ക്കണം.
3. ക്ലാസ് മുറി വൃത്തിയും വെടിപ്പുമുള്ളതാണ്.
4. ക്ലാസ് മുറിയിൽ ആവശ്യത്തിന് വായുവും വെളിച്ചവും ലഭിക്കുന്നുണ്ട്.
5. ക്ലാസ് മുറിയിൽ ഇരിപ്പിടങ്ങൾ ക്രമീകരിച്ചിരിക്കുന്നത് പുറം കാഴ്ചകൾ കാണത്തക്കവിധത്തിലാണ്.
6. ക്ലാസിൽ പഠനസാമഗ്രികൾ സൂക്ഷിക്കുവാനുള്ള സൗകര്യമുണ്ട്.
7. ക്ലാസ് മുറിയിൽ സയൻസിലെ പരീക്ഷണങ്ങൾ ചെയ്യുവാനുള്ള സൗകര്യമുണ്ട്.
8. ക്ലാസ് മുറി സ്ഥിതി ചെയ്യുന്നത് തിരക്കേറിയ സ്ഥലത്താണ്.
9. ക്ലാസിൽ എല്ലാ കുട്ടികളും പരസ്പരം സൗഹൃദം പുലർത്താറുണ്ട്.
10. കുട്ടികൾ പുസ്തകങ്ങളും ബുക്കുകളും ആവശ്യമുള്ളപ്പോൾ പരസ്പര കൈമാറാറുണ്ട്.
11. ക്ലാസിലെ കുട്ടികൾ തമ്മിൽ തമ്മിൽ കലഹിക്കാറുണ്ട്.
12. ക്ലാസിൽ എല്ലാ കുട്ടികളും സമഭാവനയോടെയാണ്. വർത്തിക്കുന്നത്.

13. ക്ലാസിൽ മിടുക്കരായ കുട്ടികൾ മറ്റു കുട്ടികളെ ശ്രദ്ധിക്കാറില്ല.

14. ക്ലാസിൽ മികവു പുലർത്തുന്ന കുട്ടികളെ മറ്റു കുട്ടികൾ ഒറ്റപ്പെടുത്താറുണ്ട്.

15. ക്ലാസിലെ ചില കുട്ടികൾ ആരാലും ശ്രദ്ധിക്കപ്പെടാത്തവരാണ്.

16. ഗ്രൂപ്പുപ്രവർത്തനങ്ങളിൽ കഴിവു കുറഞ്ഞ കുട്ടികളെ കഴിവുള്ള കുട്ടികൾ സഹായിക്കാറുണ്ട്.

17. ഗ്രൂപ്പിൽ വ്യത്യസ്ത കഴിവുകൾ ഉള്ള കുട്ടികളെ ഉൾപ്പെടുത്താൻ അദ്ധ്യാപകൻ ശ്രദ്ധിക്കാറുണ്ട്.

18. ഒറ്റപ്പെട്ടു നിൽക്കുന്ന കുട്ടികളെ അദ്ധ്യാപകർ ശ്രദ്ധിക്കാറുണ്ട്.

19. കുട്ടികളുടെ പഠനസംബന്ധമായ പ്രശ്നങ്ങളെക്കുറിച്ച് അദ്ധ്യപകൻ മാതാപിതാക്കളുമായി ചർച്ച നടത്താറുണ്ട്.

20. അദ്ധ്യാപകൻ കുട്ടികളുടെ സംശയങ്ങൾ തീർത്തു കൊടുക്കാറുണ്ട്.

21. മത്സരപ്പരീക്ഷകളിൽ പങ്കെടുക്കാൻ അധ്യാപകൻ കുട്ടികളെ പ്രോത്സാഹിപ്പിക്കാറുണ്ട്.

22. കുട്ടികളുടെ സമ്പാദ്യശീലം അദ്ധ്യാപകൻ പ്രോത്സാഹിപ്പിക്കാറുണ്ട്

23. ക്ലാസിലെ പൊതുവായ പ്രശ്നങ്ങളെക്കുറിച്ച് അധ്യാപകൻ കുട്ടികളുമായി ചർച്ച നടത്താറുണ്ട്.

24. അധ്യാപകൻ കുട്ടികളുമായി സൗഹൃദം പുലർത്താറില്ല.

25. അദ്ധ്യപകൻ പുതിയ പാഠം ആരംഭിക്കുമ്പോൾ ആ പാഠത്തിൽ താല്പര്യം ജനിപ്പിക്കുന്ന രീതിയിൽ അവതാരിക നൽകാറുണ്ട്.

26. പാഠങ്ങൾക്കനുയോജ്യമായ ഉദാഹരണങ്ങൾ/വിശദീകരണങ്ങൾ അധ്യാപകൻ നൽകാറുണ്ട്.

27. പ്രയാസമുള്ള പാഠഭാഗങ്ങൾ കണ്ടെത്തി ലളിതമായി അദ്ധ്യാപകൻ പഠിപ്പിക്കാറുണ്ട്.

28. പഠിപ്പിക്കുന്നതിനിടയിൽ അദ്ധ്യാപകൻ കുട്ടികളെ പേരു ചൊല്ലി വിളിക്കാറുണ്ട്.

29. കുട്ടികൾ പറയുന്ന ശരി ഉത്തരങ്ങൾ അദ്ധ്യാപകൻ ബോർഡിൽ എഴുതാറുണ്ട്.

30. പഠിപ്പിക്കുന്നതിനിടയിൽ അദ്ധ്യാപകൻ ചോദ്യങ്ങൾ ചോദിക്കാറുണ്ട്.

31. അദ്ധ്യാപകൻ പാഠഭാഗങ്ങൾക്കനുയോജ്യമായ ചാർട്ടുകൾ മോഡലുകൾ എന്നിവ ഉപയോഗിക്കാറുണ്ട്.

32. പാഠഭാഗങ്ങൾക്കനുയോജ്യമായ പരീക്ഷണങ്ങൾ അദ്ധ്യാപകൻ കാണിച്ചു തരാറുണ്ട്.

33. ബോർഡിൽ അദ്ധ്യാപകൻ വ്യക്തമായും വൃത്തിയായും എഴുതാറുണ്ട്.

34. പഠിപ്പിക്കുന്നതിനിടയിൽ അദ്ധ്യാപകൻ എല്ലാ കുട്ടികളെയും ശ്രദ്ധിക്കാറുണ്ട്.

35. ചോദ്യങ്ങൾക്കു കുട്ടികൾ ശരിയായ ഉത്തരം നൽകുമ്പോൾ അദ്ധ്യാപകൻ പ്രശംസിക്കാറുണ്ട്.

36. ക്ലാസിനുള്ളിൽവെച്ചു മാത്രമെ അദ്ധ്യാപകൻ ക്ലാസ് എടുക്കാറുള്ളു.

37. കുട്ടികളെ ചെറു സംഘമായ് തിരിച്ച് ഗ്രൂപ്പു പഠനം നടത്താറുണ്ട്.

38. സയൻസിലെ പരീക്ഷണങ്ങൾ അദ്ധ്യാപകൻ കുട്ടികളെക്കൊണ്ട് ചെയ്യിക്കാറുണ്ട്.

39. അദ്ധ്യാപകൻ ഗൃഹപാഠങ്ങൾ നൽകാറുണ്ട്.

40. വർക്കു ബുക്കുകൾ, പാഠാഭ്യാസം എന്നിവ അദ്ധ്യാപകൻ ശ്രദ്ധിക്കാറുണ്ട്.

41. അദ്ധ്യാപകൻ പാഠം എടുത്തു കഴിയുമ്പോൾ അതിലെ പ്രധാന ആശയങ്ങൾ ക്രോഡീകരിച്ച് പറയാറുണ്ട്.

42. വിദഗ്ദ്ധരായ അദ്ധ്യാപകരെക്കൊണ്ട് മാതൃകാപാഠങ്ങൾ എടുപ്പിക്കാറുണ്ട്.

43. അദ്ധ്യാപകൻ പരീക്ഷകൾ നടത്തി ഫലം പ്രഖ്യാപിക്കാറുണ്ട്.

44. ചിലവു കുറഞ്ഞ വസതുക്കളും പാഴ്‌വസ്തുക്കളും ഉപയോഗിച്ച് പഠനോപകരണങ്ങളുടെ മോഡലുകൾ നിർമ്മിക്കുന്നതിന് അദ്ധ്യാപകൻ പരിശീലനം നൽകാറുണ്ട്.

45. സയൻസ് ക്ലബ് സംഘടിപ്പിച്ച് പ്രവർത്തനം നടത്താറുണ്ട്.

46. അദ്ധ്യാപകൻ പഠനയാത്രകൾ സംഘടിപ്പിച്ചു നടത്താറുണ്ട്.

47. ക്ലാസിലെ പഠനപ്രവർത്തനങ്ങളിൽ ഉദാസീനരായ ചില കുട്ടികൾ ക്ലാസിലുണ്ട്.

48. ക്ലാസിലെ പഠനപ്രവർത്തനങ്ങൾകൊണ്ട് തുടർന്നുള്ള പഠനത്തിനു പ്രചോദനം ലഭിക്കാറുണ്ട്.

49. പഠനോപകരണങ്ങളുടെ മോഡലുകൾ സ്വയം നിർമ്മിക്കുന്നതിൽ കുട്ടികൾ സംതൃപ്തി കണ്ടെത്താറുണ്ട്.

50. ഈ ക്ലാസിൽ നിന്നു മാറി മറ്റേതെങ്കിലും ക്ലാസിൽ ചേർന്നു പഠിക്കുവാൻ കുട്ടികൾക്കു താല്പര്യമുണ്ട്.

51. പ്രോജക്ട് വർക്കുകൾ കുട്ടികൾ സന്തോഷത്തോടെ ചെയ്തു തീർക്കാറുണ്ട്.

52. ഗ്രൂപ്പായി പഠനപ്രവർത്തനങ്ങൾ ചെയ്തു തീർക്കുവാൻ കുട്ടികൾ ഉത്സാഹം പ്രകടിപ്പിക്കാറുണ്ട്.

53. ഈ വർഷം പഠിപ്പിക്കുന്ന അദ്ധ്യപകൻ അടുത്ത വർഷവും പഠിപ്പിക്കണമെന്ന് കുട്ടികൾ ആഗ്രഹിക്കാറുണ്ട്.

54. പഠായാത്രകൾ വിനോദത്തിനാണെന്നു തോന്നാറുണ്ട്.

55. സയൽസ് ക്ലബിന്റെ ഭാഗമായി ആൽബം തയ്യാറാക്കുന്നതിന് കുട്ടികൾ ഉത്സാഹിക്കാറുണ്ട്.

56. ക്ലാസിലെ കുട്ടികളുടെ പൊതുവായ പ്രശ്നങ്ങൾ പരിഹരിക്കുവാൻ അദ്ധ്യാപകനോട് പറയാറുണ്ട്.

57. കുട്ടികളുടെ പ്രശ്നങ്ങൾ പരിഹരിക്കുവാൻ അദ്ധ്യാപകൻ ശ്രമിക്കാറുണ്ട്.

58. കുട്ടികൾ ഉത്തരവാദിത്തങ്ങൾ ഏറ്റെടുക്കവാൻ സ്വയം മുന്നോട്ടു വരാറുണ്ട്.

59. കുട്ടികൾക്കു ക്ലാസിൽ പാഠ്യേതര പ്രവർത്തനങ്ങൾ സംഘടിപ്പിക്കാനുള്ള സ്വാതന്ത്ര്യമുണ്ട്.

60. ക്ലാസിൽ അദ്ധ്യാപകൻ പാഠമെടുക്കുന്നതിനിടയിൽ കുട്ടികൾക്കു സംശയം ചോദിക്കുവാൻ ഭയമാണ്.

61. കുട്ടികൾ ഭയമില്ലാതെ ക്ലാസിൽ കഴിവുകൾ പ്രകടിപ്പിക്കാറുണ്ട്.

62. ഗ്രൂപ്പുവർക്കുകളിൽ ഗ്രൂപ്പുകളെ തിരഞ്ഞെടുക്കുന്നത് അദ്ധ്യാപകനാണ്.

63. കുട്ടികളുടെ അഭിപ്രായങ്ങൾ അദ്ധ്യാപകൻ അംഗീകരിക്കാറുണ്ട്.

64. ക്ലാസിലെ കുട്ടികളുടെ ഇരിപ്പിടം അദ്ധ്യാപകനാണ് തീരുമാനിക്കുന്നത്.

65. അദ്ധ്യാപകൻ കൃത്യസമയത്ത് പഠനം തുടങ്ങുകയും അവസാനിപ്പിക്കുകയും ചെയ്യാറുണ്ട്.

66. ക്ലാസിൽ എല്ലാ കുട്ടികളും കൃത്യസമയത്ത് എത്തിച്ചേരാൻ അദ്ധ്യാപകൻ നിർബന്ധിക്കാറുണ്ട്.

67. ക്ലാസിൽ വരാൻ പറ്റാതിരുന്നാൽ അതിന്റെ കാരണം അദ്ധ്യാപകനെ അറിയിക്കാറുണ്ട്.

68. ക്ലാസിലെ പെരുമാറ്റരീതിയെക്കുറിച്ച് അദ്ധ്യാപകൻ പറഞ്ഞു തരാറുണ്ട്.

69. ക്ലാസിൽ കുട്ടികൾ അദ്ധ്യാപകൻ പറയുന്നത് ശ്രദ്ധിക്കാറുണ്ട്.

70. ക്ലാസിൽ അനുസരണക്കേട് കാണിക്കുന്ന കുട്ടികളെ അദ്ധ്യാപകൻ ഉപദേശിക്കാറുണ്ട്.

71. ക്ലാസിൽ അനുസരണക്കേട് കാണിക്കുന്ന കുട്ടികളെ അദ്ധ്യാപകൻ ശിക്ഷിക്കാറുണ്ട്.

72. കുട്ടികൾ ഏതൊക്കെ കളികളിൽ ഏർപ്പെടണമെന്ന് തീരുമാനിക്കുന്നത് അദ്ധ്യാപകനാണ്.

73. ക്ലാസിൽ പഠനകാര്യങ്ങളിൽ കുട്ടികൾ തമ്മിൽ ആരോഗ്യപരമായ മത്സരങ്ങളുണ്ട്.

74. ക്ലാസിലെ മിടുക്കനായ കുട്ടിയായിത്തീരുവാൻ ഓരോരുത്തരും മത്സരിക്കാറുണ്ട്.

75. കുട്ടികൾ പൊതുവിജ്ഞാന പരീക്ഷകളിൽ മത്സരിക്കാറുണ്ട്.

76. പരീക്ഷയിൽ ഉയർന്ന മാർക്കുകൾ നേടുന്ന കുട്ടികൾക്കു ക്ലാസിൽ പ്രത്യേക പ്രാധാന്യമുണ്ട്.

77. ഗ്രൂപ്പുകൾ തമ്മിൽ കലാകായിക മത്സരങ്ങൾ നടത്താറുണ്ട്.

78. പഠനോപകരണങ്ങളുടെ മോഡലുകൾ ഏറ്റവും നന്നായി ഉണ്ടാക്കുവാൻ കുട്ടികൾ തമ്മിൽ മത്സരിക്കാറുണ്ട്.

79. പ്രോജക്ട് വർക്കുകൾ മെച്ചമായി ചെയ്യുവാൻ ഗ്രൂപ്പുകൾ മത്സരിക്കാറുണ്ട്.

80. ക്ലാസിലെ പഠനഗ്രൂപ്പുകൾ തമ്മിൽ കലഹിക്കാറുണ്ട്.

APPENDIX - II B

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

SCALE OF CLASSROOM CLIMATE
(FINAL)

Dr. P. USHA & ARUNA. P.K.

നിർദ്ദേശങ്ങൾ

താഴെ കൊടുത്തിരിക്കുന്ന പ്രസ്താവനകൾ നിങ്ങളുടെ ക്ലാസ് മുറിയിലെ പഠന വുമായി ബന്ധപ്പെട്ടവയാണ്. ഇതിൽ പറയുന്ന കാര്യങ്ങൾ നിങ്ങളുടെ യഥാർത്ഥ ക്ലാസ്മുറിയെ സംബന്ധിച്ചിടത്തോളം എത്രമാത്രം ശരിയാണെന്ന് തീരുമാനിക്കുക. ആ പ്രതികരണമാണ് ഉത്തരക്കടലാസ്സിൽ രേഖപ്പെടുത്തേണ്ടത്. 1 മുതൽ 8 വരെയുള്ള പ്രസ്താവനകൾക്ക് ഉണ്ട്/ഇല്ല (അതെ/അല്ല) എന്നു രണ്ടുവീതം പ്രതികരണങ്ങൾ കൊടു ത്തിരിക്കുന്നു. 9 മുതൽ 70 വരെയുള്ള പ്രസ്താവനകൾക്ക് 1. എല്ലായ്പ്പോഴും 2. ചിലപ്പോൾ മാത്രം. 3. ഒരിക്കലുമില്ല. എന്നീ മൂന്നു പ്രതികരണങ്ങൾ കൊടുത്തിരിക്കു ന്നു.

ഉത്തരക്കടലാസുകൾ പ്രത്യേകം തന്നിട്ടുണ്ട്. പ്രസ്താവനകൾ വായിച്ച് ഉത്തരക്ക ടലാസിലെ അതേ നമ്പറിനു നേരെയുള്ള ഉചിതമായ ഏതെങ്കിലും ഒരു പ്രതികരണത്തിനു നേരെയുള്ള കോളത്തിൽ X ചിഹ്നം രേഖപ്പെടുത്തുക. എല്ലാ പ്രസ്താവനകൾക്കും പ്രതികരണം രേഖപ്പെടുത്താൻ ശ്രദ്ധിക്കണം.

1. ക്ലാസ് മുറിയിൽ ആവശ്യത്തിന് ബഞ്ചും ഡസ്ക്കും ഉണ്ട്.
2. എല്ലാ കുട്ടികൾക്കും കാണുവാൻ കഴിയുന്ന വിധത്തിലാണ് ബോർഡ് സ്ഥാപിച്ചി രിക്കണം.
3. ക്ലാസ് മുറി വൃത്തിയും വെടിപ്പുമുള്ളതാണ്.
4. ക്ലാസ് മുറിയിൽ ആവശ്യത്തിന് വായുവും വെളിച്ചവും ലഭിക്കുന്നുണ്ട്.
5. ക്ലാസ് മുറിയിൽ ഇരിപ്പിടങ്ങൾ ക്രമീകരിച്ചിരിക്കുന്നത് പുറം കാഴ്ചകൾ കാണാത്ത ക്കവിധത്തിലാണ്.
6. ക്ലാസിൽ പഠനസാമഗ്രികൾ സൂക്ഷിക്കുവാനുള്ള സൗകര്യമുണ്ട്.
7. ക്ലാസ് മുറിയിൽ സയൻസിലെ പരീക്ഷണങ്ങൾ ചെയ്യുവാനുള്ള സൗകര്യമുണ്ട്.
8. ക്ലാസ് മുറി സ്ഥിതി ചെയ്യുന്നത് തിരക്കേറിയ സ്ഥലത്താണ്.
9. ക്ലാസിൽ എല്ലാ കുട്ടികളും പരസ്പരം സൗഹൃദം പുലർത്താറുണ്ട്.
10. കുട്ടികൾ പുസ്തകങ്ങളും ബുക്കുകളും ആവശ്യമുള്ളപ്പോൾ പരസ്പര കൈമാ റാറുണ്ട്.
11. ക്ലാസിൽ എല്ലാ കുട്ടികളും സമഭാവനയോടെയാണ്. വർത്തിക്കുന്നത്.
12. ക്ലാസിലെ ചില കുട്ടികൾ ആരാലും ശ്രദ്ധിക്കപ്പെടാത്തവരാണ്.

13. ഗ്രൂപ്പുപ്രവർത്തനങ്ങളിൽ കഴിവു കുറഞ്ഞ കുട്ടികളെ കഴിവുള്ള കുട്ടികൾ സഹായിക്കാറുണ്ട്.

14. ഗ്രൂപ്പിൽ വ്യത്യസ്ത കഴിവുകൾ ഉള്ള കുട്ടികളെ ഉൾപ്പെടുത്താൻ അദ്ധ്യാപകൻ ശ്രദ്ധിക്കാറുണ്ട്.

15. ഒറ്റപ്പെട്ടു നിൽക്കുന്ന കുട്ടികളെ അദ്ധ്യാപകർ ശ്രദ്ധിക്കാറുണ്ട്.

16. കുട്ടികളുടെ പഠനസംബന്ധമായ പ്രശ്നങ്ങളെക്കുറിച്ച് അദ്ധ്യപകൻ മാതാപിതാക്കളുമായി ചർച്ച നടത്താറുണ്ട്.

17. അദ്ധ്യാപകൻ കുട്ടികളുടെ സംശയങ്ങൾ തീർത്തു കൊടുക്കാറുണ്ട്.

18. മത്സരപ്പരീക്ഷകളിൽ പങ്കെടുക്കാൻ അദ്ധ്യാപകൻ കുട്ടികളെ പ്രോത്സാഹിപ്പിക്കാറുണ്ട്.

19. കുട്ടികളുടെ സമ്പാദ്യശീലം അദ്ധ്യാപകൻ പ്രോത്സാഹിപ്പിക്കാറുണ്ട്

20. ക്ലാസിലെ പൊതുവായ പ്രശ്നങ്ങളെക്കുറിച്ച് അധ്യാപകൻ കുട്ടികളുമായി ചർച്ച നടത്താറുണ്ട്.

21. അധ്യാപകൻ കുട്ടികളുമായി സൗഹൃദം പുലർത്താറില്ല.

22. പാഠങ്ങൾക്കനുയോജ്യമായ ഉദാഹരണങ്ങൾ/വിശദീകരണങ്ങൾ അധ്യാപകൻ നൽകാറുണ്ട്.

23. പ്രയാസമുള്ള പാഠഭാഗങ്ങൾ കണ്ടെത്തി ലളിതമായി അദ്ധ്യാപകൻ പഠിപ്പിക്കാറുണ്ട്.

24. പഠിപ്പിക്കുന്നതിനിടയിൽ അദ്ധ്യാപകൻ കുട്ടികളെ പേരു ചൊല്ലി വിളിക്കാറുണ്ട്.

25. കുട്ടികൾ പറയുന്ന ശരി ഉത്തരങ്ങൾ അദ്ധ്യാപകൻ ബോർഡിൽ എഴുതാറുണ്ട്.

26. പഠിപ്പിക്കുന്നതിനിടയിൽ അദ്ധ്യാപകൻ ചോദ്യങ്ങൾ ചോദിക്കാറുണ്ട്.

27. അദ്ധ്യാപകൻ പാഠഭാഗങ്ങൾക്കനുയോജ്യമായ ചാർട്ടുകൾ മോഡലുകൾ എന്നിവ ഉപയോഗിക്കാറുണ്ട്.

28. പാഠഭാഗങ്ങൾക്കനുയോജ്യമായ പരീക്ഷണങ്ങൾ അദ്ധ്യാപകൻ കാണിച്ചു തരാറുണ്ട്.

29. ബോർഡിൽ അദ്ധ്യാപകൻ വ്യക്തമായും വൃത്തിയായും എഴുതാറുണ്ട്.

30. പഠിപ്പിക്കുന്നതിനിടയിൽ അദ്ധ്യാപകൻ എല്ലാ കുട്ടികളെയും ശ്രദ്ധിക്കാറുണ്ട്.

31. ചോദ്യങ്ങൾക്കു കുട്ടികൾ ശരിയായ ഉത്തരം നൽകുമ്പോൾ അദ്ധ്യാപകൻ പ്രശംസിക്കാറുണ്ട്.

32. ക്ലാസിനുള്ളിൽവെച്ചു മാത്രമെ അദ്ധ്യാപകൻ ക്ലാസ് എടുക്കാറുള്ളു.

33. കുട്ടികളെ ചെറു സംഘമായ് തിരിച്ച് ഗ്രൂപ്പു പഠനം നടത്താറുണ്ട്.

34. സയൻസിലെ പരീക്ഷണങ്ങൾ അദ്ധ്യാപകൻ കുട്ടികളെക്കൊണ്ട് ചെയ്യിക്കാറുണ്ട്.

35. അദ്ധ്യാപകൻ ഗൃഹപാഠങ്ങൾ നൽകാറുണ്ട്.

36. വർക്കു ബുക്കുകൾ, പാഠാഭ്യാസം എന്നിവ അദ്ധ്യാപകൻ ശ്രദ്ധിക്കാറുണ്ട്.

37. അദ്ധ്യാപകൻ പാഠം എടുത്തു കഴിയുമ്പോൾ അതിലെ പ്രധാന ആശയങ്ങൾ ക്രോഡീകരിച്ച് പറയാറുണ്ട്.

38. വിദഗ്ദ്ധരായ അദ്ധ്യാപകരെക്കൊണ്ട് മാതൃകാപാഠങ്ങൾ എടുപ്പിക്കാറുണ്ട്.

39. ചിലവു കുറഞ്ഞ വസതുക്കളും പാഴ്വസ്തുക്കളും ഉപയോഗിച്ച് പഠനോപകര ണങ്ങളുടെ മോഡലുകൾ നിർമ്മിക്കുന്നതിന് അദ്ധ്യാപകൻ പരിശീലനം നൽകാറുണ്ട്.

40. സയൻസ് ക്ലബ് സംഘടിപ്പിച്ച് പ്രവർത്തനം നടത്താറുണ്ട്.

41. അദ്ധ്യാപകൻ പഠനയാത്രകൾ സംഘടിപ്പിച്ചു നടത്താറുണ്ട്.

42. ക്ലാസിലെ പഠനപ്രവർത്തനങ്ങളിൽ ഉദാസീനരായ ചില കുട്ടികൾ ക്ലാസിലുണ്ട്.

43. ക്ലാസിലെ പഠനപ്രവർത്തനങ്ങൾകൊണ്ട് തുടർന്നുള്ള പഠനത്തിനു പ്രചോദനം ലഭിക്കാറുണ്ട്.

44. പഠനോപകരണങ്ങളുടെ മോഡലുകൾ സ്വയം നിർമ്മിക്കുന്നതിൽ കുട്ടികൾ സംതൃപ്തി കണ്ടെത്താറുണ്ട്.

45 പ്രോജക്ട് വർക്കുകൾ കുട്ടികൾ സന്തോഷത്തോടെ ചെയ്തു തീർക്കാറുണ്ട്.

46. ഗ്രൂപ്പായി പഠനപ്രവർത്തനങ്ങൾ ചെയ്തു തീർക്കുവാൻ കുട്ടികൾ ഉത്സാഹം പ്രകടിപ്പിക്കാറുണ്ട്.

47. ഈ വർഷം പഠിപ്പിക്കുന്ന അദ്ധ്യപകൻ അടുത്ത വർഷവും പഠിപ്പിക്കണമെന്ന് കുട്ടികൾ ആഗ്രഹിക്കാറുണ്ട്.

48. സയൽസ് ക്ലബിന്റെ ഭാഗമായി ആൽബം തയ്യാറാക്കുന്നതിന് കുട്ടികൾ ഉത്സാഹ ക്കാറുണ്ട്.

49. ക്ലാസിലെ കുട്ടികളുടെ പൊതുവായ പ്രശ്നങ്ങൾ പരിഹരിക്കുവാൻ അദ്ധ്യാപക നോട് പറയാറുണ്ട്.

50. കുട്ടികളുടെ പ്രശ്നങ്ങൾ പരിഹരിക്കുവാൻ അദ്ധ്യാപകൻ ശ്രമിക്കാറുണ്ട്.

51. കുട്ടികൾ ഉത്തരവാദിത്തങ്ങൾ ഏറ്റെടുക്കവാൻ സ്വയം മുന്നോട്ടു വരാറുണ്ട്.

52. കുട്ടികൾ ഭയമില്ലാതെ ക്ലാസിൽ കഴിവുകൾ പ്രകടിപ്പിക്കാറുണ്ട്.

53. ഗ്രപ്പുവർക്കുകളിൽ ഗ്രപ്പുകളെ തിരഞ്ഞെടുക്കുന്നത് അദ്ധ്യാപകനാണ്.

54. കുട്ടികളുടെ അഭിപ്രായങ്ങൾ അദ്ധ്യാപകൻ അംഗീകരിക്കാറുണ്ട്.

55. ക്ലാസിലെ കുട്ടികളുടെ ഇരിപ്പിടം അദ്ധ്യാപകനാണ് തീരുമാനിക്കുന്നത്.

56. അദ്ധ്യാപകൻ കൃത്യസമയത്ത് പഠനം തുടങ്ങുകയും അവസാനിപ്പിക്കുകയും ചെയ്യാറുണ്ട്.

57. ക്ലാസിൽ എല്ലാ കുട്ടികളും കൃത്യസമയത്ത് എത്തിച്ചേരാൻ അദ്ധ്യാപകൻ നിർബ ന്ധിക്കാറുണ്ട്.

58. ക്ലാസിൽ വരാൻ പറ്റാതിരുന്നാൽ അതിന്റെ കാരണം അദ്ധ്യാപകനെ അറിയിക്കാ റുണ്ട്.

59. ക്ലാസിലെ പെരുമാറ്റരീതിയെക്കുറിച്ച് അദ്ധ്യാപകൻ പറഞ്ഞു തരാറുണ്ട്.

APPENDIX - II A

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

SCALE OF CLASSROOM CLIMATE
(DRAFT)

Dr. P. USHA & ARUNA. P.K.

നിർദ്ദേശങ്ങൾ

താഴെ കൊടുത്തിരിക്കുന്ന പ്രസ്താവനകൾ നിങ്ങളുടെ ക്ലാസ് മുറിയിലെ പഠന വുമായി ബന്ധപ്പെട്ടവയാണ്. ഇതിൽ പറയുന്ന കാര്യങ്ങൾ നിങ്ങളുടെ യഥാർത്ഥ ക്ലാസ്മുറിയെ സംബന്ധിച്ചിടത്തോളം എത്രമാത്രം ശരിയാണെന്ന് തീരുമാനിക്കുക. ആ പ്രതികരണമാണ് ഉത്തരക്കടലാസ്സിൽ രേഖപ്പെടുത്തേണ്ടത്. 1 മുതൽ 8 വരെയുള്ള പ്രസ്താവനകൾക്ക് ഉണ്ട്/ഇല്ല (അതെ/അല്ല) എന്നു രണ്ടുവീതം പ്രതികരണങ്ങൾ കൊടുത്തിരിക്കുന്നു. 9 മുതൽ 80 വരെയുള്ള പ്രസ്താവനകൾക്ക് 1. എല്ലായ്പ്പോഴും 2. ചിലപ്പോൾ മാത്രം. 3. ഒരിക്കലുമില്ല. എന്നീ മൂന്നു പ്രതികരണങ്ങൾ കൊടുത്തിരിക്കുന്നു.

ഉത്തരക്കടലാസുകൾ പ്രത്യേകം തന്നിട്ടുണ്ട്. പ്രസ്താവനകൾ വായിച്ച് ഉത്തരക്കടലാസിലെ അതേ നമ്പറിനു നേരെയുള്ള ഉചിതമായ ഏതെങ്കിലും ഒരു പ്രതികരണത്തിനു നേരെയുള്ള കോളത്തിൽ X ചിഹ്നം രേഖപ്പെടുത്തുക. എല്ലാ പ്രസ്താവനകൾക്കും പ്രതികരണം രേഖപ്പെടുത്താൻ ശ്രദ്ധിക്കണം.

1. ക്ലാസ് മുറിയിൽ ആവശ്യത്തിന് ബഞ്ചും ഡസ്ക്കും ഉണ്ട്.
2. എല്ലാ കുട്ടികൾക്കും കാണുവാൻ കഴിയുന്ന വിധത്തിലാണ് ബോർഡ് സ്ഥാപിച്ചിരി ക്കണം.
3. ക്ലാസ് മുറി വൃത്തിയും വെടിപ്പുമുള്ളതാണ്.
4. ക്ലാസ് മുറിയിൽ ആവശ്യത്തിന് വായുവും വെളിച്ചവും ലഭിക്കുന്നുണ്ട്.
5. ക്ലാസ് മുറിയിൽ ഇരിപ്പിടങ്ങൾ ക്രമീകരിച്ചിരിക്കുന്നത് പുറം കാഴ്ചകൾ കാണത്തക്കവിധത്തിലാണ്.
6. ക്ലാസിൽ പഠനസാമഗ്രികൾ സൂക്ഷിക്കുവാനുള്ള സൗകര്യമുണ്ട്.
7. ക്ലാസ് മുറിയിൽ സയൻസിലെ പരീക്ഷണങ്ങൾ ചെയ്യുവാനുള്ള സൗകര്യമുണ്ട്.
8. ക്ലാസ് മുറി സ്ഥിതി ചെയ്യുന്നത് തിരക്കേറിയ സ്ഥലത്താണ്.
9. ക്ലാസിൽ എല്ലാ കുട്ടികളും പരസ്പരം സൗഹൃദം പുലർത്താറുണ്ട്.
10. കുട്ടികൾ പുസ്തകങ്ങളും ബുക്കുകളും ആവശ്യമുള്ളപ്പോൾ പരസ്പര കൈമാറാറുണ്ട്.
11. ക്ലാസിലെ കുട്ടികൾ തമ്മിൽ തമ്മിൽ കലഹിക്കാറുണ്ട്.
12. ക്ലാസിൽ എല്ലാ കുട്ടികളും സമഭാവനയോടെയാണ്. വർത്തിക്കുന്നത്.

60. ക്ലാസിൽ കുട്ടികൾ അദ്ധ്യാപകൻ പറയുന്നത് ശ്രദ്ധിക്കാറുണ്ട്.

61. ക്ലാസിൽ അനുസരണക്കേട് കാണിക്കുന്ന കുട്ടികളെ അദ്ധ്യാപകൻ ഉപദേശിക്കാറുണ്ട്.

62. ക്ലാസിൽ അനുസരണക്കേട് കാണിക്കുന്ന കുട്ടികളെ അദ്ധ്യാപകൻ ശിക്ഷിക്കാറുണ്ട്.

63. കുട്ടികൾ ഏതൊക്കെ കളികളിൽ ഏർപ്പെടണമെന്ന് തീരുമാനിക്കുന്നത് അദ്ധ്യാപകനാണ്.

64. ക്ലാസിൽ പഠനകാര്യങ്ങളിൽ കുട്ടികൾ തമ്മിൽ ആരോഗ്യപരമായ മത്സരങ്ങളുണ്ട്.

65. ക്ലാസിലെ മിടുക്കനായ കുട്ടിയായിത്തീരുവാൻ ഓരോരുത്തരും മത്സരിക്കാറുണ്ട്.

66. കുട്ടികൾ പൊതുവിജ്ഞാന പരീക്ഷകളിൽ മത്സരിക്കാറുണ്ട്.

67. പരീക്ഷയിൽ ഉയർന്ന മാർക്കുകൾ നേടുന്ന കുട്ടികൾക്കു ക്ലാസിൽ പ്രത്യേക പ്രാധാന്യമുണ്ട്.

68. ഗ്രൂപ്പുകൾ തമ്മിൽ കലാകായിക മത്സരങ്ങൾ നടത്താറുണ്ട്.

69. പഠനോപകരണങ്ങളുടെ മോഡലുകൾ ഏറ്റവും നന്നായി ഉണ്ടാക്കുവാൻ കുട്ടികൾ തമ്മിൽ മത്സരിക്കാറുണ്ട്.

70. പ്രോജക്ട് വർക്കുകൾ മെച്ചമായി ചെയ്യുവാൻ ഗ്രൂപ്പുകൾ മത്സരിക്കാറുണ്ട്.

APPENDIX IIC

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

SCALE OF CLASS ROOM CLIMATE (Draft)

Response Sheet

Name..................................Boy/Girl..............Age......................
Standard...............................School...

Sl. No.	Yes	No		Sl..No.	Yes	No	
1	0	0		5	0	0	
2	0	0		6	0	0	
3	0	0		7	0	0	
4	0	0		8	0	0	
Sl.No.	Always	Sometimes	Never	Sl.No.	Always	Sometimes	Never
9	0	0	0	29	0	0	0
10	0	0	0	30	0	0	0
11	0	0	0	31	0	0	0
12	0	0	0	32	0	0	0
13	0	0	0	33	0	0	0
14	0	0	0	34	0	0	0
15	0	0	0	35	0	0	0
16	0	0	0	36	0	0	0
17	0	0	0	37	0	0	0
18	0	0	0	38	0	0	0
19	0	0	0	39	0	0	0
20	0	0	0	40	0	0	0
21	0	0	0	41	0	0	0
22	0	0	0	42	0	0	0
23	0	0	0	43	0	0	0
24	0	0	0	44	0	0	0
25	0	0	0	45	0	0	0
26	0	0	0	46	0	0	0
27	0	0	0	47	0	0	0
28	0	0	0	48	0	0	0
49	0	0	0	65	0	0	0
50	0	0	0	66	0	0	0
51	0	0	0	67	0	0	0
52	0	0	0	68	0	0	0
53	0	0	0	69	0	0	0
54	0	0	0	70	0	0	0
55	0	0	0	71	0	0	0
56	0	0	0	72	0	0	0
57	0	0	0	73	0	0	0
58	0	0	0	74	0	0	0
59	0	0	0	75	0	0	0
60	0	0	0	76	0	0	0
61	0	0	0	77	0	0	0
62	0	0	0	78	0	0	0
63	0	0	0	79	0	0	0
64	0	0	0	80	0	0	0

APPENDIX - II D

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

SCALE OF CLASSROOM CLIMATE
(DRAFT)

Dr. P. USHA & ARUNA. P.K.

Instructions:

The statement given below are related to learning practices in your classroom. For statements one to eight two options viz., Yes/No are given. For statement from nine to eighty, three options, namely Always/Sometimes/never are given.

Response sheet are provided. Read the statements carefully and put an 'X' mark in the appropriate column given for recording your choice against the corresponding number of statement in the scale. You must take care to record your opinion for all statements.

1. There are enough number of benches and desks in the class room.
2. Black board is placed in such a way that every learner is able to see it properly.
3. Class room is neat and tidy.
4. Class room is airy and there is sufficient light.
5. Seats in the class room are arranged in such a way that students can have the outside view.
6. There is facility to keep learning materials inside the class room.
7. There is facility inside the class room to perform science experiment.
8. Class room is situated in a busy area.
9. All students maintain mutual friendship in the classroom.
10. Whenever necessary students exchange their books and text books.
11. Students quarrel each other in the classroom.
12. Students maintain equanimity in the class room.
13. Bright students in the class do not care for other students.
14. Other students in the class isolates bright students.

15. Some students in the class room are unnoticed.

16. Students who are efficient in group works helps less efficient students.

17. Teacher takes special care to include students of different abilities in the same group.

18. Teacher identifies isolates in the class.

19. Teacher makes discussion with parents regarding studies of the students.

20. Teacher clears the students doubts.

21. Teacher encourages students to participate in competitive examinations.

22. Teacher encourages saving mentality of the students.

23. Teacher conducts discussion with students regarding common issues of the class.

24. The teacher is unfriendly to students.

25. Whenever the teacher begin a new lesson he introduces the lesson in an interesting way.

26. Teacher always gives suitable examples/illustrations for the lesson.

27. Teacher identifies difficult part of the lesson and teaches it in a simple way.

28. While teaching the teacher calls students by their names.

29. Teacher writes the right answer given by the students on the black board.

30. While teaching the teacher asks questions.

31. Teacher uses suitable models and charts for the lessons.

32. Teacher shows suitable experiments for the lessons.

33. Teacher writes neatly and legibly on the black board.

34. While teaching the teacher attends to each students.

35. Teacher praises the student when they give right answers to the questions.

36. Teacher conducts classes only in the class room.

37. Group learning is conducted by dividing students into small groups.

38. Teacher gives opportunity to students to do science experiments by themselves.

39. Teacher gives home works.

40. Teacher cares for workbook and exercise of the text book.

41. After teaching a lesson, teacher summarises the important points of the lesson.

42. Model classes are conducted by expert teachers.

43. Teacher conducts examination and declares the results.

44. Teacher train the students to make models and teaching aids from low cost and waste materials.

45. Science club is organized and conducted.

46. Teacher organises and conducts study tours.

47. Some students in the class are indifferent in the learning activities.

48. Learning activities in the classroom rives encouragement to students for further study.

49. Students finds satisfaction in making models and teaching aids by themselves.

50. Students are interested to leave this class and to join some other classes.

51. Students are happy to do the project work.

52. Students shows interest to complete learning activities in groups.

53. Students likes to be taught next year by the same teacher who teaches them this year.

54. Study tours seem to be for enjoyment.

55. Students shows interest in preparing album as a part of the activities of the science club.

56. Student tell the common problems of the class to their teacher.

57. Teacher tries to solve the problems of the students.

58. Students volunteer themselves to take responsibilities.

59. Students are free to organise co-curricular activities in the class.

60. Students are afraid of asking doubts while the teacher is taking lesson.

61. Students express their abilities in class without any fear.

62. In group work, groups are selected by teacher.

63. Teacher accept the opinion of the students.

64. Teacher decides the seats of the students.

65. Teacher begins and ends the classes on time.

66. Teacher compels the students to be in the class at the right time.

67. Students reports for their absence in the class to the teacher.

68. Students are told how to behave in the class room.

69. Students listen to the teacher.

70. Teacher advises disobedient students.

71. Teacher punishes the disobedient students.

72. Teacher decides what games students should play.

73. There are healthy competitions in studies among the class students.

74. Each student compete to become the best student in the class.

75. Students contest in general knowledge test.

76. Importance is given to those students who score high marks in examination.

77. Sports and Arts competition are conducted among groups.

78. Students compete each other to make the best teaching model.

79. Groups compete each other to do project work in a better way.

80. Study groups of the class quarrels each other.

APPENDIX IIIA

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF PROCESS OUTCOMES IN SCIENCE FOR SECONDARY SCHOOL PUPILS
(DRAFT)

ARUNA. P.K.

നിർദ്ദേശങ്ങൾ

ഈ ടെസ്റ്റിൽ ആകെ 60 ചോദ്യങ്ങൾ ഉണ്ട്. ഓരോന്നിനും a,b,c, എന്നീ ഉത്തരങ്ങൾ കൊടുത്തിട്ടുണ്ട്. അവയിൽ ഒരു ഉത്തരം മാത്രമേ ശരിയായിട്ടുള്ളൂ. ഇതോടൊപ്പം തരുന്ന ഉതത്തരകടലാസിൽ ആ ഉത്തരം രേഖപ്പെടുത്തണം. ശരിയായ ഉത്തരം സൂചിപ്പിക്കുന്ന അക്ഷരത്തിൽ ചുറ്റും ✓ അടയാളം ഇടുക. പരിശോധകൻ "start" എന്നു പറയുമ്പോൾ മാത്രം ഉത്തരം രേഖപ്പെടുത്താൻ തുടങ്ങുക. കഴിയുന്നതും വേഗത്തിൽ എല്ലാ ചോദ്യങ്ങൾക്കും 60 മിനിറ്റിനുള്ളിൽ കണ്ടുപിടിച്ച് രേഖപ്പെടുത്താൻ ശ്രമിക്കുക.

ഉദാഹരണം.: സമുദ്രനിരപ്പിനേക്കാൾ കുന്നിൻമുകളിൽ ജലം വളരെ വേഗം തിളയ്ക്കുന്നു. ഇതിന്റെ ശരിയായ കാരണം താഴെ പറയുന്നവയിൽ ഏതാകാം?

a) കുന്നിൻ മുകളിൽ അന്തരീക്ഷംമർദ്ദം കുറവാണ് എന്നുള്ളതാകാം.

b) കുന്നിൻ മുകളിൽ ജ്വാലയുടെ ചൂട് കൂടുതലാണ്. എന്നുള്ളതാകാം.

c) കുന്നിൻ മുകളിൽ തണുപ്പ് കുറവാണ് എന്നുള്ളതാകാം.

'ശരിയായ ഉത്തരം a) ആണ്.

1. മാങ്ങ ഞെട്ടറ്റാൽ ഭൂമിയിൽ പതിക്കുന്നു. ഇവിടുത്തെ പ്രശ്നം?

a) മാങ്ങയെ ഒരു ബലം ഭൂമിയിലേക്കു വലിക്കുന്നുണ്ടോ എന്നതാണ്.

b) മാങ്ങയിൽ ഒരു ബലം മുകളിൽനിന്ന് പ്രയോഗിക്കപ്പെടുനന്നുണ്ടോ എന്നതാണ്.

c) മാങ്ങയ്ക്കു മുകളിലേക്കു പോകുവാൻ സ്ഥലമുണ്ടോ എന്നതാണ്.

2. ഒരേ വലിപ്പമുള്ള രണ്ടു ആണികൾ ഒരു ഡ്രോയിംഗ് ബോർഡിൽ ഒന്നിന്റെ മുനമേല്പോട്ടും മറ്റേതിന്റെ മുന താഴേട്ടുമായി കുത്തനെ പിടിക്കുക. ഒരു പലകക്കഷണം ഉപയോഗിച്ച് രണ്ടു ആണികളും ഒന്നിച്ച് അമർത്തുക. താഴോട്ടു മുനയായിട്ടുള്ള ആണി പെട്ടെന്ന് ഡ്രോയിംഗ് ബോർഡിൽ തുളച്ചു കയറുന്നു. ഇവിടുത്തെ പ്രശ്നം?

a) പരന്ന അഗ്രത്തെ അപേക്ഷിച്ച് മുനയ്ക്ക് വിസ്താരം കുറവായതിനാലാണോ എന്നുള്ളതാണ്.

b) ആണികൾ വ്യത്യസ്തമായ ലോഹങ്ങൾ കൊണ്ടുള്ളതാണോ എന്നുള്ളതാണ്.

c) ആണികൾ ബോർഡിന്റെ രണ്ടു വ്യത്യസ്തസ്ഥലങ്ങളിൽ അടിച്ചുകയറ്റപ്പെടുന്നതു കൊണ്ടാണോ എന്നുള്ളതാണ്.

3. ഒരു ബക്കറ്റ് വെള്ളത്തിൽ ഒരു കോർക്ക് താഴ്ത്തിപപ്പിടിച്ചിട്ട് വിടുക. കോർക്ക് ജലനിരപ്പിലേക്ക് തെറിച്ചുപൊങ്ങിവരുന്നു. ഇവിടുത്തെ പ്രശ്നം?

a) വെള്ളം അതിൽ മുങ്ങിക്കിടക്കുന്ന കോർക്കിൽ മുകളിലേക്ക് ഒരു തള്ളൽ ബലം പ്രയോഗിക്കുന്നുണ്ടോ എനന്നതാണ്.

b) വെള്ളത്തിൽ മുങ്ങിയിരിക്കുന്ന കോർക്കിൽ ഭൂമി ഒരി ബലം താഴേയ്ക്ക് പ്രയോഗിക്കുന്നുണ്ടോ എന്നതാണ്.

a) കോർക്കിന്മേൽ മുകളിൽ നിന്ന് പ്രയോഗിക്കപ്പെടുന്ന ബലത്തിന്റെ പ്രതിപ്രവർത്തനം കൊണ്ടാണോ എന്നതാണ്.

4. വലിയ കോൺക്രീറ്റു കെട്ടിടങ്ങൾ പണിയുമ്പോൾ സ്ലാബുകൾക്കിടയ്ക്ക് അല്പം സ്ഥലം വിടാറുണ്ട്. ഇവിടുത്തെ പ്രശ്നം?

a) സ്ലാബുകൾക്ക് എല്ലാ കാലവും ഒരുപോലെ സ്ഥിതി ചെയ്യുവാൻ കഴിയുമോ എന്നതാണ്.

b) വേനൽകക്കാലത്ത് സ്ലാബുകൾ ചീടുപിടിച്ച് വികസികക്കുന്നുണ്ടോ എന്നതാണ്.

c) സ്ലാബുകൾക്കിടയിൽ വായു സഞ്ചാരത്തിനുവേണ്ടിയാണോ എന്നതാണ്.

5. ഈർപ്പമുള്ള വായുവിൽ ഇരുമ്പുപാത്രങ്ങൾ വെച്ചിരുന്നാൽ തുരുമ്പ് പിടിക്കുന്നു ഇവിടുത്തെ പ്രശ്നം.

a) ഇരുമ്പുപാത്രങ്ങൾക്ക് ഈർപ്പമുള്ള വായുവുമായി പ്രവർത്തനമുണ്ടോ എന്നതാണ്.

b) ഇരുമ്പുപാത്രം ഈരർപ്പത്തെ ആഗിരണം ചെയ്യുന്നുണ്ടോ എന്നതാണ്.

c) ഇരുമ്പുപാത്രങ്ങളിൽ പൊടിപടലങ്ങൾ അടിഞ്ഞുകൂടുന്നുണ്ടോ എന്നുള്ളതാണ്.

6. പരൽ രൂപത്തിലുള്ള കറിയുപ്പ് വൈദ്യുതി വഹിക്കുന്നില്ല. ഉരുകിയ രൂപത്തിലുള്ള കറിയുപ്പ് വൈദ്യുതി വഹികക്കുന്നു. ഇവിടുത്തെ പ്രശ്നം.?

a) പരൽ രൂപത്തിലുള്ള കറിയുപ്പ് സാധാരണ ഊഷ്മാവിലും ഉരുകിയ കറിയുപ്പ് ഉയർന്ന ഊഷ്മാവിലും സ്ഥിതിചെയ്യുന്നതുകൊണ്ടാണോ എന്നതാണ്.?

b) പരൽ രൂപത്തിലുള്ള കറിയുപ്പ് സുസ്ഥിരാവസ്ഥയിലും ഉരുകിയ കറിയുപ്പ് അസ്ഥിരാവസ്ഥയിലും സ്ഥിതിചെയ്യുന്നതുകൊണ്ടാണോ എന്നതാണ്.

c) പരൽ രൂപത്തിലുള്ള കറിയുപ്പ് തന്മാത്രാരൂപത്തിലും ഉരുകിയ കറിയുപ്പ് അയോണുകളുമായി സ്ഥിതിചെയ്യുന്നതുകൊണ്ടാണോ എന്നതാണ്.

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7. കള്ളിച്ചെടിയുടെ ഇലകൾ ശൽക്കങ്ങളായി രൂപാന്തരപ്പെട്ടിരിക്കുന്നു. ഇവിടുത്തെ പ്രശ്നം.?

a) സ്വേദനം കൊണ്ടുള്ള ജലനഷ്ടം കുറയ്ക്കുനന്നതിന് വേണ്ടിയാണോ എന്നതാണ്.

b) ഉപദ്രവകാരികളായ ജന്തുക്കളിൽ നിന്ന് രക്ഷനേടുന്നതിനുവേണ്ടിയാണോ എന്നതാണ്.

c) ചെറുപ്രാണികളെ പിടിച്ചുതിന്നുന്നതിനുവേണ്ടിയാണോ എന്നതാണ്.

8. ഒരു ആറ്റത്തിൽ വൈദ്യുതി ചാർജ്ജുള്ള കണികകൾ ഉണ്ടെങ്കിലും ആറ്റം സാധാരണ വൈദ്യുതിപരമായി നിർവീര്യമാണ്. ഇവിടുത്തെ പ്രശ്നം.?

a) ഒരാറ്റതത്തിന് ഉരുകിയ അവസ്ഥയിൽ മാത്രമേ വൈദ്യുതി കടത്തിവിടാൻ കഴിയുകയുള്ളോ എന്നതാണ്.

b) ആറ്റത്തിൽ അടങ്ങിയിരിക്കുന്ന പോസറ്റീവ് നെഗറ്റീവ് ചാർജ്ജിന്റെയും അളവു തുല്യമാണോ എന്നതാണ്.

c) ഒരാറ്റത്തിന് ഉയർന്ന ഊഷ്മാവിലും മർദ്ദത്തിലും മാത്രമേ വൈദ്യുതി കടത്തിവിടാൻ കഴിവുള്ളോ എന്നതാണ്.

9. ഫോട്ടോഗ്രാഫിക് പ്ലേറ്റുകളും ഫിലിമുകളും പ്രകാശം കടക്കാത്ത വിധത്തിൽ കറുത്ത കടലാസുകൊണ്ട് പൊതിഞ്ഞോ, കറുത്ത പെട്ടിക്കുള്ളിലോ ആണ് സൂക്ഷിക്കുന്നത്. ഫിലിം കഴുകുന്നതിന് പ്രകാശം കടക്കാത്ത മുറിയാണ് ഉപയോഗിക്കിന്നത്. ഇവിടുത്തെ പ്രശ്നം?

a) ഫോട്ടോഗ്രാഫിക് ഫിലിമുകൾക്കും പ്ലേറ്റുകൾക്കും പ്രകാശ രശ്മികളുമായി രാസപ്രവർത്തനം ഉണ്ടോ എന്നതാണ്.

b) ഫോട്ടോഗ്രാഫിക് ഫിലിമുകളും പ്ലേറ്റുകളും പ്രകാശം തട്ടി ചീത്തയാകുമോ എന്നതാണ്

c) ഊഷ്മാവു വർദ്ധിച്ച് ഫിലിമുകളും പ്ലേറ്റുകളും ചീത്തയാകുമോ എന്നതാണ്.

10. ആടിന്റെ ബ്ലാഡർ (മൂത്രസഞ്ചി) നല്ലവണ്ണം കഴുകി അതിൽ പഞ്ചസാര ലായനി നിറക്കുക. ബ്ലാഡിന്റെ വായ നല്ലവണ്ണം കെട്ടി ഒരു പാത്രം വെള്ളത്തിൽ വെക്കുക. ബ്ലാഡർ വികസിക്കുന്നു. ഇവിടുത്തെ പ്രശ്നം?

a) ജലം ബ്ലാഡറിന്റെ ഉള്ളിലേക്ക് പ്രവഹിക്കുന്നുണ്ടോ എന്നതാണ്.

b) ബ്ലാഡറിനു വെളിയിലെ ജലത്തിന്റെ ഊഷ്മാവു സ്വീകരിച്ച് ബ്ലാഡറിനുള്ളിലെ ലായനി വികസിക്കുന്നുണ്ടോ എന്നതാണ്.

c) ബ്ലാഡറിനകത്ത് വാതകം ഉല്പാദിക്കപ്പെടുന്നുണ്ടോ എന്നതാണ്.

11. വിമാനയാത്രക്കരോട് വിമാനത്തിൽ കയറും മുൻപ് ഫൗണ്ടൻപേനയിലുള്ള മഷി ഒഴിവാക്കാൻ ആവശ്യപ്പെടാറുണ്ട്. ഇതിന്റെ കാരണം എന്താകാം.?

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a) വിമാനം വളരെ ഉയരത്തിൽ പറക്കുമ്പോൾ വിമാനത്തിനുള്ളിലെ വായു മർദ്ദം കൃത്രിമമായി ക്രമീകരിക്കുന്നതുകൊണ്ടാവാം.

b) വിമാനം വളരെ ഉയരത്തിൽപറക്കുമ്പോൾ അന്തരീക്ഷമർദ്ദം തീരെ കുറവായതിനൽ പേനയിലെ മഷി എളുപ്പത്തിൽ ചോർന്നുപോകും എന്നുള്ളതുകൊണ്ടാവാം.

c) വിമാനത്തന്റെ അമിതമായ ഗതിവേഗംകൊണ്ട് പേനയിൽ നിന്ന് മഷി എളുപ്പത്തിൽ ചോർന്നുപോകും എന്നതുകൊണ്ടാവാം.

12. പല രാസവസ്തുക്കളും തവിട്ടുനിറമുള്ള കുപ്പികളിൽ സൂക്ഷിക്കുന്നതിനു കാരണം എന്താകാം?

a) രാസവസ്തുക്കൾ പ്രകാശവുമായി പ്രവർത്തിച്ച് വിഘടിക്കും എന്നതുകൊണ്ടാകാം

b) രാസവസ്തുക്കളുടെ നിറം മങ്ങിപ്പോകും എന്നതുകൊണ്ടാകാം.

c) രാസവസ്തുക്കൾ പ്രകാശം പുറപ്പെടുവിച്ചുകൊണ്ട് വിഘടിക്കപ്പെടും എന്നതുകൊണ്ടാകാം)

13. ഫലങ്ങൾ പാകമാവുമ്പോൾ ചുവപ്പുനിറമോ ഓറഞ്ചുനിറമോ ആകുന്നു ഇതിന്റെ കാരണം എന്താകാം.?

a) ഫലങ്ങൾ പാകമാവുമ്പോൾ അവയിലെ ഹരിതകണങ്ങൾ വർണ്ണ കണങ്ങളായി മാറുന്നു എന്നതുകൊണ്ടാകാം

b) ഫലങ്ങൾ പാകമാവുമ്പോൾ അവയിലെ കോശഫേനങ്ങളിൽ ലവണങ്ങൾ ലയിച്ചു ചേരുന്നു എന്നതുകൊണ്ടാകാം

c) പക്ഷിമൃഗാദികളെ ആകർഷിക്കുന്നു എന്നതുകൊണ്ടാകാം

14. മനുഷ്യർക്ക് കിടന്നുകൊണ്ട് ആഹാരം കഴിക്കാൻ സാധിക്കുന്നു ഇത് എന്തു കാരണംകൊണ്ടാണ്.

a) അന്നനാളത്തിലെ പേശികൾ തരംഗരൂപത്തിൽ ചലിക്കുന്നു എന്നതുകൊണ്ടാകാം

b) അന്നനാളത്തിലെ പേശികളുടെ തരംഗരൂപത്തിലുള്ള സങ്കോചം ആഹാരത്തെ ആമാശയത്തിൽ എത്തിക്കുന്നു എന്നതുകൊണ്ടാകാം

c) ഉമിനീരിലെ രാസാഗ്നി ആഹാരത്തെ കുഴമ്പുരൂപത്തിലാക്കി ആമാശയത്തിൽ എത്തിക്കുന്നതുകൊണ്ടാവാം.

15. ഇലകൾ പച്ചനിറത്തിൽ കാണപ്പെടുന്നു. ഇതിന്റെ കാരണം എന്തായിരിക്കാം.?

a) സൂര്യപ്രകാശത്തിലെ വർണ്ണരാജികളിലെ ഘടകനിറങ്ങളായ വയലറ്റ്, നീലം, ചുവപ്പ്, എന്നീ നിറങ്ങളെ ഇലകൾ ആഗിരണം ചെയ്യുകയും പച്ച പ്രകാശത്തെ തിരികെ പ്രതിഫലിപ്പിക്കുകയും ചെയ്യുന്നതുകൊണ്ടായിരിക്കാം.

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b) സൂര്യപ്രകാശത്തിലെ വർണ്ണരാജികളിലെ ഘടകനിറമായ പച്ചപ്രകാശത്തിൽ പ്രകാശസംശ്ലേഷണനിരക്ക് പർദ്ധിച്ച തോതിൽ നടക്കുന്നതുകൊണ്ടായിരികക്കാം.

c) സൂര്യപ്രകാശത്തിലെ ഘടകനിറങ്ങളായ നീല, ചുവപ്പ്, വയലറ്റ് എന്നീ നിറങ്ങളെ ഹരിതകം ഒന്നിച്ചു പ്രതിഫലിപ്പിക്കുന്നതുകൊണ്ടായിരിക്കാം.

16. അക്വേറിയങ്ങളിൽ വായുകുമിളകൾ കടത്തിവിടുന്നു. ഇതിന്റെ കാരണം എന്തായിരിക്കാം.?

a) അക്വേറിയത്തിലെ ജലത്തിലുള്ള മാലിന്യങ്ങൾ നീക്കം ചെയ്യുന്നതിനുവേണ്ടിയായിരിക്കാം.

b) അക്വേറിയത്തിന്റെ ഭംഗി വർദ്ധിപ്പിക്കുന്നതിനുവേണ്ടിയായിരിക്കാം.

c) അക്വേറിയത്തിലെ ജലത്തിൽ വായുസഞ്ചാരം വർദ്ധിപ്പിക്കുന്നതിനുവേണ്ടിയായിരിക്കാം.

17. മണ്ണിരയെ കുറച്ചുനേരം സൂര്യപ്രകാശത്തിലിട്ടാൽ ചത്തുപോകുന്നു ഇതിന്റെ കാരണം എന്തായിരിക്കാം.?

a) മണ്ണിര ഈർപ്പമുള്ള ത്വക്ക് വഴിയാണ് ശ്വസനം നടത്തുന്നത് എന്നതുകൊണ്ടായിരിക്കാം.

b) മണ്ണിരയുടെ ത്വക്കിൽ അനേകം രക്തവാഹിനികൾ ഉള്ളതുകൊണ്ടായിരിക്കാം.

c) മണ്ണിരയുടെ ത്വക്കിലുള്ള അനേകം സൂക്ഷ്മ സുഷിരങ്ങളിലൂടെയാണ് ഓക്സിൻ വാതകം ഉള്ളിലുള്ള ശ്വാസനാളികളിലെത്തുന്നത് എന്നതുകൊണ്ടായിരിക്കാം.

18. മൂർച്ചയുള്ള കോടാലികൊണ്ട് മരം മുറിക്കാൻ പ്രയാസമാണ്. ഇത് എന്തുകൊണ്ടായിരിക്കാം.?

a) മൂർച്ചയില്ലാത്ത കോടാലിയുടെ വായ്ത്തല പരന്നിരിക്കുന്നതുകൊണ്ട് മരത്തിൽ പ്രയോഗിക്കപ്പെടുന്ന ബലം (മർദ്ദം) കുറവായതിനാൽ ആയിരിക്കാം.

b) മൂർച്ചയില്ലാത്ത കോടാലിയുടെ വിസ്താരമുള്ള വായ്ത്തല കൊണ്ട് മരത്തിൽ പ്രയോഗിക്കുന്ന മർദ്ദം കൂടുതലായതിനാൽ ആയിരിക്കാം.

b) മൂർച്ചയില്ലാത്ത കോടാലിയുടെ വിസ്താരമുള്ള വായ്ത്തല മരത്തിൽ തട്ടി കൂടുതൽ വിസ്താരമുള്ളതാകുന്നതിനാൽ ആയിരിക്കാം.

19. ഇടിമിന്നൽ ഉണ്ടാകുമ്പോൾ പൊക്കമുള്ള മരങ്ങളുടെ താഴെ നില്ക്കരുത് ഇത് എന്തുകൊണ്ടായിരിക്കാം.?

a) മിന്നലിന്റെ ആഘാതത്തിൽ പൊക്കമുള്ള മരങ്ങൾ എളുപ്പം വിധേയമാകുന്നതിനാൽ ആയിരിക്കാം.

b) മിന്നലേറ്റ് വലിയ മരങ്ങളുടെ ചില്ലകൾ മുറിഞ്ഞുവീഴുന്നതിനാലായിരിക്കാം.

c) ഇടിമിന്നൽ ഉണ്ടാവുമ്പോൾ മരച്ചുവട്ടിലെ മാളങ്ങൽ പാർക്കുന്ന വിഷപ്പാമ്പുകൾ വെളിയിലേക്കുവരും അതിനാലായിരിക്കാം.

20. വെള്ളത്തൽ തുള്ളിതുള്ളിയായി ഗാഢ സൾഫ്യൂറിക് ആസിഡ് കലർത്തി ഇളക്കിയാണ് സൾഫ്യൂറിക് നേർപ്പിക്കുന്നത് ഇത് എന്തുകൊണ്ടായിരിക്കാം.?

a)ജലം സൾഫ്യൂറിക് ആസിഡിൽ ഒഴിച്ചാൽ അത്യധികമായി താപം ഉണ്ടായി നാലുപാടും തെറിക്കാനിടയാകുന്നതുകൊണ്ടായിരിക്കാം.

b) ജലം സൾഫ്യൂറിക് ആസിഡിൽ ചേർക്കുമ്പോൾ സൾഫ്യൂറിക് ആസിഡുമായി പ്രവർത്തിച്ച് വിഘടിക്കപ്പെടുന്നതു കൊണ്ടായിരിക്കാം.

c) സാന്ദ്രത കൂടിയതിനാൽ സൾഫ്യൂറിക് ആസിഡിലേക്ക് വെള്ളം ഒഴിച്ചാൽ ഇവ രണ്ടും കൂടിക്കലരാതെ വേറിട്ടു നിൽക്കുന്നതുകൊണ്ടായിരിക്കാം.

21. രണ്ടു ജാറുകളിൽ ഒന്നിൽ CO_2 ഉം ഒന്നിൽ O_2 ഉം നിറച്ചിരിക്കുന്നു. ഇവ തമ്മിൽ തിരിച്ചറിയുന്നതിന് ഉചിതമായ പരിശോധന ഏത്?

a) മെഴുകുതിരി കത്തിച്ച് ജാറുകളിൽ ഇറക്കുക. CO_2 നിറച്ച ജാറിലെ തിരി അണഞ്ഞു പോകുകയും O_2 ജാറിലെ തിരി കത്തിക്കൊണ്ടിരികക്കുകയും ചെയ്യുന്നു.

b) മെഴുകുതിരി കത്തിച്ച് ജാറുകളിൽ ഇറക്കുക. CO_2 നിറച്ച ജാറിലെ തിരികത്തിക്കൊണ്ടിരിക്കും. O_2 നിറച്ച ജാറിലെ തിരികെട്ടുപോകുകയും ചെയ്യുന്നു.

c) മെഴുകുതിരി കത്തിച്ച് ജാറുകളിൽ ഇറക്കുക. CO_2 നിറച്ച ജാറിലെ തിരി വെളുത്തപുകയോടുകൂടി കത്തുകയും ചെയ്യുന്നു.

22. ലോഹങ്ങളുടെ താപചാലകത വ്യത്യസ്തമാണ്. ഇത് തെളിയിക്കാൽ അനുയോജ്യമായ പരീക്ഷണം എത്?

a) ഒരേ പോലെയുള്ള ഇരുമ്പുദണ്ഡും ചെമ്പുദണ്ഡും ഒരേ ഊഷ്മാവിൽ ചൂടാക്കുക. ഫലം നിരീക്ഷിക്കുക.

b) ഒരു ഇരുമ്പുദണ്ഡും ഒരു ചെമ്പുദണ്ഡും എടുത്തു ചൂടാക്കുക. ഫലം നിരീക്ഷിക്കുക.

c) ഒരേ പോലെയുള്ള ഇരുമ്പുദണ്ഡും ചെമ്പുദണ്ഡും വ്യത്യസ്ത ഊഷ്മാവിൽ ചൂടാക്കുക. ഫലം നിരീക്ഷിക്കുക.

23. തന്നിരിക്കുന്ന മൂന്ന് തരം മണ്ണുകളിൽ അതായത് കളിമണ്ണ്, കരിമണൽ, പൂഴിമണ്ണ് ഇവയിൽ പയർചെടി ഏറ്റവും നന്നായി വിളവു തരുന്നത് ഏതിലാണെന്നു തെളിയിക്കാൻ ഉചിതമായ പരിശോധന ഏത്?

a) ഒരേപോലെയുള്ള മൂന്നു ചട്ടികൾ എടുക്കുക, ഒന്നിൽ കളിമണ്ണ്, രണ്ടാമത്തേതിൽ കരിമണൽ, മൂന്നാമത്തേതിൽ പൂഴിമണ്ണ് നിറക്കുക. മൂന്നിലും ഒരേ അളവിൽ പയർ നടുക. ഒരേ സ്ഥലത്തു വയ്ക്കുക. മൂന്നിലും ഒരേ അളവിൽ ജലം നൽകുക. വിളവ് പരിശോധിക്കുക.

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b) മൂന്നുചെടിച്ചട്ടികൾ എടുക്കുക. വ്യത്യസ്ത അളവിൽ കളിമണ്ണ് കരിമണൽ, പൂഴിണ്ണ്, എടുക്കുക. മൂന്നിലും ഒരേ അളവിൽ പയറു നടുക. ഒരേ സ്ഥലത്തു വയ്ക്കുക. ഒരേ അളവിൽ ജലം നൽകുക. വിളവ് പരിശോധിക്കുക.

c) മൂന്നുചെടിച്ചട്ടികൾ എടുക്കുക. മൂന്നിലും ഒരേ അളവിൽ കരിമണൽ, പൂഴിണ്ണ്, കളിമണ്ണ് എടുക്കുക. ഓരോന്നിലും വ്യത്യസ്ത അളവിൽ പയറു നടുക. ഒരേ സ്ഥലത്തു വയ്ക്കുക. ഒരേ അളവിൽ ജലം നൽകുക. വിളവ് പരിശോധിക്കുക.

24. ക്ലോറിന്റെ ബ്ലീച്ചിംങ്ങിന് ഈർപ്പം ആവശ്യമാണ്. ഇതു തെളിയിക്കുന്നതിന് അനുയോജ്യമായ പരിശോധന ഏത്?

a) രണ്ടു ജാറുകളിൽ ഈർപ്പമില്ലാത്ത ക്ലോറിൻ വാതകം ശേഖരിക്കുക. കുറച്ചു ലിറ്റമസ് പേപ്പർ നിറമുള്ള പൂവ് ഇലകൾ ചായം മുക്കിയ തുണി മഷി കൊണ്ടെഴുതിയ പേപ്പർ ഇവ രണ്ടു ഭാഗങ്ങളായി തിരിക്കുക. ഒരു ഭാഗം നല്ലവണ്ണം നനച്ച ശേഷം ഒന്നാമത്തെ ജാറിലിടുക. രണ്ടാമത്തെ ഭാഗം രണ്ടാമത്തെ ജാറിൽ ഇടുക. ബ്ലീച്ചിംഗ് പ്രവർത്തനം നിരീക്ഷിക്കുക.

b) രണ്ടു ജാറുകളിൽ ഈർപ്പമുള്ള ക്ലോറിൻ വാതകം ശേഖരിക്കുക. കുറച്ചു ലിറ്റമസ് പേപ്പർ നിറമുള്ള പൂവ് ഇലകൾ ചായം മുക്കിയ തുണി മഷി കൊണ്ടെഴുതിയ പേപ്പർ ഇവ രണ്ടു ഭാഗങ്ങളായി തിരിക്കുക. ഒരു ഭാഗം നല്ലവണ്ണം നനച്ചെടുക്കുക. അതിനുശേഷം ജാറുകളിലാക്കി ബ്ലീച്ചിംഗ് പ്രവർത്തനം നിരീക്ഷിക്കുക.

c) രണ്ടു ജാറുകളിൽ ഈർപ്പമുള്ള ക്ലോറിൻ വാതകം ശേഖരിക്കുക. കുറച്ചു ലിറ്റമസ് പേപ്പർ നിറമുള്ള പൂവ് ഇലകൾ ചായം മുക്കിയ തുണി മഷി കൊണ്ടെഴുതിയ പേപ്പർ ഇവ രണ്ടു ഭാഗങ്ങളായി നല്ലവണ്ണം നനച്ചശേഷം ജാറുകളിലാക്കി ബ്ലീച്ചിംഗ് പ്രവർത്തനം നിരീക്ഷിക്കുക.

25. കെട്ടിക്കിടക്കുന്ന വെള്ളത്തിൽ മണ്ണെണ്ണ ഒഴിക്കുന്നത് കൊതുക് വളരുന്നത് തടയാൻ സഹായകമാണ്. ഇത് തെളിയിക്കാൻ നിങ്ങൾക്കു ചെയ്യാവുന്ന ഉചിതമായി പരിശോധന ഏത്?

a) രണ്ടു പാത്രത്തിൽ ജലം എടുത്തിട്ട് രണ്ടിലും മണ്ണെണ്ണ ഒഴിച്ചശേഷം കൊതുക് വളരാൻ അനുവദിക്കുക.

b) രണ്ടു പാത്രത്തിൽ ജലം എടുത്തിട്ട് ഒന്നിൽ മണ്ണെണ്ണ ഒഴിച്ചശേഷം ഒന്നിൽ മണ്ണെണ്ണ ഒഴിക്കാതെയും രണ്ടിലും കൊതുക് വളരാൻ അനുവദിക്കുക.

c) രണ്ടു പാത്രത്തിൽ ജലം എടുത്തിട്ട് രണ്ടിലും മണ്ണെണ്ണ ഒഴിക്കാതെ കൊതുക് വളരാൻ അനുവദിക്കുക.

26. ദ്രാവകത്തിന്റെ പ്രതലവസ്തീർണ്ണം വർദ്ധിക്കുമ്പോൾ ബാഷ്പീകരണനിരക്ക് വർദ്ധിക്കുന്നു. ഇതു തെളിയിക്കാൻ അനുയോജ്യമായ പരീക്ഷണം ഏത്?

a) ഒരേ വലിപ്പത്തിലും രണ്ടു പദാർത്ഥങ്ങൾ കൊണ്ടുണ്ടാക്കിയതുമായ രണ്ടു ഹാൻഡ്കർച്ചീഫുകൾ എടുത്തു വെള്ളത്തിൽ മുക്കുക. ഒരു ഹാൻഡ്കർച്ചീഫ് മേശപ്പുറത്ത് വെയ്ക്കുക. ബാഷ്പീകരണ വേഗത താരതമ്യപ്പെടുത്തുക.

b) ഒരേ വലിപ്പത്തിലും രണ്ടു പദാർത്ഥങ്ങൾ കൊണ്ടുണ്ടാക്കിയതുമായ രണ്ടു ഹാൻഡ്കർച്ചീഫുകൾ എടുത്തു വെള്ളത്തിൽ മുക്കിയെടുക്കുക. ഒരു ഹാൻഡ്കർച്ചീഫ് മേശപ്പുറത്ത് നിവർത്തി വിരക്കുക. ഒരു ഹാൻഡ്കർച്ചീഫ് പന്തു പോലെ ഉരുട്ടുക. അതും മേശപ്പുറത്ത്വെയ്ക്കുക. ബാഷ്പീകരണ വേഗത താരതമ്യപ്പെടുത്തുക.

c) വാവട്ടമുള്ള രണ്ടു പാത്രങ്ങൾ എടുക്കുക. രണ്ടിലും ജലം നിറയ്ക്കുക. രണ്ടും സൂര്യപ്രകാശത്തിൽ വയ്ക്കുക. ബാഷ്പീകരണവേഗത താരതമ്യപ്പെടുത്തുക.

27. ഏതൊരു പ്രവർത്തനത്തിലും തുല്യവും വിപരീതവുമായ ഒരു പ്രതിപ്രവർത്തനം ഉണ്ട്. ഈ തത്വം തെളിയിക്കുനന്നതിന് താഴെ തന്നിരിക്കുന്നവയിൽ അനുയോജ്യമായ പരിശോധന ഏത്?

a) തുല്യമായ രണ്ട് സ്പ്രിംഗ് ത്രാസ്സുകൾ എടുത്ത് അവയുടെ കൊളുത്തുകൾ തമ്മിൽ പരസ്പരം കൊളുത്തുക. ഒരു ത്രാസ്സിനെ എവിടെയെങ്കിലും ഉറപ്പിച്ചു കൊണ്ട് മറ്റേ ത്രാസ്സിനെ വലിക്കുക. രണ്ടു ത്രാസ്സുകളിലെയും അളവു തുല്യമായിരിക്കും.

b) കുറെ നാണയങ്ങൾ ഒന്നിനുമീതെ ഒന്നായി അടുക്കി വെയ്ക്കുക. ഒരു കത്തി കൊണ്ട് ഏറ്റവും അടിയിലത്തെ നാണയത്തെമാത്രം തട്ടിതെറിപ്പിക്കുക. ഏറ്റവും അടിയിലെത്തെ നാണയംതെറിച്ചുപോകുകയും ബാക്കിയുള്ളവ അതേ അടുക്കോടുകൂടിത്തന്നേ ഇരിക്കുകയും ചെയ്യുന്നു.

c) നിരപ്പായ തറയിലൂടെ ഒരു പന്തിനെ തട്ടിവിടുക. പന്ത് കുറേ ദൂരം പോയതിനു ശേഷം നിൽക്കുന്നു.

28. മണ്ണു കരിമ്പുകൃഷിക്കു പറ്റിയതാണോ എന്നു പരിശോധിക്കുന്നതിനുള്ള പരിശോധന ഏത്?

a) മണ്ണിന്റെ സാമ്പിൾ എടുത്തു ജലതത്തിൽ കലക്കി p^H പേപ്പർ മുക്കി നോക്കുക. ലായനിയുടെ p^H മൂല്യം 7 ആണെങ്കിൽ കരിമ്പുകൃഷിക്കുപറ്റിയതാണ്.

b) മണ്ണിന്റെ സാമ്പിൾ എടുത്തു ജലത്തിൽ കലക്കി നീല ലിറ്റ്മസ് പേപ്പർ മുക്കി നോക്കുക. ചുവപ്പാകുന്നെങ്കിൽ മണ്ണ് അമ്ലസ്വഭാവമള്ളതാണ്. കരിമ്പുകൃഷിക്കുപറ്റിയതാണ്.

c) മണ്ണിന്റെ സാമ്പിൾ എടുത്തു ജലത്തിൽ കലക്കി നീല ലിറ്റ്മസ് പേപ്പർ മുക്കി നോക്കുക. നീലയാകുന്നെങ്കിൽ മണ്ണ് ക്ഷാരസ്വാഭാവമുള്ളതാണ്. കരിമ്പുകൃഷിക്കു പറ്റിയതാണ്.

29. മൂത്രത്തിൽ പഞ്ചസാരയുടെ അംശം ഉണ്ടോ എന്നു കണ്ടുപിടിക്കാൻ ഉചിതമായ പരിശോധന ഏത്?

a) അല്പം മൂത്രം ഒരു ഗ്ലാസ്സിൽ എടുത്ത് അയഡിൻ ലായനി ചേർക്കുക. നീല നിറമാകുന്നു.

b) അല്പം മൂത്രം ഒരു ഗ്ലാസ്സിൽ എടുത്ത് നൈട്രിക് ആസിഡ് ഒഴിച്ചുനോക്കുക. മഞ്ഞ നിറമാകുന്നു.

c) അല്പം മൂത്രം ഒരു ഗ്ലാസ്സിൽ എടുത്ത് അല്പം ബെൻസിൻ ഒഴിച്ചുനോക്കുക. മഞ്ഞ നിറമാകുന്നു.

30. മൂന്നു കുപ്പികളിൽ വ്യത്യസ്തമായ ആസിഡുകൾ നൽകിയിരിക്കുന്നു. അതിൽനിന്ന് സൾഫ്യൂറിക് ആസിഡ് കണ്ടുപിടിക്കുന്നതിന് അനുയോജ്യമായ പരീക്ഷണം ഏത്?

a) നൽകപ്പെട്ട ആസിഡുകൾ വ്യത്യസ്തമായ മൂന്നുടെസ്റ്റ്ട്യൂബുകളിൽ എടുക്കുക. മൂന്നിലും തുല്യ അളവിൽ ഫെറസ് സൽഫേറ്റ് ലായനി ചേർക്കുക. ടെസ്റ്റ് ട്യൂബു കൾ അല്പം ചരിച്ചുപിടിച്ച് വശങ്ങളിൽക്കൂടി ഗാഢസൾഫ്യൂരിക് ആസിഡ് ചേർക്കുക. രണ്ടു ദ്രാവകങ്ങളുടെയും സംയോജനസ്ഥാനത്ത് തവിട്ടു നിറമുള്ള ഒരു വലയം കാണാൻ കഴിയുന്നു എങ്കിൽ അത് സൾഫ്യൂറിക് ആസിഡാണ്.

b) നൽകപ്പെട്ട ആസിഡുകൾ വ്യത്യസ്തമായ മൂന്നുടെസ്റ്റ്ട്യൂബുകളിൽ എടുക്കുക. മൂന്നിലും തുല്യ അളവിൽ ബേരിയം ക്ലോറൈഡ് ലായനി ചേർക്കുക. ഒരു വെളുത്ത അവക്ഷിപ്തം കിട്ടുന്നു എങ്കിൽ അത് സൾഫ്യൂറിക് ആസിഡാണ്..

c) നൽകപ്പെട്ട ആസിഡുകൾ വ്യത്യസ്തമായ മൂന്നുടെസ്റ്റ്ട്യൂബുകളിൽ എടുക്കുക. മൂന്നിലും തുല്യ അളവിൽ സിൽവർനൈട്രേറ്റ് ലായനി ചേർക്കുക. വെളുത്ത അവക്ഷിപ്തം കിട്ടുന്നു എങ്കിൽ അത് സൾഫ്യൂറിക് ആസിഡാണ്.

31. ഒരു ട്രഫിൽ പകുതിജലം നിറയ്ക്കുക. ഒരു സ്കെയിൽ അതിൽ പകുതി മുക്കി വെയ്ക്കുക. ജാലോപരിതലത്തിൽ വെച്ച് സ്കെയിൽ വളഞ്ഞതായി തോന്നുന്നു. ഇതിന് എറ്റവും ഉചിതമായ വിശദീകരണം ഏത്?

a) പ്രകാശത്തിനു അപവർത്തനം സംഭവിക്കുന്നതുകൊണ്ട്.

b) പ്രകാശത്തിനു പ്രകീർണ്ണനം സംഭവിക്കുന്നതുകൊണ്ട്.

c) പ്രകാശത്തിനു പ്രതിഫലനം സംഭവിക്കുന്നതുകൊണ്ട്.

32. ചക്രവാളം വൃത്താകാരമായി കാണപ്പെടുന്നു. ഇതിന് അനുയോജ്യമായ വിശദീക രണം ഏത്?

a) കണ്ണിലെ കൃഷ്ണമണി ഗോളാകൃതിയിലായതുകൊണ്ട്.

b) ഭൂമി ഉരുണ്ടായതുകൊണ്ട്.

c) ഭൂമി സ്വന്തം അച്ചുതണ്ടിൽ കറങ്ങിക്കൊണ്ടിരിക്കുന്നതുകൊണ്ടാണ്.

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33. ഓടിക്കൊണ്ടിരിക്കുന്ന ട്രെയിനിൽനിന്ന് പ്ലാറ്റുഫോമിലേയ്ക്കു ചാടുന്ന ഒരാൾ മുന്നോട്ടു തെറിച്ചുവീഴുന്നു. ഇതിന് അനുയോജ്യമായ വിശദീകരണം ഏത്?

a) അയാളുടെ ശരീരം ട്രെയിനിന്റെ വേഗതയിൽ മുന്നോട്ടു സഞ്ചരിക്കുകയും കാൽജഡത്വം പ്രാപിക്കുകയും ചെയ്യുന്നു.

b) ഗുരുത്വാകർഷണം അയാളുടെ ശരീരത്തിന് മേൽഭാഗത്തെ മുന്നോട്ടു പിടിച്ചു വലിക്കുന്നു.

c) അയാളുടെ ശരീരമാകെ ട്രെയിനിന്റെ വേഗതയിൽ മുന്നോട്ടു സഞ്ചരിക്കുന്നു.

34. റബ്ബറൈസ്ഡ് റോഡുകളിൽ സുരക്ഷിതമായി വളരെ വേഗത്തിൽ വാഹനങ്ങൾ ഓടിച്ചുപോകുവാൻ സാധിക്കുന്നു. ഇതിന് ഏറ്റവും ഉചിതമായ വിശദീകരണം ഏത്?

a) റബ്ബറൈസ്ഡ് റോഡുകൾക്ക് ഘർഷണം വളരെ കുറവാണ്.

b) റബ്ബറൈസ്ഡ് റോഡുകൾക്ക് ഘർഷണം വളരെ കൂടുതലാണ്.

c) റബ്ബറൈസ്ഡ് റോഡുകൾക്ക് വളരെ പെട്ടെന്ന് നാശം സംഭവിക്കുന്നില്ല.

35. ശുദ്ധജലത്തിൽ നീന്തുന്നതിനേക്കാൾ സമുദ്രജലത്തിൽ നീന്തുവാൻ എളുപ്പമാണ്. ഇതിന് ഏറ്റവും ഉചിതമായ വിശദീകരണം ഏത്?

a)സമുദ്രജലത്തിന് ശുദ്ധജലത്തിനേക്കാൾ സാന്ദ്രത കൂടുതലായതിനാൽ നീന്തൽക്കാർക്ക് ഭാരക്കുറവ് അനുഭവപ്പെടുന്നതുകൊണ്ട്.

b)സമുദ്രജലത്തിന് ശുദ്ധജലത്തിനേക്കാൾ സാന്ദ്രത കുറവായതിനാൽ നീന്തൽക്കാർക്ക് ഭാരക്കുറവ് അനുഭവപ്പെടുന്നതുകൊണ്ട്.

c)സമുദ്രജലത്തിന് ശുദ്ധജലത്തിനേക്കാൾ ഒട്ടൽ ബലം കുറവായതിനാൽ നീന്തൽക്കാർക്ക് ഭാരക്കുറവ് അനുഭവപ്പെടുന്നതുകൊണ്ട്.

36. ചെമ്മീനിന്റെ പുറം തോട് രാത്രിയിൽ തിളങ്ങിക്കാണുന്നു. ഇതിന് ഏറ്റവും ഉചിതമായ വിശദീകരണം ഏത്?

a)ചെമ്മീനിന്റെ പുറംതോടിന് സ്വയം പ്രകാശിക്കാൻ കഴിവുള്ളതിനാൽ

b)ചെമ്മീനിന്റെ പുറംതോടിൽ സ്വയം പ്രകാശം പരത്തുന്ന ബാക്ടീരിയ ഉള്ളതിനാൽ.

c)ചെമ്മീനിന്റെ പുറംതോടിന് ധാരാളം ഫോസ്ഫറസ് അടങ്ങിയിരിക്കുന്നതിനാൽ

37. എല്ലുകരി പഞ്ചസാരയുടെ നിറം കളയുന്നതിന് ഉപയോഗിക്കുന്നു ഇതിന് ഏറ്റവും ഉചിതമായ വിശദീകരണം ഏത്?

a) എല്ലുകരി പഞ്ചസാരയ്ക്കു നിറം നൽകുന്ന വസ്തുവിനെ ആഗിരണം ചെയ്യുന്നു.

b) എല്ലുകരി പഞ്ചസാരയ്ക്കു നിറം കൊടുക്കുന്ന വസ്തുവിനെ അവക്ഷിപ്തമാക്കി മറ്റുന്നു.

c) എല്ലുകരി പഞ്ചസാരയ്ക്കു നിറം കൊടുക്കുന്ന വസ്തുവിനെ ഓക്സീകരിക്കുന്നു.

38. തണുപ്പുകാലത്ത് പക്ഷികൾ തൂവൽ ഇടയ്ക്കിടെ കുടഞ്ഞു വിടർത്തുന്നു. ഇതിനു ഏറ്റവും ഉചിതമായ വിശദീകരണം എത്.

a) തൂവലുകൾക്കിടയിൽ വായുനിറയുകയും അത് ശരീരോഷ്മാവ് നഷ്ടപ്പെടുന്നതു തടയുകയും ചെയ്യുന്നു.

b) എണ്ണമയം തൂവലുകളിൽ വ്യാപിച്ച് ശരീരോഷ്മാവ് നഷ്ടപ്പെടുന്നതിനെ തടയുന്നു.

c) തൂവലുകൾക്കിടയിൽ തണുത്ത വായുനിറച്ച് ശരീരോഷ്മാവും അന്തരീക്ഷോഷ്മാവും തമ്മിൽ സന്തുലിതാവസ്ഥ നിലനിർത്തുന്നു.

39. തുറന്ന കലത്തിൽ ഭക്ഷണം പാകം ചെയ്യുമ്പോൾ കൂടുതൽ സമയം എടുക്കുന്നു. എന്നാൽ പ്രഷർ കുക്കറിൽ പാചകം ചെയ്യുമ്പോൾ സമയദൈർഘ്യം കുറയുന്നു. ഇതിന് ഏറ്റവും ഉചിതമായ വിശദീകരണം ഏത്?

a) തുറന്ന കലത്തിൽ നിന്ന് താപം നഷ്ടപ്പെട്ടുകൊണ്ടിരിക്കുന്നതിനാൽ ഭക്ഷണം പാകം ചെയ്യാൻ സമയം എടുക്കുന്നു.

b) പ്രഷർ കുക്കറിൽ ആവി മർദ്ദം വർദ്ധിപ്പിച്ച് ക്വഥനാങ്കത്തെ താഴ്ത്തുന്നതിനാൽ ഭക്ഷണസാധനങ്ങൾ വേഗം വേകുന്നു. തുറന്ന കലത്തിൽ അങ്ങനെ സംഭവിക്കുന്നില്ല.

c) പ്രഷർ കുക്കറിൽ ആവി മർദ്ദം വർദ്ധിപ്പിച്ച ക്വഥനാങ്കം വർദ്ധിപ്പിക്കുന്നതിനാൽ ഭക്ഷണസാധനങ്ങൾ വേഗം വേകുന്നു. തുറന്ന കലത്തിൽ അങ്ങനെ സംഭവിക്കുന്നില്ല.

40. പരീക്ഷണശാലയിൽ SO_2 ഈർപ്പരഹിതമാക്കാൻ ഗാഢസൾഫ്യൂറിക്ക് ആസിഡിൽ കൂടി കടത്തിവിടുന്നു. ഇതിന് ഏറ്റവും ഉചിതമായ വിശദീകരണം. ഏത്?

a) സൾഫ്യൂറിക്ക് ആസിഡ് ഈർപ്പത്തെ വിഘടിപ്പിച്ച് ഓക്സിജൻ ഗ്യാസും ഹൈഡ്രജൻ ഗ്യാസുമാക്കി മാറ്റുന്നു.

b) സൾഫ്യൂറിക്ക് ആസിഡ് നിർജ്ജലീകാരകമാണ്..

c) സൾഫ്യൂറിക്ക് ആസിഡ് SO_2 ഉള്ള ഈർപ്പത്തെ ബാഷ്പീകരിച്ച് പുറം തള്ളുന്നു.

41. നീരാവി തട്ടി ഉണ്ടാകുന്ന പൊള്ളൽ തിളച്ച വെള്ളം വീണുണ്ടാകുന്ന പൊള്ളലിനേക്കാൾ ഗുരുതരമാണ്. ഇതിൽ നിന്നും അനുമാനിക്കാവുന്നത്.

a) നീരാവി ഒരു വസ്തുവിൽ തട്ടി സാന്ദ്രീകരിച്ച് ജലമായി മാറുമ്പോൾ അത്രയും താപം ആ വസതുവിൽ ഏൽപ്പിക്കുന്നു.

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b) നീരാവിയാൽ ജലതന്മാത്രകൾ ഉയർന്ന മർദ്ദത്തിൽ സ്ഥിതിചെയ്യുന്നതിനാൽ അത്രയും താപം വസ്തുവിൽ ഏൽപ്പിക്കുന്നു.

c) നീരാവിയാൽ ജലതന്മാത്രകൾ തമ്മിൽ അഡ്ഹിഷൻ ബലമുള്ളതിനാൽ സാധാരണ ജലത്തിനേകക്കാൾ കൂടുതലായി പൊള്ളൽ ഏല്പ്പിക്കുന്നു.

42. മഴത്തുള്ളികൾ ഗോളാകൃതി പ്രാപിക്കുന്നു. ഇതിൽ നിന്നും ആനുമാനിക്കാവുന്നത്

a) മഴത്തുള്ളികൾക്ക് പ്രതലവിസ്തീർണ്ണം കുറഞ്ഞിരിക്കുന്നത് ഗോളാകൃതി കൈക്കൊള്ളുമ്പോഴാണ്..

b) മഴത്തുള്ളികൾക്ക് പ്രതലവിസ്തീർണ്ണം കൂടിയിരിക്കുന്നത് ഗോളാകൃതി കൈക്കൊള്ളുമ്പോഴാണ്..

c) മഴത്തുള്ളികൾക്ക് തന്മാത്രാബലം കൂടിയിരിക്കുന്നത് ഗോളാകൃതി കൈക്കൊള്ളുമ്പോഴാണ്..

43. വിയർക്കുമ്പോൾ ശരീരത്തോട് വസ്ത്രം ഒട്ടിച്ചേർന്നുകിടക്കുനന്നു. ഇതിൽനിന്നും അനുമാനിക്കാവുന്നത്

a) വിയർക്കുമ്പോൾ ഉണ്ടാകുന്ന ജലതന്മാത്രകൾ വസ്ത്രങ്ങളുടെ വ്യത്യസ്ത ഇനം തന്മാത്രകളായി ഒട്ടിച്ചേർന്നു നിൽക്കുന്നു.

b) വിയർക്കുമ്പോൾ ജലതന്മാത്രകൾ വസ്ത്രങ്ങളുടെ തന്മാത്രകളിലേക്ക് വ്യാപനം ചെയ്ത് നിൽക്കുന്നു

c) വിയർക്കുമ്പോൾ ജലതന്മാത്രകൾ വസ്ത്ര തന്മാത്രകളുമായി നിഗ്ദബലം മൂലം ചേർന്നു നിൽക്കുന്നു.

44. കടന്നൽ കുത്തേറ്റ ഭാഗത്ത് ആസിഡ് ഗുണമുള്ള ട്രൈക്ലോറോഫിനോൾ ഉപയോഗിച്ച് കഴുകുമ്പോൾ വേദന കുറയുന്നു. ഇതിൽ അനുമാനിക്കാവുന്നത്.

a) കടന്നൽ കുത്തു മൂലമുണ്ടാകുന്ന വേദന അതിൽ അടങ്ങിയിരിക്കുന്ന ബേസുകൾ മൂലമാണ്. ആസിഡുകൊണ്ട കഴുകുമ്പോൾ വിഷം നിർവീര്യമാകുന്നു.

b) കടന്നൽകുത്തേറ്റ ഭാഗത്ത് ട്രൈക്ലോറോഫിനോൾ ഉപയോഗിച്ച് കഴുകുമ്പോൾ അണുക്കൾ നശിക്കുന്നു.

c) ട്രൈക്ലോറോഫിനോൾ ഉപയോഗിച്ച് കഴുകുമ്പോൾ കടന്നൽ കുത്തേറ്റ ഭാഗത്ത് രക്തം കട്ടപിടിക്കുന്നതുമൂലം വേദന കുറയുന്നു..

45. നിറയെ കാർബൺഡയോക്സൈഡുള്ള ഒരു ജാറിനെ ഒരു ട്രഫിലുള്ള ജലത്തിൽ തല കീഴായി താഴ്ത്തി പിടിക്കുക. ഗ്യാസ് ജാറിലെ ജലനിരപ്പ് ഉയരുന്നു. ഇതിൽ നിന്നും എന്ത് അനുമാനിക്കാം.

a) കേശികത്വം മൂലം ഗ്യാസ് ജാറിലെ ജലനിരപ്പ് ഉയരുന്നു.

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b) കാർബൺഡയോക്സൈഡ് ജലത്തിൽ ലയിക്കുന്നതുമൂലം ഗ്യാസ് ജാറിലെ ജലനിരപ്പ് ഉയരുന്നു.

c) കാർബൺഡയോക്സൈഡിലെ ഓക്സിജൻ ജലവുമായി കൂടിച്ചേരുന്നതുമൂലം ജലനിരപ്പ് ഉയരുന്നു.

46. പയർ വിത്തിന്റെ വളർച്ചാ നിരക്ക് പരിശോധിക്കുന്നതിന്റെ ഭാഗമായി കുറച്ചു പയർ എടുത്ത് ഒരു ഭാഗം ഒരു പാത്രത്തിലെ നനഞ്ഞ പഞ്ഞിയിൽ വച്ചു വേറൊരു ഗ്ലാസ്സ് വെള്ളത്തിൽ ഇട്ടുവച്ചു. രണ്ടു ദിവസ്ങ്ങൾക്കുശേഷം പഞ്ഞിയിൽ വെച്ചിരുന്ന വിത്തുകൾ മുളച്ചിരിക്കുന്നതായും ഗ്ലാസ്സിലെ വിത്തുകൾ ചീഞ്ഞുപോയതായും കണ്ടു. ഇതിൽ നിന്നും അനുമാനിക്കാവുന്നത്.

a) ഗ്ളാസ്സിലേ വിതത്തിന് ആവശ്യത്തിന് ഓക്സിജൻ ലഭിച്ചില്ല.

b) പഞ്ഞിയിൽ വെച്ചിരുന്ന വിത്തുകൾ നല്ലവണ്ണം ഉണങ്ങിയതായിരുന്നു.

c) ഗ്ലാസ്സിലെ വിത്തിന് വളർച്ചായ്ക്കാവശ്യമായ കാർബൺഡയോക്സൈഡ് ലഭിച്ചില്ല.

47. ഭൂമിയിൽ ജന്തുക്കളുടെ ഫോസിലുകളെ അപേക്ഷിച്ച് സസ്യഫോസിലുകൾ വളരെ കുറവാണ്. ഇതിൽ നിന്നു അനുമാനിക്കാവുന്നത്.

a) ഭൂമിയിൽ ആദ്യം ആവിർഭവിച്ചത് ജന്തുവർഗമാണ്.

b) ഭൂമിയിൽ സസ്യങ്ങളെ അപേക്ഷിച്ച് ജന്തുക്കൾ വളരം കൂടുതലാണ്.

c) ജന്തുക്കളെൾക്ക് കട്ടിയുള്ള പല്ല്, എല്ല്, നഖങ്ങൾ മുതലായവ ഉള്ളതുകൊണ്ട്.

48. മലമുകളിൽ വസിക്കുന്ന മനുഷ്യരുടെ രക്തത്തിൽ R.B.C. യുടെ അളവ് സമതല പ്രദേശങ്ങളിൽ വസിക്കുന്നവരുടേതിനേക്കാൾ വളരെ കൂടുതലാണ്. ഇതിൽ നിന്നു അനുമാനിക്കാവുന്നത്.

a) മലമുകളിൽ ഓക്സിജന്റെ അളവു കുറവാണ്. കൂടുതൽ R.B.C. ഉള്ളപ്പോൾ കൂടുതൽ ഓക്സിജൻ ആഗിരണം ചെയ്യുവാൻ കഴിയുന്നു.

b)ബ്ലഡ്പ്രഷർ കുറവായതിനാൽ ചുവന്ന രക്താണുക്കൾ വളരെ വേഗത്തിൽ ഉണ്ടാകുന്നു.

c) രക്തത്തിൽ W.B.C. യുടെ അളവ് കൂടുതലായിതനാൽ R.B.C. ആനുപാതികമായി വർദ്ധിക്കുന്നതാണ്.

49. ഒരു ബ്രഷിന്റെ നാരുകൾ വെള്ളത്തിൽ മുക്കുന്നതിനു മുൻപ് വിടർന്നു നില്ക്കുന്നതായും വെള്ളത്തിൽ മുക്കിയെടുക്കുമ്പോൾ ഒരുമിച്ചു ചേർന്നു നിൽക്കുന്നതായും കാണുന്നു. ഇതിൽ നിന്നു അനുമാനിക്കാവുന്നത്.

a) ജലം പ്രയോഗിക്കുന്ന പ്രതലബലം നാരുകളെ ചേർത്തു നിർത്തുന്നു.

b) ജലം പ്രയോഗിക്കുന്ന സ്നിഗ്ദബലം നാരുകളെ ചേർത്തു നിർത്തുന്നു.

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c) നാരുകളും ജ.ലവും തമ്മിലുള്ള ഘർഷണം മൂലം നാരുകൾ ചേർന്നു നിൽക്കുന്നു.

50. ഒരു ബീക്കറിൽ 40^0 സെൽഷ്യസ് ചൂടിൽ 200 ഗ്രാം ജലം എടുകക്കുക. മറ്റൊന്നിൽ 80^0 സെൽഷ്യസിലുള്ള അതേ അളവുള്ള ജലം എടുക്കുക. ഇവ പരസ്പരം കലർത്തുക. പരിണത ഊഷ്മാവ് 60^0 സെൽഷ്യസ് എന്നു കിട്ടുന്നു. ഇതിൽ നിന്നു അനുമാനിക്കാവുന്നത്.

a) ജലം ഒരു നല്ല താപ വാഹിയാണ്..

b) ചൂടുകൂടിയ വസ്തുവിൽ നിന്നും ചൂടുകുറഞ്ഞ വസ്തുവിലേക്ക് രണ്ടിന്റേയും ഊഷ്മാവ് തുല്യമാകുന്നതുവരെ താപം പ്രവഹിക്കും.

c) ജലത്തിന്റെ ചൂടുകൂടിയ ഭാഗത്തുനിന്ന് ചൂടുകുറഞ്ഞ ഭാഗത്തേക്ക് ജലതന്മാത്രകൾ വ്യാപനം ചെയ്യുന്നു.

51. രണ്ടു ട്രെയിനുകൾ സമാന്തരമായി ഒരേ ദിശയിൽ ഒരേ വേഗതയിൽ സഞ്ചരിച്ചു കൊണ്ടിരിക്കുന്നു. ഇതിൽ ഒരു ട്രെയിനിൽ നിന്ന് നോക്കുന്ന ആൾക്ക് മറ്റേതു സഞ്ചരിക്കുന്നതായിട്ടോ അനങ്ങുനന്നതായിട്ടോ തോന്നുന്നില്ല. ഇതിൽ നിന്ന് മനസ്സിലാവുന്നത്.

a) ഇരു ട്രെയിനുകളുടെയും ആപേക്ഷികപ്രവേഗം ഒന്നല്ല.

b) ട്രെയിനിന്റെ ആപേക്ഷികപ്രവേഗവും മറ്റേ ട്രെയിനിൽ നിന്നു നോക്കുന്ന ആളുടെ ആപേക്ഷികപ്രവേഗവും പൂജ്യം ആണ്.

c) ട്രെയിനിന്റെ ആപേക്ഷികപ്രവേഗവും മറ്റേ ട്രെയിനിൽ നിന്നു നോക്കുന്ന ആളുടെയും ആപേക്ഷികപ്രവേഗവും വ്യത്യസ്തമാണ്.

52. പെട്രോൾ ട്രക്കുകളുടെ പിന്നിൽ തറയിൽ തൊട്ടുരസിക്കൊണ്ടു പോകത്തക്കവിധമുള്ള ചങ്ങലകൾ തൂക്കിയിട്ടിരിക്കുന്നതുകാണാം. ഇതിൽ നിന്ന് മനസ്സിലാവുന്നത്.

a) ട്രക്കിന്റെ ബോഡിയിൽ സ്വരൂപിക്കപ്പെടുന്ന വൈദ്യുതി ചാർജ് ഭൂമിയിലേക്ക് വിടുന്ന ചാലകമായി ഇവ വർത്തിക്കുന്നു എന്നതാണ്.

b) ട്രക്കിന്റെ ബോഡിയും റോഡും തമ്മിൽ ഘർഷണബലം കൂട്ടുന്നതിനുപയോഗിക്കന്നു.

c) ട്രക്കിന്റെ ബോഡിയും റോഡും തമ്മിലുള്ള ഘർഷണബലം കുറക്കുന്നതിനുപയോഗിക്കുന്നു.

53. മരയോന്തിന് ഒരേ സമയത്ത് മുൻവശത്തും പിൻവശത്തും ഉള്ള വ്സതുക്കൾ കാണാൻ കഴിയുന്നു. ഇതിൽ നിന്ന് മനസ്സിലാവുന്നത്.

a) മരയോന്തിന്റെ ഓരോ കണ്ണിനും സ്വതന്ത്രമായ പ്രത്യേകമായ കാഴ്ചശക്തിയുണ്ട്.

b) മരയോന്തിന്റെ കണ്ണ് തലയുടെ മുകളിൽ ഇരുവശവും കാണാവുന്ന രീതിയിൽ ആണ് ഉള്ളത്.

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c) മരയോന്തിന്റെ ശരീരത്തിന്റെ മുൻപിലും പിൻഭാഗത്തും സ്വതന്ത്രമായ കണ്ണുകളുണ്ട്.

54. കോശഭിത്തി താര്യസ്തരം ആണ്. ഇതിൽ നിന്ന് മനസ്സിലാവുന്നത്.

a) കോശഭിത്തിയിൽ ധാരാളം സുഷിരങ്ങളുണ്ട്. അതുകൊണ്ട് തന്മാത്രകൾ സ്വതന്ത്രമായി കടന്നുപോകുനന്നു.

b) കോശഭിത്തിയിൽ ധാരാളം സെല്ലുലോസ് അടങ്ങിയിരിക്കുന്നു.

c) കോശഭിത്തി നിർജീവമായതിനാൽ പദാർത്ഥങ്ങൾ കടന്നുപോകുന്നു.

55. മന്തുരോഗമുള്ള സ്ഥലത്ത് കൊതുകുനശീകരണ നടപടികൾ സ്വീകരിക്കാറുണ്ട്. ഇതിൽ നിന്ന് മനസ്സിലാവുന്നത്.

a) മന്തുരോഗം പരത്തുന്നത് കൊതുകുകളാണ്.

b) കൊതുകുകൾ പെരുകുന്നതുകൊണ്ട് പരിസ്ഥിതിപ്രശ്നം ഉണ്ടാവുന്നു.

c) കൊതുകിന്റെ ലാർവ മനുഷ്യരിൽ മന്തുരോഗം ഉണ്ടാക്കുന്നു.

56. ഭൗതികവും രാസികവുമായി ഒരു ഗ്ലാസ്സിന്റെ ഗുണങ്ങൾ കൊടുത്തിരിക്കുന്നു.

1. കളറില്ല

2. ചീഞ്ഞമുട്ടയുടെ ഗന്ധമുണ്ട്.

3. സൾഫർഡൈ ഓക്സൈഡുമായി പ്രവർത്തിച്ച് വെള്ളവും സൾഫറും ഉണ്ടാകുന്നു.

മുകളിൽ പറഞ്ഞിരിക്കുന്ന സ്വഭാവഗുണങ്ങളിൽ നിന്ന് ഗ്യാസ് ഏതാണെന്ന് മനസ്സിലാവുനന്നത്.

a) അമോണിയ b) നൈട്രജൻ പൊറോക്സൈഡ്

c) കാർബൺ ഡൈ ഓക്സൈഡ് d) ഹൈഡ്രജൻ സൾഫൈഡ്

57. ഒരു ചലിക്കുന്ന കപ്പി ഉപയോഗിക്കുമ്പോഴുണ്ടാകുന്ന യാന്ത്രികലാഭം രണ്ടും രണ്ട് ചലിക്കുന്ന കപ്പി ഉപയോഗിക്കുമ്പോൾ യാന്ത്രിക ലാഭം നാലും മൂന്ന് ചലിക്കുന്ന കപ്പി ഉപയോഗിക്കുമ്പോഴുണ്ടാകുന്ന യാന്ത്രികലാഭം എട്ടും ആണെങ്കിൽ ഇതിൽ നിന്നും മനസ്സിലാവുന്ന പൊതു തത്വം ഏത്?

a) 2n, ചലിക്കുന്ന കപ്പി ഉപയോഗിക്കുമ്പോൾ യാന്ത്രിക ലാഭം n^2 ആയിരിക്കും.

b) n, ചലിക്കുന്ന കപ്പി ഉപയോഗിക്കുമ്പോൾ യാന്ത്രിക ലാഭം n^2 ആയിരിക്കും

c) n, ചലിക്കുന്ന കപ്പി ഉപയോഗിക്കുമ്പോൾ യാന്ത്രിക ലാഭം 2^1 ആയിരിക്കും

58. ഓക്സിജനേക്കാൾ ഇലക്ട്രോ നെഗറ്റിവിറ്റി കൂടിയ ഏക മൂലകം ഫ്ളൂറിനാണ്. ഇതിൽ നിന്നും മനസ്സിലാവുന്നത്.

a) രാസപ്രവർത്തനങ്ങളിൽ എല്ലാം ഓക്സിജൻ ഒരു ഇലക്ട്രോൺ ദാതാവായി നിരോക്സീകാരിയായി പ്രവർത്തിക്കുന്നു.

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b) ഓക്സിജൻ രാസപ്രവർത്തനങ്ങളിൽ ഏർപ്പെടുമ്പോൾ ഫ്ളൂറിൻ ഒഴികെ യുള്ള മറ്റെല്ലാ മൂലകങ്ങളിൽ നിന്നും ഇലക്ട്രോൺ സ്വീകരിക്കുന്നു.

c) ഓക്സിജൻ ഫ്ളൂറിനുമായി രാസപ്രവർത്തനത്തിൽ ഏർപ്പെടുമ്പോൾ ഇലക്ട്രോൺ സ്വീകരിച്ച് ഓക്സീകാരിയായി പ്രവർത്തിക്കുന്നു.

59. ഒരി ഗ്ലാസ്സ് പ്ലേറ്റ് എടുത്ത് അതിൻമേൽ ജലത്തിന്റെ നേർത്ത പടലം ഉണ്ടാക്കി മറ്റൊരു ഗ്ലാസ്സ് പ്ലേറ്റ് വച്ച് അമർത്തിയാൽ ഗ്ലാസ്സ് പ്ലേറ്റുകൾ തമ്മിൽ വിടർത്തിയെടു ക്കുമ്പോൾ പ്രയാസമാണ്. ഇതിൽ നിന്നും മനസ്സിലാവുനന്നത്.

a) ഗ്ലാസ്സ് പ്ലേറ്റുകൾക്കിടയിലുള്ള ജലത്തിന്റെ സ്നിഗ്ദബലം മൂലം അവ തമ്മിൽ ചേർന്നിരിക്കുന്നു.

b) ഗ്ലാസ്സ് പ്ലേറ്റുകൾക്കിടയിലുള്ള ജലത്തിന്റെ പ്രതലബലം മൂലം അവ അടർത്തിയെടുക്കാൻ പ്രയാസമാണ്.

c) ഗ്ലാസ്സ് പ്ലേറ്റുകൾക്കിടയിലുള്ള ജലത്തിന്റെ ഘർഷണബലം മൂലം അവ ചേർന്നിരിക്കുന്നു.

60. ശൂന്യാകാശത്തിൽ വെച്ച് നടക്കുന്ന ഒരു പൊട്ടിത്തെറി ശബ്ദവും നമുക്കു കേൾക്കാൻ കഴിയുകയില്ല. എന്നാൽ ഭൂമിയിൽ നിന്നും വളരെ ഉയരത്തിലായിരി ക്കുന്ന വിമാനങ്ങളുടെ ശബ്ദം നാം കേൾക്കുന്നു. ഇതിൽ നിന്നും മനസ്സിലാവുന്ന ത്.

a) ശൂന്യാകാശം ഭൂമിയിൽ നിന്നും വളരെ അകലെയായതിനൽ ശബ്ദം കേൾക്കാൻ കഴിയുന്നില്ല.

b) വിമാനം കാണാൻ കഴിയുന്നതുകൊണ്ട് ശബ്ദം കേൾക്കാൻ സാധിക്കു ന്നു.

c) ശൂന്യാകശത്തിൽ വെച്ചുണ്ടാകുന്ന ശബ്ദത്തിന് മാധ്യമം ഇല്ലാത്തിനാൽ ഭൗമാന്തരീക്ഷത്തിൽ പ്രവേശിക്കുവാൻ സാധിക്കുന്നില്ല.

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APPENDIX IIIB

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF PROCESS OUTCOMES IN SCIENCE FOR SECONDARY SCHOOL PUPILS

(FINAL)

ARUNA. P.K.

നിർദ്ദേശങ്ങൾ

ഈ ടെസ്റ്റിൽ ആകെ 40 ചോദ്യങ്ങൾ ഉണ്ട്. ഓരോന്നിനും a,b,c, എന്നീ ഉത്തരങ്ങൾ കൊടുത്തിട്ടുണ്ട്. അവയിൽ ഒരു ഉത്തരം മാത്രമേ ശരിയായിട്ടുള്ളൂ. ഇതോടൊപ്പം തരുന്ന ഉതത്തരകടലാസിൽ ആ ഉത്തരം രേഖപ്പെടുത്തണം. ശരിയായ ഉത്തരം സൂചിപ്പിക്കുന്ന അക്ഷരത്തിൽ ചുറ്റും ✓ അടയാളം ഇടുക. പരിശോധകൻ "start" എന്നു പറയുമ്പോൾ മാത്രം ഉത്തരം രേഖപ്പെടുത്താൻ തുടങ്ങുക. കഴിയുന്നതും വേഗത്തിൽ എല്ലാ ചോദ്യങ്ങൾക്കും 60 മിനിറ്റിനുള്ളിൽ കണ്ടുപിടിച്ച് രേഖപ്പെടുത്താൻ ശ്രമിക്കുക.

ഉദാഹരണം.: സമുദ്രനിരപ്പിനേക്കാൾ കുന്നിൻമുകളിൽ ജലം വളരെ വേഗം തിളയ്ക്കുന്നു. ഇതിന്റെ ശരിയായ കാരണം താഴെ പറയുന്നവയിൽ ഏതാകാം?

a) കുന്നിൻ മുകളിൽ അന്തരീക്ഷംമർദ്ദം കുറവാണ് എന്നുള്ളതാകാം.

b) കുന്നിൻ മുകളിൽ ജ്വാലയുടെ ചൂട് കൂടുതലാണ്. എന്നുള്ളതാകാം.

c) കുന്നിൻ മുകളിൽ തണുപ്പ് കുറവാണ് എന്നുള്ളതാകാം.

'ശരിയായ ഉത്തരം a) ആണ്.

1. മാങ്ങ ഞെട്ടറ്റാൽ ഭൂമിയിൽ പതിക്കുന്നു. ഇവിടുത്തെ പ്രശ്നം?

a) മാങ്ങയെ ഒരു ബലം ഭൂമിയിലേക്കു വലിക്കുന്നുണ്ടോ എന്നതാണ്.

b) മാങ്ങയിൽ ഒരു ബലം മുകളിലൽനിന്ന് പ്രയോഗിക്കപ്പെടുനന്നുണ്ടോ എന്നതാണ്.

c) മാങ്ങയ്ക്കു മുകളിലേക്കു പോകുവാൻ സ്ഥലമുണ്ടോ എന്നതാണ്.

2. ഒരേ വലിപ്പമുള്ള രണ്ടു ആണികൾ ഒരു ഡ്രോയിംഗ് ബോർഡിൽ ഒന്നിന്റെ മുനമേല്പോട്ടും മറ്റേതിന്റെ മുന താഴേട്ടുമായി കുത്തനെ പിടിക്കുക. ഒരു പലകക്കഷണം ഉപയോഗിച്ച് രണ്ടു ആണികളും ഒന്നിച്ച് അമർത്തുക. താഴോട്ടു മുനയായിട്ടുള്ള ആണി പെട്ടെന്ന് ഡ്രോയിംഗ് ബോർഡിൽ തുളച്ചു കയറുന്നു. ഇവിടുത്തെ പ്രശ്നം?

a) പരന്ന അഗ്രത്തെ അപേക്ഷിച്ച് മുനയ്ക്ക് വിസ്താരം കുറവായതിനാലാണോ എന്നുള്ളതാണ്.

b) ആണികൾ വ്യത്യസ്തമായ ലോഹങ്ങൾ കൊണ്ടുള്ളതാണോ എന്നുള്ളതാണ്.

c) ആണികൾ ബോർഡിന്റെ രണ്ടു വ്യത്യസ്തസ്ഥലങ്ങളിൽ അടിച്ചുകയറ്റപ്പെടുന്നതു കൊണ്ടാണോ എന്നുള്ളതാണ്.

3. വലിയ കോൺക്രീറ്റു കെട്ടിടങ്ങൾ പണിയുമ്പോൾ സ്ലാബുകൾക്കിടയ്ക്ക് അല്പം സ്ഥലം വിടാറുണ്ട്. ഇവിടുത്തെ പ്രശ്നം?

a) സ്ലാബുകൾക്ക് എല്ലാ കാലവും ഒരുപോലെ സ്ഥിതി ചെയ്യുവാൻ കഴിയുമോ എന്നതാണ്.

b) വേനൽക്കാലത്ത് സ്ലാബുകൾ ചീടുപിടിച്ച് വികസികക്കുന്നുണ്ടോ എന്നതാണ്.

c) സ്ലാബുകൾക്കിടയിൽ വായു സഞ്ചാരത്തിനുവേണ്ടിയാണോ എന്നതാണ്.

4. ഈർപ്പമുള്ള വായുവിൽ ഇരുമ്പുപാത്രങ്ങൾ വെച്ചിരുന്നാൽ തുരുമ്പ് പിടിക്കുന്നു ഇവിടുത്തെ പ്രശ്നം.

a) ഇരുമ്പുപാത്രങ്ങൾക്ക് ഈർപ്പമുള്ള വായുവുമായി പ്രവർത്തനമുണ്ടോ എന്നതാണ്.

b) ഇരുമ്പുപാത്രം ഈരർപ്പത്തെ ആഗിരണം ചെയ്യുന്നുണ്ടോ എന്നതാണ്.

c) ഇരുമ്പുപാത്രങ്ങളിൽ പൊടിപടലങ്ങൾ അടിഞ്ഞുകൂടുന്നുണ്ടോ എന്നുള്ളതാണ്.

5. പരൽ രൂപത്തിലുള്ള കറിയുപ്പ് വൈദ്യുതി വഹിക്കുന്നില്ല. ഉരുകിയ രൂപത്തിലുള്ള കറിയുപ്പ് വൈദ്യുതി വഹികക്കുന്നു. ഇവിടുത്തെ പ്രശ്നം.?

a) പരൽ രൂപത്തിലുള്ള കറിയുപ്പ് സാധാരണ ഊഷ്മാവിലും ഉരുകിയ കറിയുപ്പ് ഉയർന്ന ഊഷ്മാവിലും സ്ഥിതിചെയ്യുന്നതുകൊണ്ടാണോ എന്നതാണ്.?

b) പരൽ രൂപത്തിലുള്ള കറിയുപ്പ് സുസ്ഥിരാവസ്ഥയിലും ഉരുകിയ കറിയുപ്പ് അസ്ഥിരാവസ്ഥയിലും സ്ഥിതിചെയ്യുന്നതുകൊണ്ടാണോ എന്നതാണ്.

c) പരൽ രൂപത്തിലുള്ള കറിയുപ്പ് തന്മാത്രാരൂപത്തിലും ഉരുകിയ കറിയുപ്പ് അയോണുകളുമായി സ്ഥിതിചെയ്യുന്നതുകൊണ്ടാണോ എന്നതാണ്.

6. കള്ളിച്ചെടിയുടെ ഇലകൾ ശൽക്കങ്ങളായി രൂപാന്തരപ്പെട്ടിരിക്കുന്നു. ഇവിടുത്തെ പ്രശ്നം.?

a) സ്വേദനം കൊണ്ടുള്ള ജലനഷ്ടം കുറയ്ക്കുനന്നതിന് വേണ്ടിയാണോ എന്നതാണ്.

b) ഉപദ്രവകാരികളായ ജന്തുക്കളിൽ നിന്ന് രക്ഷനേടുന്നതിനുവേണ്ടിയാണോ എന്നതാണ്.

c) ചെറുപ്രാണികളെ പിടിച്ചുതിന്നുന്നതിനുവേണ്ടിയാണോ എന്നതാണ്.

7. ഒരു ആറ്റത്തിൽ വൈദ്യുതി ചാർജ്ജുള്ള കണികകൾ ഉണ്ടെങ്കിലും ആറ്റം സാധാരണ വൈദ്യുതിപരമായി നിർവീര്യമാണ്. ഇവിടുത്തെ പ്രശ്നം.?

a) ഒരാറ്റതത്തിന് ഉരുകിയ അവസ്ഥയിൽ മാത്രമേ വൈദ്യുതി കടത്തിവിടാൻ കഴിയുകയുള്ളോ എന്നതാണ്.

b) ആറ്റത്തിൽ അടങ്ങിയിരിക്കുന്ന പോസറ്റീവ് നെഗറ്റീവ് ചാർജ്ജിന്റെയും അളവു തുല്യമാണോ എന്നതാണ്.

c) ഒരാറ്റത്തിന് ഉയർന്ന ഊഷ്മാവിലും മർദ്ദത്തിലും മാത്രമേ വൈദ്യുതി കടത്തിവിടാൻ കഴിവുള്ളോ എന്നതാണ്.

8. ഫോട്ടോഗ്രാഫിക് പ്ലേറ്റുകളും ഫിലിമുകളും പ്രകാശം കടക്കാത്ത വിധത്തിൽ കറുത്ത കടലാസുകൊണ്ട് പൊതിഞ്ഞോ, കറുത്ത പെട്ടിക്കുള്ളിലോ ആണ് സൂക്ഷിക്കുന്നത്. ഫിലിം കഴുകുന്നതിന് പ്രകാശം കടക്കാത്ത മുറിയാണ് ഉപയോഗിക്കിന്നത്. ഇവിടുത്തെ പ്രശ്നം?

a) ഫോട്ടോഗ്രാഫിക് ഫിലിമുകൾക്കും പ്ലേറ്റുകൾക്കും പ്രകാശ രശ്മികളുമായി രാസപ്രവർത്തനം ഉണ്ടോ എന്നതാണ്.

b) ഫോട്ടോഗ്രാഫിക് ഫിലിമുകളും പ്ലേറ്റുകളും പ്രകാശം തട്ടി ചീത്തയാകുമോ എന്നതാണ്

c) ഊഷ്മാവു വർദ്ധിച്ച് ഫിലിമുകളും പ്ലേറ്റുകളും ചീത്തയാകുമോ എന്നതാണ്.

9. പല രാസവസ്തുക്കളും തവിട്ടുനിറമുള്ള കുപ്പികളിൽ സൂക്ഷിക്കുന്നതിനു കാരണം എന്താകാം?

a) രാസവസ്തുക്കൾ പ്രകാശവുമായി പ്രവർത്തിച്ച് വിഘടിക്കും എന്നതുകൊണ്ടാകാം

b) രാസവസ്തുക്കളുടെ നിറം മങ്ങിപ്പോകും എന്നതുകൊണ്ടാകാം.

c) രാസവസ്തുക്കൾ പ്രകാശം പുറപ്പെടുവിച്ചുകൊണ്ട് വിഘടിക്കപ്പെടും എന്നതുകൊണ്ടാകാം)

10. ഫലങ്ങൾ പാകമാവുമ്പോൾ ചുവപ്പുനിറമോ ഓറഞ്ചുനിറമോ ആകുന്നു ഇതിന്റെ കാരണം എന്താകാം.?

a) ഫലങ്ങൾ പാകമാവുമ്പോൾ അവയിലെ ഹരിതകണങ്ങൾ വർണ്ണ കണങ്ങളായി മാറുന്നു എന്നതുകൊണ്ടാകാം

b) ഫലങ്ങൾ പാകമാവുമ്പോൾ അവയിലെ കോശഫേനങ്ങളിൽ ലവണങ്ങൾ ലയിച്ചു ചേരുന്നു എന്നതുകൊണ്ടാകാം

c) പക്ഷിമൃഗാദികളെ ആകർഷിക്കുന്നു എന്നതുകൊണ്ടാകാം

11. മനുഷ്യർക്ക് കിടന്നുകൊണ്ട് ആഹാരം കഴിക്കാൻ സാധിക്കുന്നു ഇത് എന്തു കാരണംകൊണ്ടാണ്.

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a) അന്നനാളത്തിലെ പേശികൾ തരംഗരൂപത്തിൽ ചലിക്കുന്നു എന്നതുകൊണ്ടാകാം

b) അന്നനാളത്തിലെ പേശികളുടെ തരംഗരൂപത്തിലുള്ള സങ്കോചം ആഹാരത്തെ ആമാശയത്തിൽ എത്തിക്കുന്നു എന്നതുകൊണ്ടാകാം

c) ഉമിനീരിലെ രാസഗ്നി ആഹാരത്തെ കുഴമ്പുരൂപത്തിലാക്കി ആമാശയത്തിൽ എത്തിക്കുന്നതുകൊണ്ടാവാം.

12. ഇലകൾ പച്ചനിറത്തിൽ കാണപ്പെടുന്നു. ഇതിന്റെ കാരണം എന്തായിരിക്കാം.?

a) സൂര്യപ്രകാശത്തിലെ വർണ്ണരാജികളിലെ ഘടകനിറങ്ങളായ വയലറ്റ്, നീലം, ചുവപ്പ്, എന്നീ നിറങ്ങളെ ഇലകൾ ആഗിരണം ചെയ്യുകയും പച്ച പ്രകാശത്തെ തിരികെ പ്രതിഫലിപ്പിക്കുകയും ചെയ്യുന്നതുകൊണ്ടായിരിക്കാം.

b) സൂര്യപ്രകാശത്തിലെ വർണ്ണരാജികളിലെ ഘടകനിറമായ പച്ചപ്രകാശത്തിൽ പ്രകാശസംശ്ലേഷണനിരക്ക് വർദ്ധിച്ച തോതിൽ നടക്കുന്നതുകൊണ്ടായിരികക്കാം.

c) സൂര്യപ്രകാശത്തിലെ ഘടകനിറങ്ങളായ നീല, ചുവപ്പ്, വയലറ്റ് എന്നീ നിറങ്ങളെ ഹരിതകം ഒന്നിച്ചു പ്രതിഫലിപ്പിക്കുന്നതുകൊണ്ടായിരിക്കാം.

13. അക്വേറിയങ്ങളിൽ വായുകുമിളകൾ കടത്തിവിടുന്നു. ഇതിന്റെ കാരണം എന്തായിരിക്കാം.?

a) അക്വേറിയത്തിലെ ജലത്തിലുള്ള മാലിന്യങ്ങൾ നീക്കം ചെയ്യുന്നതിനു വേണ്ടിയായിരിക്കാം.

b) അക്വേറിയത്തിന്റെ ഭംഗി വർദ്ധിപ്പിക്കുന്നതിനുവേണ്ടിയായിരിക്കാം.

c) അക്വേറിയത്തിലെ ജലത്തിൽ വായുസഞ്ചാരം വർദ്ധിപ്പിക്കുന്നതിനുവേണ്ടിയായിരിക്കാം.

14. മണ്ണിരയെ കുറച്ചുനേരം സൂര്യപ്രകാശത്തിലിട്ടാൽ ചത്തുപോകുന്നു ഇതിന്റെ കാരണം എന്തായിരിക്കാം.?

a) മണ്ണിര ഈർപ്പമുള്ള ത്വക്ക് വഴിയാണ് ശ്വസനം നടത്തുന്നത് എന്നതുകൊണ്ടായിരിക്കാം.

b) മണ്ണിരയുടെ ത്വക്കിൽ അനേകം രക്തവാഹിനികൾ ഉള്ളതുകൊണ്ടായിരിക്കാം.

c) മണ്ണിരയുടെ ത്വക്കിലുള്ള അനേകം സൂക്ഷ്മ സുഷിരങ്ങളിലൂടെയാണ് ഓക്സിൻ വാതകം ഉള്ളിലുള്ള ശ്വാസനാളികളിലെത്തുന്നത് എന്നതുകൊണ്ടായിരിക്കാം.

15. മൂർച്ചയുള്ള കോടാലികൊണ്ട് മരം മുറിക്കാൻ പ്രയാസമാണ്. ഇത് എന്തുകൊണ്ടായിരിക്കാം.?

a) മൂർച്ചയില്ലാത്ത കോടാലിയുടെ വായ്ത്തല പരന്നിരിക്കുന്നതുകൊണ്ട് മരത്തിൽ പ്രയോഗിക്കപ്പെടുന്ന ബലം (മർദ്ദം) കുറവായതിനാൽ ആയിരിക്കാം.

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b) മൂർച്ചയില്ലാത്ത കോടാലിയുടെ വിസ്താരമുള്ള വായ്ത്തല കൊണ്ട് മരത്തിൽ പ്രയോഗിക്കുന്ന മർദ്ദം കൂടുതലായതിനാൽ ആയിരിക്കാം.

b) മൂർച്ചയില്ലാത്ത കോടാലിയുടെ വിസ്താരമുള്ള വായ്ത്തല മരത്തിൽ തട്ടി കൂടുതൽ വിസ്താരമുള്ളതാകുന്നതിനാൽ ആയിരിക്കാം.

16. ഇടിമിന്നൽ ഉണ്ടാകുമ്പോൾ പൊക്കമുള്ള മരങ്ങളുടെ താഴെ നില്ക്കരുത് ഇത് എന്തുകൊണ്ടായിരിക്കാം.?

a) മിന്നലിന്റെ ആഘാതത്തിൽ പൊക്കമുള്ള മരങ്ങൾ എളുപ്പം വിധേയമാകുന്നതിനാൽ ആയിരിക്കാം.

b) മിന്നലേറ്റ് വലിയ മരങ്ങളുടെ ചില്ലകൾ മുറിഞ്ഞുവീഴുന്നതിനാലായിരിക്കാം.

c) ഇടിമിന്നൽ ഉണ്ടാവുമ്പോൾ മരച്ചുവട്ടിലെ മാളങ്ങൽ പാർക്കുന്ന വിഷപ്പാമ്പുകൾ വെളിയിലേക്കുവരും അതിനാലായിരിക്കാം.

17. വെള്ളത്തിൽ തുള്ളിതുള്ളിയായി ഗാഢ സൾഫ്യൂറിക് ആസിഡ് കലർത്തി ഇളക്കിയാണ് സൾഫ്യൂറിക് നേർപ്പിക്കുന്നത് ഇത് എന്തുകൊണ്ടായിരിക്കാം.?

a)ജലം സൾഫ്യൂറിക് ആസിഡിൽ ഒഴിച്ചാൽ അത്യധികമായി താപം ഉണ്ടായി നാലുപാടും തെറിക്കാനിടയാകുന്നതുകൊണ്ടായിരിക്കാം.

b) ജലം സൾഫ്യൂറിക് ആസിഡിൽ ചേർക്കുമ്പോൾ സൾഫ്യൂറിക് ആസിഡുമായി പ്രവർത്തിച്ച് വിഘടിക്കപ്പെടുന്നതു കൊണ്ടായിരിക്കാം.

c) സാന്ദ്രത കൂടിയതിനാൽ സൾഫ്യൂറിക് ആസിഡിലേക്ക് വെള്ളം ഒഴിച്ചാൽ ഇവ രണ്ടും കൂടിക്കലരാതെ വേറിട്ടു നിൽക്കുന്നതുകൊണ്ടായിരിക്കാം.

18. രണ്ടു ജാറുകളിൽ ഒന്നിൽ CO_2 ഉം ഒന്നിൽ O_2 ഉം നിറച്ചിരിക്കുന്നു. ഇവ തമ്മിൽ തിരിച്ചറിയുന്നതിന് ഉചിതമായ പരിശോധന ഏത്?

a) മെഴുകുതിരി കത്തിച്ച് ജാറുകളിൽ ഇറക്കുക. CO_2 നിറച്ച ജാറിലെ തിരി അണഞ്ഞു പോകുകയും O_2 ജാറിലെ തിരി കത്തിക്കൊണ്ടിരികക്കുകയും ചെയ്യുന്നു.

b) മെഴുകുതിരി കത്തിച്ച് ജാറുകളിൽ ഇറക്കുക. CO_2 നിറച്ച ജാറിലെ തിരികത്തിക്കൊണ്ടിരിക്കും. O_2 നിറച്ച ജാറിലെ തിരികെട്ടുപോകുകയും ചെയ്യുന്നു.

c) മെഴുകുതിരി കത്തിച്ച് ജാറുകളിൽ ഇറക്കുക. CO_2 നിറച്ച ജാറിലെ തിരി വെളുത്തപുകയോടുകൂടി കത്തുകയും ചെയ്യുന്നു.

19. ലോഹങ്ങളുടെ താപചാലകത വ്യത്യസ്തമാണ്. ഇത് തെളിയിക്കാൽ അനുയോജ്യമായ പരീക്ഷണം എത്?

a) ഒരേ പോലെയുള്ള ഇരുമ്പുദണ്ഡും ചെമ്പുദണ്ഡും ഒരേ ഊഷ്മാവിൽ ചൂടാക്കുക. ഫലം നിരീക്ഷിക്കുക.

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b) ഒരു ഇരുമ്പുദണ്ഡും ഒരു ചെമ്പുദണ്ഡും എടുത്തു ചൂടാക്കുക. ഫലം നിരീക്ഷിക്കുക.

c) ഒരേ പോലെയുള്ള ഇരുമ്പുദണ്ഡും ചെമ്പുദണ്ഡും വ്യത്യസ്ത ഊഷ്മാവിൽ ചൂടാക്കുക. ഫലം നിരീക്ഷിക്കുക.

20. തന്നിരിക്കുന്ന മൂന്ന് തരം മണ്ണുകളിൽ അതായത് കളിമണ്ണ്, കരിമണൽ, പൂഴിമണ്ണ് ഇവയിൽ പയർചെടി ഏറ്റവും നന്നായി വിളവു തരുന്നത് ഏതിലാണെന്നു തെളിയിക്കാൻ ഉചിതമായ പരിശോധന ഏത്?

a) ഒരേപോലെയുള്ള മൂന്നു ചട്ടികൾ എടുക്കുക, ഒന്നിൽ കളിമണ്ണ്, രണ്ടാമത്തേതിൽ കരിമണൽ, മൂന്നാമത്തേതിൽ പൂഴിമണ്ണ് നിറക്കുക. മൂന്നിലും ഒരേ അളവിൽ പയർ നടുക. ഒരേ സ്ഥലത്തു വയ്ക്കുക. മൂന്നിലും ഒരേ അളവിൽ ജലം നൽകുക. വിളവ് പരിശോധിക്കുക.

b) മൂന്നുചെടിച്ചട്ടികൾ എടുക്കുക. വ്യത്യസ്ത അളവിൽ കളിമണ്ണ് കരിമണൽ, പൂഴിണ്ണ്, എടുക്കുക. മൂന്നിലും ഒരേ അളവിൽ പയറു നടുക. ഒരേ സ്ഥലത്തു വയ്ക്കുക. ഒരേ അളവിൽ ജലം നൽകുക. വിളവ് പരിശോധിക്കുക.

c) മൂന്നുചെടിച്ചട്ടികൾ എടുക്കുക. മൂന്നിലും ഒരേ അളവിൽ കരിമണൽ, പൂഴിണ്ണ്, കളിമണ്ണ് എടുക്കുക. ഓരോന്നിലും വ്യത്യസ്ത അളവിൽ പയറു നടുക. ഒരേ സ്ഥലത്തു വയ്ക്കുക. ഒരേ അളവിൽ ജലം നൽകുക. വിളവ് പരിശോധിക്കുക.

21. ക്ലോറിന്റെ ബ്ലീച്ചിംങ്ങിന് ഈർപ്പം ആവശ്യമാണ്. ഇതു തെളിയിക്കുന്നതിന് അനുയോജ്യമായ പരിശോധന ഏത്?

a) രണ്ടു ജാറുകളിൽ ഈർപ്പമില്ലാത്ത ക്ലോറിൻ വാതകം ശേഖരിക്കുക. കുറച്ചു ലിറ്റമസ് പേപ്പർ നിറമുള്ള പൂവ് ഇലകൾ ചായം മുക്കിയ തുണി മഷി കൊണ്ടെഴുതിയ പേപ്പർ ഇവ രണ്ടു ഭാഗങ്ങളായി തിരിക്കുക. ഒരു ഭാഗം നല്ലവണ്ണം നനച്ച ശേഷം ഒന്നാമത്തെ ജാറിലിടുക. രണ്ടാമത്തെ ഭാഗം രണ്ടാമത്തെ ജാറിൽ ഇടുക. ബ്ലീച്ചിംഗ് പ്രവർത്തനം നിരീക്ഷിക്കുക.

b) രണ്ടു ജാറുകളിൽ ഈർപ്പമുള്ള ക്ലോറിൻ വാതകം ശേഖരിക്കുക. കുറച്ചു ലിറ്റമസ് പേപ്പർ നിറമുള്ള പൂവ് ഇലകൾ ചായം മുക്കിയ തുണി മഷി കൊണ്ടെഴുതിയ പേപ്പർ ഇവ രണ്ടു ഭാഗങ്ങളായി തിരിക്കുക. ഒരു ഭാഗം നല്ലവണ്ണം നനച്ചെടുക്കുക. അതിനുശേഷം ജാറുകളിലാക്കി ബ്ലീച്ചിംഗ് പ്രവർത്തനം നിരീക്ഷിക്കുക.

c) രണ്ടു ജാറുകളിൽ ഈർപ്പമുള്ള ക്ലോറിൻ വാതകം ശേഖരിക്കുക. കുറച്ചു ലിറ്റമസ് പേപ്പർ നിറമുള്ള പൂവ് ഇലകൾ ചായം മുക്കിയ തുണി മഷി കൊണ്ടെഴുതിയ പേപ്പർ ഇവ രണ്ടു ഭാഗങ്ങളായി നല്ലവണ്ണം നനച്ചശേഷം ജാറുകളിലാക്കി ബ്ലീച്ചിംഗ് പ്രവർത്തനം നിരീക്ഷിക്കുക.

22. കെട്ടിക്കിടക്കുന്ന വെള്ളത്തിൽ മണ്ണെണ്ണ ഒഴിക്കുന്നത് കൊതുക് വളരുന്നത് തടയാൻ സഹായകമാണ്. ഇത് തെളിയിക്കാൻ നിങ്ങൾക്കു ചെയ്യാവുന്ന ഉചിതമായി പരിശോധന എത്?

a) രണ്ടു പാത്രത്തിൽ ജലം എടുത്തിട്ട് രണ്ടിലും മണ്ണെണ്ണ ഒഴിച്ചശേഷം കൊതുക് വളരാൻ അനുവദിക്കുക.

b) രണ്ടു പാത്രത്തിൽ ജലം എടുത്തിട്ട് ഒന്നിൽ മണ്ണെണ്ണ ഒഴിച്ചശേഷം ഒന്നിൽ മണ്ണെണ്ണ ഒഴിക്കാതെയും രണ്ടിലും കൊതുക് വളരാൻ അനുവദിക്കുക.

c) രണ്ടു പാത്രത്തിൽ ജലം എടുത്തിട്ട് രണ്ടിലും മണ്ണെണ്ണ ഒഴിക്കാതെ കൊതുക് വളരാൻ അനുവദിക്കുക.

23. ദ്രാവകത്തിന്റെ പ്രതലവസ്തീർണ്ണം വർദ്ധിക്കുമ്പോൾ ബാഷ്പീകരണനിരക്ക് വർദ്ധിക്കുന്നു. ഇതു തെളിയിക്കാൻ അനുയോജ്യമായ പരീക്ഷണം ഏത്?

a) ഒരേ വലിപ്പത്തിലും രണ്ടു പദാർത്ഥങ്ങൾ കൊണ്ടുണ്ടാക്കിയതുമായ രണ്ടു ഹാൻഡ്കർച്ചീഫുകൾ എടുത്തു വെള്ളത്തിൽ മുക്കുക. ഒരു ഹാൻഡ്കർച്ചീഫ് മേശപ്പുറത്ത് വെയ്ക്കുക. ബാഷ്പീകരണ വേഗത താരതമ്യപ്പെടുത്തുക.

b) ഒരേ വലിപ്പത്തിലും രണ്ടു പദാർത്ഥങ്ങൾ കൊണ്ടുണ്ടാക്കിയതുമായ രണ്ടു ഹാൻഡ്കർച്ചീഫുകൾ എടുത്തു വെള്ളത്തിൽ മുക്കിയെടുക്കുക. ഒരു ഹാൻഡ്കർച്ചീഫ് മേശപ്പുറത്ത് നിവർത്തി വിരക്കുക. ഒരു ഹാൻഡ്കർച്ചീഫ് പന്തു പോലെ ഉരുട്ടുക. അതും മേശപ്പുറത്തെ്വവയ്ക്കുക. ബാഷ്പീകരണ വേഗത താരതമ്യപ്പെടുത്തുക.

c) വാവട്ടമുള്ള രണ്ടു പാത്രങ്ങൾ എടുക്കുക. രണ്ടിലും ജലം നിറയ്ക്കുക. രണ്ടും സൂര്യപ്രകാശത്തിൽ വയ്ക്കുക. ബാഷ്പീകരണവേഗത താരതമ്യപ്പെടുത്തുക.

24. മണ്ണു കരിമ്പുകൃഷിക്കു പറ്റിയതാണോ എന്നു പരിശോധിക്കുന്നതിനുള്ള പരിശോധന ഏത്?

a) മണ്ണിന്റെ സാമ്പിൾ എടുത്തു ജലതത്തിൽ കലക്കി p^H പേപ്പർ മുക്കി നോക്കുക. ലായനിയുടെ p^H മൂല്യം 7 ആണെങ്കിൽ കരിമ്പുകൃഷിക്കുപറ്റിയതാണ്.

b) മണ്ണിന്റെ സാമ്പിൾ എടുത്തു ജലത്തിൽ കലക്കി നീല ലിറ്റ്മസ് പേപ്പർ മുക്കി നോക്കുക. ചുവപ്പാകുന്നെങ്കിൽ മണ്ണ് അമ്ലസ്വഭാവമുള്ളതാണ്. കരിമ്പുകൃഷിക്കുപറ്റിയതാണ്.

c) മണ്ണിന്റെ സാമ്പിൾ എടുത്തു ജലത്തിൽ കലക്കി നീല ലിറ്റ്മസ് പേപ്പർ മുക്കി നോക്കുക. നീലയാകുന്നെങ്കിൽ മണ്ണ് ക്ഷാരസ്വാഭാവമുള്ളതാണ്. കരിമ്പുകൃഷിക്കു പറ്റിയതാണ്.

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25. ഒരു ട്രഫിൽ പകുതിജലം നിറയ്ക്കുക. ഒരു സ്കെയിൽ അതിൽ പകുതി മുക്കി വെയ്ക്കുക. ജാലോപരിതലത്തിൽ വെച്ച് സ്കെയിൽ വളഞ്ഞതായി തോന്നുന്നു. ഇതിന് എറ്റവും ഉചിതമായ വിശദീകരണം ഏത്?

a) പ്രകാശത്തിനു അപവർത്തനം സംഭവിക്കുന്നതുകൊണ്ട്.

b) പ്രകാശത്തിനു പ്രകീർണ്ണനം സംഭവിക്കുന്നതുകൊണ്ട്.

c) പ്രകാശത്തിനു പ്രതിഫലനം സംഭവിക്കുന്നതുകൊണ്ട്.

26. ഓടിക്കൊണ്ടിരിക്കുന്ന ട്രെയിനിൽനിന്ന് പ്ലാറ്റുഫോമിലേയ്ക്കു ചാടുന്ന ഒരാൾ മുന്നോട്ടു തെറിച്ചുവീഴുന്നു. ഇതിന് അനുയോജ്യമായ വിശദീകരണം ഏത്?

a) അയാളുടെ ശരീരം ട്രെയിനിന്റെ വേഗതയിൽ മുന്നോട്ടു സഞ്ചരിക്കുകയും കാൽജഡത്വം പ്രാപിക്കുകയും ചെയ്യുന്നു.

b) ഗുരിത്വാകർഷണം അയാളുടെ ശരീരത്തിന് മേൽഭാഗത്തെ മുന്നോട്ടു പിടിച്ചു വലിക്കുന്നു.

c) അയാളുടെ ശരീരമാകെ ട്രെയിനിന്റെ വേഗതയിൽ മുന്നോട്ടു സഞ്ചരിക്കുന്നു.

27. റബ്ബറൈസ്ഡ് റോഡുകളിൽ സുരക്ഷിതമായി വളരെ വേഗത്തിൽ വാഹനങ്ങൾ ഓടിച്ചുപോകുവാൻ സാധിക്കുന്നു. ഇതിന് ഏറ്റവും ഉചിതമായ വിശദീകരണം ഏത്?

a) റബ്ബറൈസ്ഡ് റോഡുകൾക്ക് ഘർഷണം വളരെ കുറവാണ്.

b) റബ്ബറൈസ്ഡ് റോഡുകൾക്ക് ഘർഷണം വളരെ കുടുതലാണ്.

c) റബ്ബറൈസ്ഡ് റോഡുകൾക്ക് വളരെ പെട്ടെന്ന് നാശം സംഭവിക്കുന്നില്ല.

28. ചെമ്മീനിന്റെ പുറം തോട് രാത്രിയിൽ തിളങ്ങിക്കാണുന്നു. ഇതിന് ഏറ്റവും ഉചിതമായ വിശദീകരണം ഏത്?

a)ചെമ്മീനിന്റെ പുറംതോടിന് സ്വയം പ്രകാശിക്കാൻ കഴിവുള്ളതിനാൽ

b)ചെമ്മീനിന്റെ പുറംതോടിൽ സ്വയം പ്രകാശം പരത്തുന്ന ബാക്ടീരിയ ഉള്ളതിനാൽ.

c)ചെമ്മീനിന്റെ പുറംതോടിന് ധാരാളം ഫോസ്ഫറസ് അടങ്ങിയിരിക്കുന്നതിനാൽ

29. പരീക്ഷണശാലയിൽ SO_2 ഈർപ്പരഹിതമാക്കാൻ ഗാഢസൾഫ്യൂറിക്ക് ആസിഡിൽ കൂടി കടത്തിവിടുന്നു. ഇതിന് ഏറ്റവും ഉചിതമായ വിശദീകരണം. ഏത്?

a) സൾഫ്യൂറിക്ക് ആസിഡ് ഈർപ്പത്തെ വിഘടിപ്പിച്ച് ഓക്സിജൻ ഗ്യാസും ഹൈഡ്രജൻ ഗ്യാസുമാക്കി മാറ്റുന്നു.

b) സൾഫ്യൂറിക്ക് ആസിഡ് നിർജ്ജലീകാരകമാണ്..

c) സൾഫ്യൂറിക്ക് ആസിഡ് SO_2 ഉള്ള ഈർപ്പത്തെ ബാഷ്പീകരിച്ച് പുറം തള്ളുന്നു.

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30. നീരാവി തട്ടി ഉണ്ടാകുന്ന പൊള്ളൽ തിളച്ച വെള്ളം വീണുണ്ടാകുന്ന പൊള്ളലിനേക്കാൾ ഗുരുതരമാണ്. ഇതിൽ നിന്നും അനുമാനിക്കാവുന്നത്.

a) നീരാവി ഒരു വസ്തുവിൽ തട്ടി സാന്ദ്രീകരിച്ച് ജലമായി മാറുമ്പോൾ അത്രയും താപം ആ വസതുവിൽ ഏൽപ്പിക്കുന്നു.

b) നീരാവിയാൽ ജലതന്മാത്രകൾ ഉയർന്ന മർദ്ദത്തിൽ സ്ഥിതിചെയ്യുന്നതിനാൽ അത്രയും താപം വസ്തുവിൽ ഏൽപ്പിക്കുന്നു.

c) നീരാവിയാൽ ജലതന്മാത്രകൾ തമ്മിൽ അഡ്ഹിഷൻ ബലമുള്ളതിനാൽ സാധാരണ ജലത്തിനേകക്കാൾ കൂടുതലായി പൊള്ളൽ ഏല്പ്പിക്കുന്നു.

31. മഴത്തുള്ളികൾ ഗോളാകൃതി പ്രാപിക്കുന്നു. ഇതിൽ നിന്നും ആനുമാനിക്കാവുന്നത്

a) മഴത്തുള്ളികൾക്ക് പ്രതലവിസ്തീർണ്ണം കുറഞ്ഞിരിക്കുന്നത് ഗോളാകൃതി കൈക്കൊള്ളുമ്പോഴാണ്..

b) മഴത്തുള്ളികൾക്ക് പ്രതലവിസ്തീർണ്ണം കൂടിയിരിക്കുന്നത് ഗോളാകൃതി കൈക്കൊള്ളുമ്പോഴാണ്..

c) മഴത്തുള്ളികൾക്ക് തന്മാത്രാബലം കൂടിയിരിക്കുന്നത് ഗോളാകൃതി കൈക്കൊള്ളുമ്പോഴാണ്..

32. കടന്നൽ കുത്തേറ്റ ഭാഗത്ത് ആസിഡ് ഗുണമുള്ള ട്രൈക്ലോറോഫിനോൾ ഉപയോഗിച്ച് കഴുകുമ്പോൾ വേദന കുറയുന്നു. ഇതിൽ അനുമാനിക്കാവുന്നത്.

a) കടന്നൽ കുത്തു മൂലമുണ്ടാകുന്ന വേദന അതിൽ അടങ്ങിയിരിക്കുന്ന ബേസുകൾ മൂലമാണ്. ആസിഡുകൊണ്ട കഴുകുമ്പോൾ വിഷം നിർവീര്യമാകുന്നു.

b) കടന്നൽകുത്തേറ്റ ഭാഗത്ത് ട്രൈക്ലോറോഫിനോൾ ഉപയോഗിച്ച് കഴുകുമ്പോൾ അണുക്കൾ നശിക്കുന്നു.

c) ട്രൈക്ലോറോഫിനോൾ ഉപയോഗിച്ച് കഴുകുമ്പോൾ കടന്നൽ കുത്തേറ്റ ഭാഗത്ത് രക്തം കട്ടപിടിക്കുന്നതുമൂലം വേദന കുറയുന്നു.

33. ഭൂമിയിൽ ജന്തുക്കളുടെ ഫോസിലുകളെ അപേക്ഷിച്ച് സസ്യഫോസിലുകൾ വളരെ കുറവാണ്. ഇതിൽ നിന്നു അനുമാനിക്കാവുന്നത്.

a) ഭൂമിയിൽ ആദ്യം ആവിർഭവിച്ചത് ജന്തുവർഗമാണ്.

b) ഭൂമിയിൽ സസ്യങ്ങളെ അപേക്ഷിച്ച് ജന്തുക്കൾ വളരം കൂടുതലാണ്.

c) ജന്തുക്കളൾക്ക് കട്ടിയുള്ള പല്ല്, എല്ല്, നഖങ്ങൾ മുതലായവ ഉള്ളതുകൊണ്ട്.

34. ഒരു ബീക്കറിൽ 40° സെൽഷ്യസ് ചൂടിൽ 200 ഗ്രാം ജലം എടുകക്കുക. മറ്റൊന്നിൽ 80° സെൽഷ്യസിലുള്ള അതേ അളവുള്ള ജലം എടുക്കുക. ഇവ പരസ്പരം

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കലർത്തുക. പരിണത ഊഷ്മാവ് 60° സെൽഷ്യസ് എന്നു കിട്ടുന്നു. ഇതിൽ നിന്നു അനുമാനിക്കാവുന്നത്.

a) ജലം ഒരു നല്ല താപ വാഹിയാണ്..

b) ചൂടുകൂടിയ വസ്തുവിൽ നിന്നും ചൂടുകുറഞ്ഞ വസ്തുവിലേക്ക് രണ്ടിന്റേയും ഊഷ്മാവ് തുല്യമാകുന്നതുവരെ താപം പ്രവഹിക്കും.

c) ജലത്തിന്റെ ചൂടുകൂടിയ ഭാഗത്തുനിന്ന് ചൂടുകുറഞ്ഞ ഭാഗത്തേക്ക് ജലതന്മാത്രകൾ വ്യാപനം ചെയ്യുന്നു.

35. രണ്ടു ട്രെയിനുകൾ സമാന്തരമായി ഒരേ ദിശയിൽ ഒരേ വേഗതയിൽ സഞ്ചരിച്ചു കൊണ്ടിരിക്കുന്നു. ഇതിൽ ഒരു ട്രെയിനിൽ നിന്ന് നോക്കുന്ന ആൾക്ക് മറ്റേതു സഞ്ചരിക്കുന്നതായിട്ടോ അനങ്ങുനന്നതായിട്ടോ തോന്നുന്നില്ല. ഇതിൽ നിന്ന് മനസ്സിലാവുന്നത്.

a) ഇരു ട്രെയിനുകളുടെയും ആപേക്ഷികപ്രവേഗം ഒന്നല്ല.

b) ട്രെയിനിന്റെ ആപേക്ഷികപ്രവേഗവും മറ്റേ ട്രെയിനിൽ നിന്നു നോക്കുന്ന ആളുടെ ആപേക്ഷികപ്രവേഗവും പൂജ്യം ആണ്.

c) ട്രെയിനിന്റെ ആപേക്ഷികപ്രവേഗവും മറ്റേ ട്രെയിനിൽ നിന്നു നോക്കുന്ന ആളുടെയും ആപേക്ഷികപ്രവേഗവും വ്യത്യസ്തമാണ്.

36. പെട്രോൾ ട്രക്കുകളുടെ പിന്നിൽ തറയിൽ തൊട്ടുരസിക്കൊണ്ടു പോകത്തക്കവിധമുള്ള ചങ്ങലകൾ തൂക്കിയിട്ടിരിക്കുന്നതുകാണാം. ഇതിൽ നിന്ന് മനസ്സിലാവുന്നത്.

a) ട്രക്കിന്റെ ബോഡിയിൽ സ്വരൂപിക്കപ്പെടുന്ന വൈദ്യുതി ചാർജ് ഭൂമിയിലേക്ക് വിടുന്ന ചാലകമായി ഇവ വർത്തിക്കുന്നു എന്നതാണ്.

b) ട്രക്കിന്റെ ബോഡിയും റോഡും തമ്മിൽ ഘർഷണബലം കൂട്ടുന്നതിനുപയോഗിക്കന്നു.

c) ട്രക്കിന്റെ ബോഡിയും റോഡും തമ്മിലുള്ള ഘർഷണബലം കുറക്കുന്നതിനുപയോഗിക്കുന്നു.

37. മന്തുരോഗമുള്ള സ്ഥലത്ത് കൊതുകുനശീകരണ നടപടികൾ സ്വീകരിക്കാറുണ്ട്. ഇതിൽ നിന്ന് മനസ്സിലാവുന്നത്.

a) മന്തുരോഗം പരത്തുന്നത് കൊതുകുകളാണ്.

b) കൊതുകുകൾ പെരുകുന്നതുകൊണ്ട് പരിസ്ഥിതിപ്രശ്നം ഉണ്ടാവുന്നു.

c) കൊതുകിന്റെ ലാർവ മനുഷ്യരിൽ മന്തുരോഗം ഉണ്ടാക്കുന്നു.

38. ഭൗതികവും രാസികവുമായി ഒരു ഗ്ലാസ്സിന്റെ ഗുണങ്ങൾ കൊടുത്തിരിക്കുന്നു.

1. കളറില്ല
2. ചീഞ്ഞമുട്ടയുടെ ഗന്ധമുണ്ട്.

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3. സൾഫർഡൈ ഓക്സൈഡുമായി പ്രവർത്തിച്ച് വെള്ളവും സൾഫറും ഉണ്ടാകുന്നു.

മുകളിൽ പറഞ്ഞിരിക്കുന്ന സ്വഭാവഗുണങ്ങളിൽ നിന്ന് ഗ്യാസ് ഏതാണെന്ന് മനസ്സിലാവുനന്നത്.

a) അമോണിയ b) നൈട്രജൻ പൊറോക്സൈഡ്

c) കാർബൺ ഡൈ ഓക്സൈഡ് d) ഹൈഡ്രജൻ സൾഫൈഡ്

39. ഒരു ചലിക്കുന്ന കപ്പി ഉപയോഗിക്കുമ്പോഴുണ്ടാകുന്ന യാന്ത്രികലാഭം രണ്ടും രണ്ട് ചലിക്കുന്ന കപ്പി ഉപയോഗിക്കുമ്പോൾ യാന്ത്രിക ലാഭം നാലും മൂന്ന് ചലിക്കുന്ന കപ്പി ഉപയോഗിക്കുമ്പോഴുണ്ടാകുന്ന യാന്ത്രികലാഭം എട്ടും ആണെങ്കിൽ ഇതിൽ നിന്നും മനസ്സിലാവുന്ന പൊതു തത്വം ഏത്?

a) 2n, ചലിക്കുന്ന കപ്പി ഉപയോഗിക്കുമ്പോൾ യാന്ത്രിക ലാഭം n^2 ആയിരിക്കും.

b) n, ചലിക്കുന്ന കപ്പി ഉപയോഗിക്കുമ്പോൾ യാന്ത്രിക ലാഭം n^2 ആയിരിക്കും

c) n, ചലിക്കുന്ന കപ്പി ഉപയോഗിക്കുമ്പോൾ യാന്ത്രിക ലാഭം 2^1 ആയിരിക്കും

40. ശൂന്യാകാശത്തിൽ വെച്ച് നടക്കുന്ന ഒരു പൊട്ടിത്തെറി ശബ്ദവും നമുക്കു കേൾക്കാൻ കഴിയുകയില്ല. എന്നാൽ ഭൂമിയിൽ നിന്നും വളരെ ഉയരത്തിലായിരിക്കുന്ന വിമാനങ്ങളുടെ ശബ്ദം നാം കേൾക്കുന്നു. ഇതിൽ നിന്നും മനസ്സിലാവുന്നത്.

a) ശൂന്യാകാശം ഭൂമിയിൽ നിന്നും വളരെ അകലെയായതിനൽ ശബ്ദം കേൾക്കാൻ കഴിയുന്നില്ല.

b) വിമാനം കാണാൻ കഴിയുന്നതുകൊണ്ട് ശബ്ദം കേൾക്കാൻ സാധിക്കുന്നു.

c) ശൂന്യാകശത്തിൽ വെച്ചുണ്ടാകുന്ന ശബ്ദത്തിന് മാധ്യമം ഇല്ലാത്തിനാൽ ഭൗമാന്തരീക്ഷത്തിൽ പ്രവേശിക്കുവാൻ സാധിക്കുന്നില്ല.

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APPENDIX III C

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF PROCESS OUTCOMES IN SCIENCE
(FINAL)

ARUNA. P.K.

1. Read each question carefully.
2. For each item three answers are given indicated by letters a,b, and c out of which you have to choose the most appropriate answer.
3. Start answering the items only when the examiner says "start".
4. Stop answering when the examiner says "stop".
5. Answer should be marked in the separate response sheets provided. Draw a circle around the letter which you think represents the correct answer.
6. Return the booklet and answer sheet to the examiner

Example:

Water boils quickly in hill tip than at sea level. The reason for this can be.

a) The atmospheric pressure is low at hill top.

b) The hotness of the flame is sharp at hill top.

c) The hill top is not so cold.

The correct answer for this item is a. Therefore in the response sheet is it is marked as a,b,c.

1. A mango from the tree falls down. The problem is.

(a) Whether a force pulls the mango to earth.

(b) Whether there is space for mango to go up.

(c) Whether there is space for mango to go up.

2. Take into nails of the same size and a drawing board. Place one nail point upward and other point downward on the drawing board. Push both the nails together using a small plank. The nail which point down wards pierce the drawing easily. The problem here is.

(a) Whether the surface area of pointed end is less than the broad head.

(b) Whether the nails are made of different metals.

(c) Whether the nails are thrust on the two different parts of the board.

3. While constructing concrete buildings some space is left between slabs. The problem here is.

(a) Whether concrete slab can remain some during all time.

(b) Whether concrete slab expand during summer season.

(c) Whether it is for air passage.

4. Iron vessels kept in moisture get rust. The problem here is.

(a) Whether iron vessels react with moisture

(b) Whether iron vessels absorb moisture

(c) Whether dust accumulate on iron vessels.

5. Crystal salts do not conduct electricity. But salt solution conduct electricity. The problem here is.

(a) Whether crystal salt remain in normal temperature and salt solutions remain in high temperature.

(b) Whether crystal salt is permanent state and salt solution is in temporary state.

(c) Whether crystal salt remain in molecular state and salt solution exist in ionised state.

6. Leaves of Cactus plant are modified in thorns. The problem here is

(a) Whether it is to reduce loss of water due to perspiration.

(b) Whether it is to escape from dangerous beasts.

(c) Whether it is to capture small insects

7. Atom have electrically charged electricity in molten stage.

(a) Whether atoms can conduct electricity in molten state.

(b) Whether the negative charge and positive charge in atoms are equal.

(c) Whether atoms can conduct electricity only a high pressure and temperature.

8. Photographic plates and film are warped in black paper and are kept without any access to light. For washing film, dark room are used.

The problem here is

(a) Whether photographic plates and film have chemical reaction with light.

(b) Whether photographic plates and film would be damaged by light.

(c) Whether photographic film and plates would be damaged by the increase in temperature.

9. Brown bottles are used to store many chemical what can be the reaons for this?

(a) This may be because chemical would decompose in the presence of light.

(b) This may be because chemical would loose colour.

(c) This may be because chemical would decompose emitting light.

10. When fruits ripen they become red or orange in colour. What can be the reason for this?

(a) This may be because when fruits ripen the chloroplast in fruits are converted into Chromoplast.

(b) This may be because when fruits ripen salts dissolved in their cell vacuole.

(c) This may be because colourful fruits attracts birds and animals.

11. Human being can eat while lying. What can be the reason for this?

(a) This may be because of the wavy movement of oesophagus.

(b) This may be because the wavy contraction of oesophagus takes food into the stomach.

(c) This may be because the enzymes in saliva make food into a pulp and takes into the stomach.

12. Leaves appears green. What can be the reason for this?

(a) This may be because leaves absorb composite colours of the sunlight like violet, blue, red etc., and reflect green light.

(b) This may be because photosynthesis takes in high rate in green light which constituent colour of the sunlight.

(c) This may be because chlorophyll reflect, blue, violent and red which are the constituent colours of the sunlight.

13. Air bubbles are passed through the water insider the aquarium. What can be the reason for this?

(a) This may be for removing dirt particles inside the aquarium.

(b) This may be for beautifying the aquarium.

(c) This may be for increasing air circulation inside the aquarium.

14. Earthworm dies if it is put in sunlight for some time. What can be the reason for this?

(a) This may be because earthworm breath through the moist skin.

(b) This may be because earthworm have a lot of blood vessels in the skin.

(c) This may be because the in take of oxygen into the breathing tube or earthworm takes place through the minute holes in the skin.

15. It is difficult to cut trees using blund axe. What can be the reason for this?

(a) This may be because the force exerted by the blund edge of axe on the tree is very low.

(b) This may be because the force exerted by the blund edge of the axe is very high.

(c) This may be because the blund edge of the axe become more blund due to the repeated hitting.

16. Do not stand below the tree which is very tall while there is lightning. What can be the reason for this?

(a) This may be because tall trees easily become subjected to lightening.

(b) This may be because the branches of big trees are cut down by lightening.

(c) This may be because venomous snakes living below the trees come out when there is lightening.

17. Sulphuric acid is diluted by adding concentrated sulphuric acid in small quantities to water and shaking after each additions. What can be the reason for this?

(a) This may be because much heat is produced when water is added to concentrated sulphuric acid and spurting will take place.

(b) This may be because when water is added to concentrated sulphuric acid, concentrated sulphuric acid will react with water.

(c) This may be because due to high density of concentrated sulphuric acid, when poured into water do not mix and they both remain independently.

18. CO_2 and O_2 are filled in two separate jars which one is the simplest test to identify them?

(a) Dip a burning candle into both jars. The candle goes out in the jar filled with carbondioxide and it continue to burn in the jar filled with oxygen.

(b) Dip a burning candle into both jars. The candle goes out in the jar filled with Oxygen and it continue to burn in the jar filled with Carbondioxide.

(c) Dip a burning candle into both jars the candle in carbondioxide jar continues to burn ordinarily and candle in the oxygen jar burned with a white fumes.

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19. Heat conductivity of metals are different. Which one is suitable experiment to prove this?

(a) Heat similar iron rod and copper rod at the same temperature. Observe the result.

(b) Heat an iron rod and copper rod at the same temperature. Observer the result.

(c) Heat similar iron rod and copper rod at different temperature. Observer the result

20. Which one is the simplest method to find out which among the three type of soil; namely - black soil, clayey soil, sandy soil - give the best yield for peas?

(a) Take three flower pots. Fill each with same quantity of black soil, clayey soil and sandy oil. Sow same quantity of peas in all the flower pots. Keep in same place. Give same amount of water and light. Examine the harvest.

(b) Take three similar flower pots. Fill each with different quantities of black soil, clayey soil and sandy oil. Sow same quantity of peas in all flower pots. Keep in same place. Give same amount of water and light. Examine the harvest.

(c) Take three similar flower pots. Fill each with same quantity of black soil, clayey soil and sandy soil. Saw different quantities of peas in all flower pots. Keep in the same place. Give same amount of water and light. Examine the harvest.

21. Moisture is essential for bleaching of chlorine. Which one is the suitable test to prove this?

(a) Take two jars of dry chlorine. Collect some litmus paper, paper written in ink, petals of flower, coloured pieces of dyed clothes. Divide them into two groups. Take one group, dip in water, put in a chlorine jar and close with a lid. Take the other group, dip in water put in the second jar and close with a lid. Examine the bleaching action.

(b) Take two jars of dry chlorine. Collect some litmus paper, paper written in ink, petals of flower, coloured pieces of dyed clothes. Divide them into two groups. Take one group, dip in water, put in a chlorine jar and close with a lid. Take the other group, dip in water put in the second jar as its.. Examine the bleaching action.

(c) Take two jars of dry chlorine. Collect some litmus paper, paper written in ink, petals of flower, leaves coloured pieces of dyed clothes. Divide them into two groups. Take one group, dip in water, put in a chlorine jar and close with a lid. Take the other set and dip in water put in the second jar and close with a lid. Examine the bleaching action.

22. Applying kerosene to damp places is a best method to prevent the growth of mosquito. Which one of the following is the suitable test to prove this?

(a) Take two pots, two third filled with water and apply kerosene to both the pots and allow mosquitos to grow.

(b) Take two pots, two third filled with water and apply kerosene to both the pots and allow mosquitos to grow in both the pots.

(c) Take two pots, two third filled with water and allow to grow mosquitos without applying kerosene in both the pots.

23. Larger is the area of exposed surface of the liquid, greater will be the rate of evaporation of that liquid. Which one of the following test is best suited to prove this?

(a) Take into handkerchiefs of the different material and same size. Dip them completely in water. Roll one of the handkerchief into ball. Place it on the table. Spread the other handkerchief. Compare the rate of evaporation.

(b) Take two handkerchiefs of the same material and size. Dipe them completely in water. Roll one of the handkerchief into ball, place it on the table and spread the other handkerchief compare the rate of evaporation.

(c) Take two vessels have wide mouths. Fill both vessels with water. Expose both vessels to sunlight. Compare rate of evaporation.

24. Which is the experiment to find out the suitability of soil for the cultivation of sugar cane?

(a) Take a sample of soil and mix it in water. Dip P^H paper and examine it. If the P^H value is seven, soil is suitable for cultivation of sugar cane.

(b) Take a sample of soil and mix it in water. Dip a blue litmus paper in it. If the blue litmas paper is changed into red the soil is acidic and it is suitable for cultivation of sugar cane.

(c) Take a sample of soil and mix it in water. Dip a red litmas paper in it. If the red litmus paper is changed into blue the sample is alkaline and the soil is suitable for cultivation of sugar cane.

(c) Take some urine in a glass. Add a few drops of benzene, The urine becomes yellow in colour.

25. Take a trough containing water and immerse one end of a scale in it. The scale is seen bend at the surface of the water. What is the suitable explanation for this phenomenon?

(a) Refraction of light.

(b) Dispersion of light

(c) Reflection of light.

26. A man jumping to platform from a running train falls forward. What is the suitable explanation for this?

(a) When he touches ground his feet acquires inertia and body continues to be in motion in the direction of the train.

(b) The upper part of his body is pulled forward due to the gravitational force.

(c) The whole body travels forward with the speed of the train.

27. Rubberised road are best for fast driving and safe driving. Which one is best suitable explanation for this?

(a) Rubberised road has less friction

(b) Rubberised road has greater friction

(c) Rubberised road does not get damaged very easily.

28. The exoskeleton of prawn illuminates during night. What is the best suitable explanation for this.

(a) The exoskeleton of prawn is a luminous substance.

(b) There are self immunising bacteria on the exoskeleton.

(c) The exoskeleton of prawn contains large amount of phosphorous.

29. In laboratories sulphuric dioxide is passed through concentrated sulphuric acid to remove moisture. What is the suitable explanation for this?

(a) Sulphuric acid decompose moisture and converts into hydrogen and oxygen

(b) Sulphuric acid is dehydrating agent.

(c) Sulphuric acid vaporises the moisture in sulphur dioxide.

30. Steam burn is severe than burns from boiling water. What can be inferred from this?

(a) When steam condenses heat is given to the body on which it condenses.

(b) As water molecule is high pressure in steam, that much heat is given to the body on which it condenses.

(c) As there is adhesion force between water molecules, steam make burns more than boiling water.

31. Rain drops acquire spherical shape. What can be inferred from this?

(a) Surface area of rain drop is lesser when it acquires spherical shape.

(b) Surface area of rain drop is greater when it acquires spherical shape.

(c) Molecular force is greater in rain drops when it acquire spherical shape.

32. Pain gets reduced when wasp bitten area is washed with trychlorophenol which is acidic. What can be inferred from this?

(a) The based contained in wasp toxin causes pain. Toxin get neutralised when washed with trychlorophenon.

(b) When washed with trychlorophenol. it kills gems.

(c) Pain gets reduces as the blood clots when washed with trychlorophenol.

33. Animal fossils are found in greater numbers than plant fossils on earth. What can be inferred from this?

(a) Animals originated first on earth.

(b) Animals are more than plants on earth.

(c) Because animals have strong teeth, bone and nails.

34. Take two beakers. In one take 200gms of water at 40°C and in the other the same quantity of water at 80°C. Mix these together. The final temperature of the mixture of obtained as 60°C. What can be inferred from this?

(a) Water is good conductor of heat.

(b) Heat flows from the hot body to the cold body till the temperature of two bodies are equal.

(c) Water molecules flows from the hot region to cold region by diffusion.

35. Consider two trains be moving on parallel tracks in the same direction with same speed. To an observer in one train the other train appears to be not moving at all. From this it can be understood that?

(a) The relative velocity of both trains are different.

(b) The relative velocity of the train with respect to an observer in the other train is zero.

(b) The relative velocity of the train with respect to an observer in the other train is zero.

(c) The relative velocity of the train with respect to an observer in the other train is different.

36. In the back side of big petrol trucks chains are hanged downwards touching the ground. What is understood from this?

(a) Chain act as conductor of electrical charge formed in the body of the truck.

(b) To increase frictional force between the road and truck.

(c) To reduce frictional force between the road and the truck.

37. Mosquito control programme are conducted in elephantiasis affected area. What can be understood from this?

(a) Mosquito spread elephantiasis

(b) Increase in mosquito creates environmental problem.

(c) Larva of mosquito make elephantiasis in human beings.

38. Below given are physical and chemical properties of a gas.

(1) Colourless

(2) Smell of rotten eggs.

(3) React with sulphur dioxide to form water and sulphur

39. It is seen the mechanical advantage of moving pulleys when used one, two or three separately is two, four or eight respectively. What is the common rule that we can understand from this?

(a) Mechanical advantage is 2n when we use 2n moving pulleys.

(b) The mechanical advantage is n^2 when we use n moving pulleys.

(c) The mechanical advantage is 2n when we use n moving pulleys.

40. We will not be able to hear any explosion in the space. But we can hear the noise of aeroplane flying high attitude. What is understood from this?

(a) Since space is at great distance from earth sound cannot be heard.

(b) Sound is audible, since aeroplane can be seen from the earth.

(c) Sound produced in the space cannot reach the atmosphere of the earth due to the absence of medium.

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APPENDIX III D

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF PROCESS OUTCOMES IN SCIENCE

Response Sheet (Final)

പേര് .... ക്ലാസ്സ് .... ഡിവിഷൻ.....................

സ്ക്കൂൾ... നമ്പർ......................... ആൺകുട്ടി/പെൺകുട്ടി

	A	B	C		A	B	C
1				21			
2				22			
3				23			
4				24			
5				25			
6				26			
7				27			
8				28			
9				29			
10				30			
11				31			
12				32			
13				33			
14				34			
15				35			
16				36			
17				37			
18				38			
19				39			
20				40			

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APPENDIX III E

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

SCORING KEY OF
TEST OF PROCESS OUTCOMES IN SCIENCE

Question No.	Key	Question No.	Key
1	a	21	b
2	a	22	b
3	b	23	a
4	a	24	a
5	c	25	a
6	a	26	a
7	b	27	a
8	a	28	b
9	a	29	b
10	a	30	a
11	b	31	a
12	c	32	c
13	a	33	b
14	a	34	b
15	a	35	a
16	a	36	a
17	a	37	d
18	a	38	b
19	a	39	b
20	b	40	c

10